

IMAGING IN SURGICAL DISEASES

DEPARTMENT OF RADIOLOGY AND
MEDICAL IMAGING

USMF "N. Testemitanu"

IMAGING MODALITIES

- 1. Plain Radiograph of the abdomen**
- 2. Barium study**
- 3. US**
- 4. CT**
- 5. Radionuclide imaging**
- 6. Magnetic Resonance Imaging (MRI)**
- 7. Angiography (aorta, celiac trunk, mesenteric arteries)**

GASTROINTESTINAL TRACT

- ⦿ Oral cavity
- ⦿ Pharynx
- ⦿ Esophagus
- ⦿ Stomach
- ⦿ Small bowel
- ⦿ Large bowel (Colon)
- ⦿ Rectum

Accessory organs

- ❖ Parotid glands
- ❖ Liver
- ❖ Gallbladder and biliary ducts
- ❖ Pancreas

PLAIN ABDOMINAL X-RAY

Indications

- Bowel obstruction
- Perforation
- Acute abdomen
- Foreign body localization
- Control or preliminary films for contrast studies
- Detection of calcification or abnormal gas collection



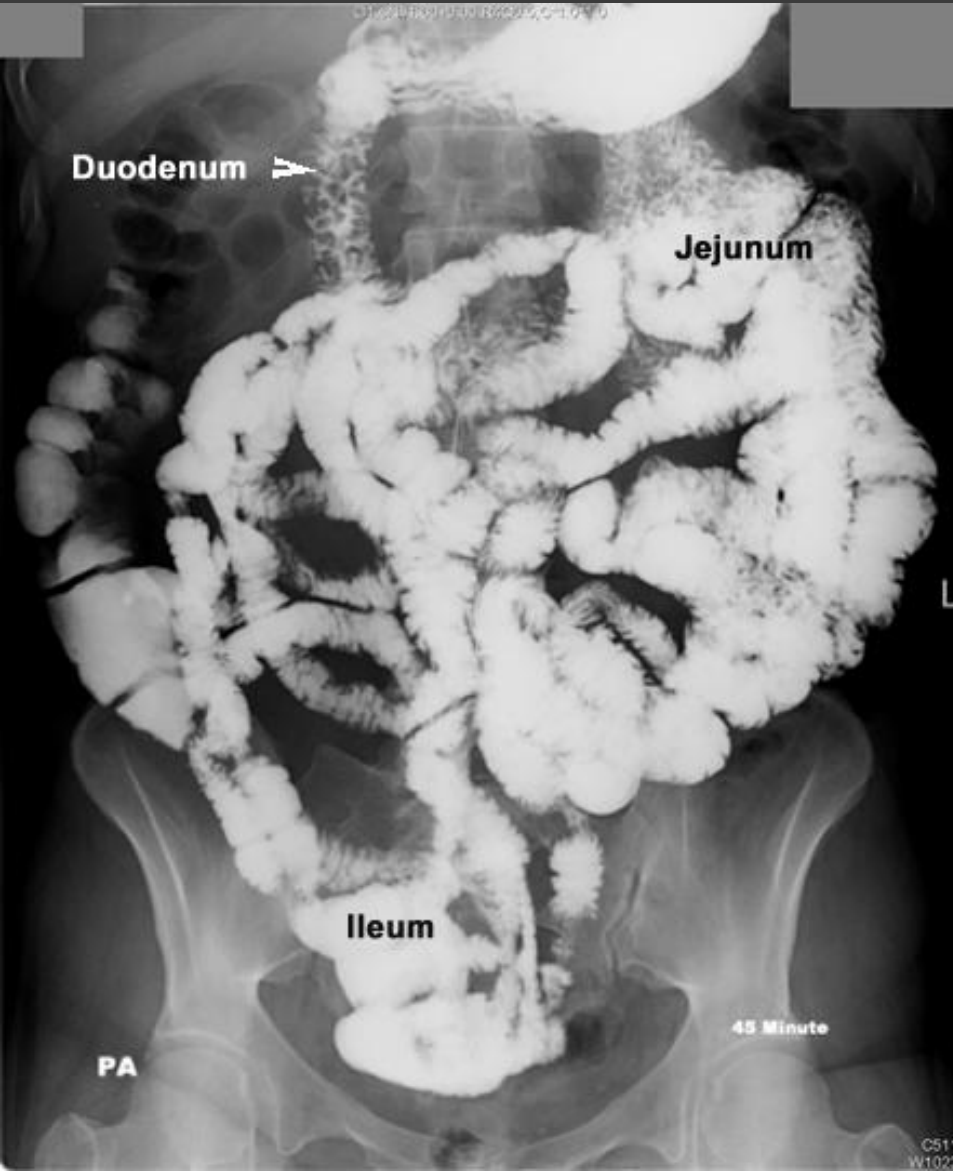
BARIUM STUDIES

- **Barium swallow**
 - **Barium meal**
 - **Barium follow-through**
 - **Barium enema**
-
- Barium salts are radioopaque and show clearly on a radiograph. If barium is swallowed before radiographs are taken, the barium within the esophagus, stomach or bowel shows the shape of the lumina of these organs.
 - Barium sulfate - an inert particulate contrast agent most commonly used in GI tract evaluation.

Barium follow-through

- X-ray images are taken as the contrast moves through the intestine, commonly at 0 minutes, 20 minutes, 40 minutes and 90 minutes.
- The test is completed when the Barium is visualised in the terminal ileum and Caecum, which marks the beginning of the large bowel. This is one of the most common places for pathology of the bowel to be found, therefore imaging of this structure is crucial.
- The test length varies from patient to patient as bowel motility is highly variable.
- It is used to diagnose various conditions of the small bowel such as Crohn's disease, ulcerative colitis, bowel cancer. For example, Crohn's disease shows up as intermittent sections of strictured bowel.

Barium follow-through



Barium enema (irrigography)

- ⦿ Also known as a **lower gastrointestinal series**
- ⦿ X-ray pictures are taken while barium sulfate fills the colon via the rectum.
- ⦿ A large balloon at the tip of the enema tube may be inflated to help keep the barium sulfate inside.
- ⦿ The flow of the barium sulfate is monitored by the health care provider on an X-ray fluoroscope screen (like a TV monitor).
- ⦿ This provides a detailed view of the inner surface of the colon, making it easier to see strictures, diverticula, or inflammation.

Indications

- Hirschprung's disease
- Fatigue / old / debilitated patient
- Suspected pelvic metastases
- Melena (bloody stools)
- Suspected colonic polyps or colon cancer
- Family history of colonic polyps or colon cancer
- Chronic diarrhea / bowel habit change
- IBD (inflammatory bowel disease)
- Abdominal pain and discomfort
- Diverticulosis

Irrigoscopy contraindications

- ⦿ Suspected bowel perforation
- ⦿ Toxic megacolon
- ⦿ After colonic biopsy
- ⦿ Pregnant patient

Irrigoscopy complications

- Gas pain
- Colonic perforation
- Intramural barium
- Stool impaction
- Bacterial contamination
- Allergy / hypersensitivity

Abdominal US

- Uses transmission and reflection of ultrasound waves to visualize internal organs through the abdominal wall



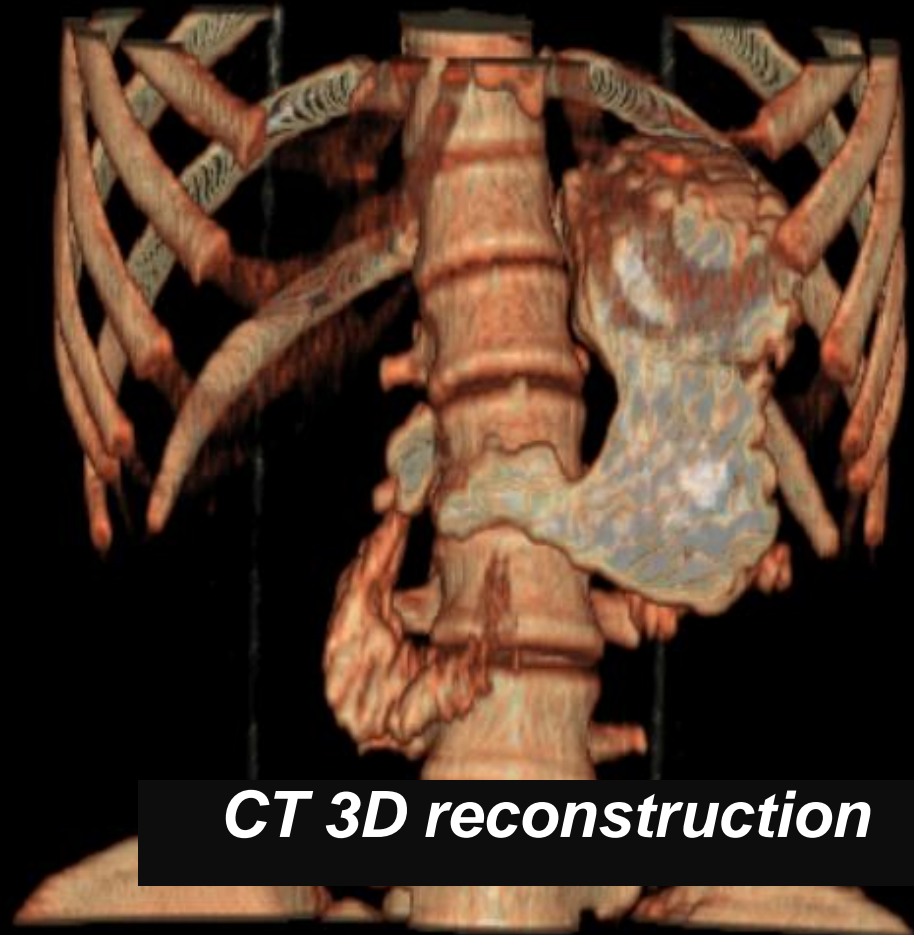
Common indications for abdominal ultrasound

- In patients with **abdominal pain** can diagnose a variety of conditions such as cholecystitis, appendicitis, gallbladder or bile duct diseases, cholestasis, tumors, etc.
- In patients with **abnormal function of pancreatic enzymes** for evaluation of pancreatic pathology
- Evaluation of abdominal aortic and other **vascular aneurysms**
- It is very useful **for detecting stones**, for example gallstones, because they create a clearly visible ultrasound shadow behind the stone.
- It is used **to guide procedures** such as needle biopsies or paracentesis.

Computed tomography (CT)

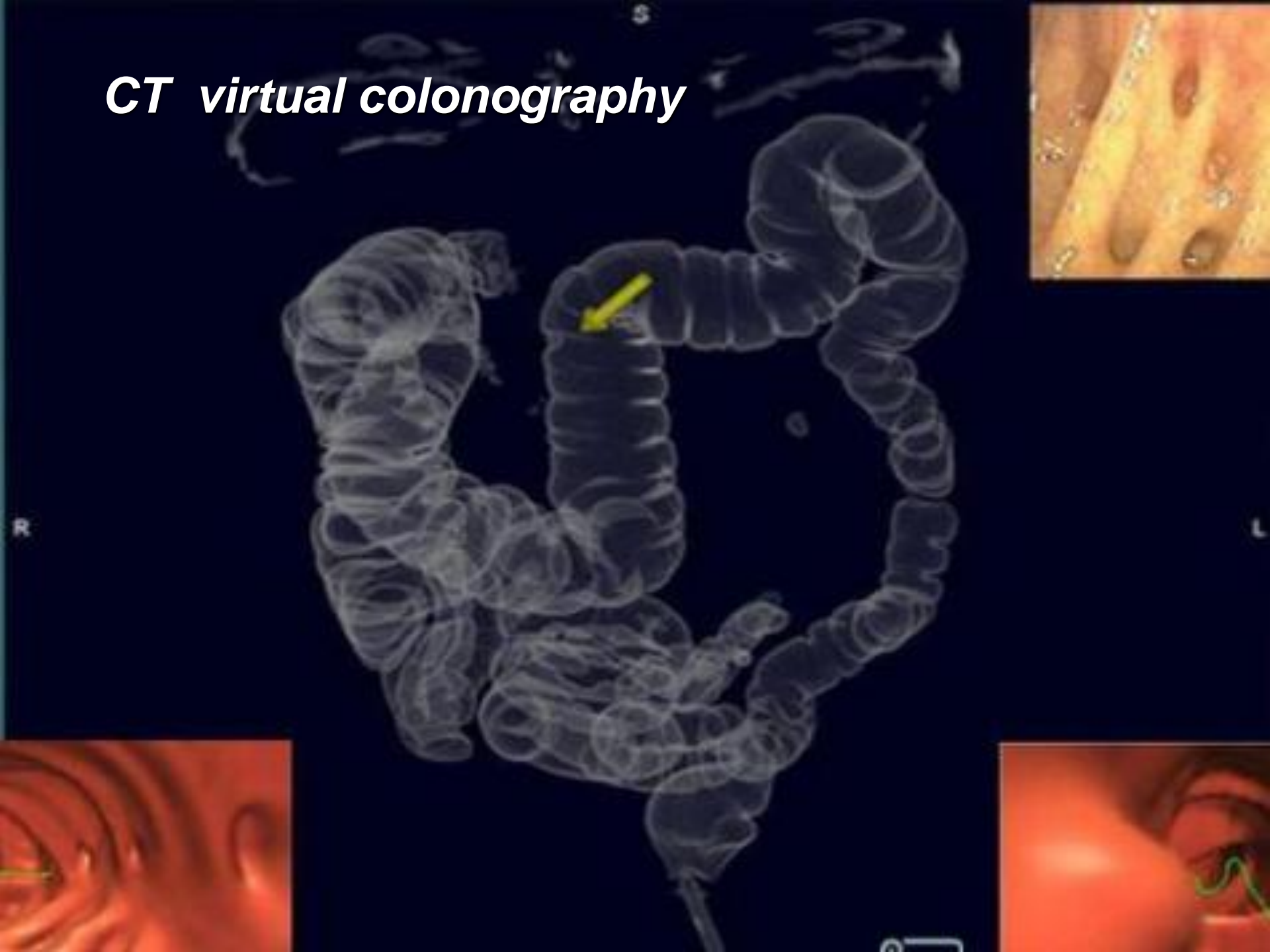
- **is a sensitive method for diagnosis of abdominal diseases**
- **the first line for detecting solid organ injury after trauma.**
- **useful for investigating acute abdominal pain** (especially of the lower quadrants, whereas ultrasound is the preferred first line investigation for right upper quadrant pain), **i.e. renal stones, appendicitis, pancreatitis, diverticulitis, abdominal aortic aneurysm, bowel obstruction etc.**
- **frequently used to determine stage of cancer and to follow its progress.**

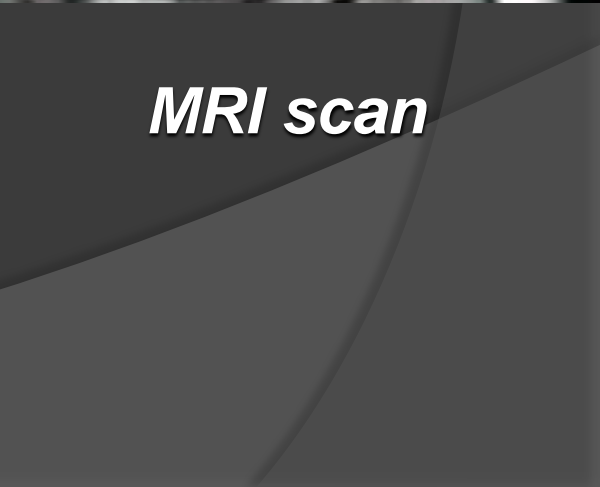




CT 3D reconstruction

CT virtual colonography

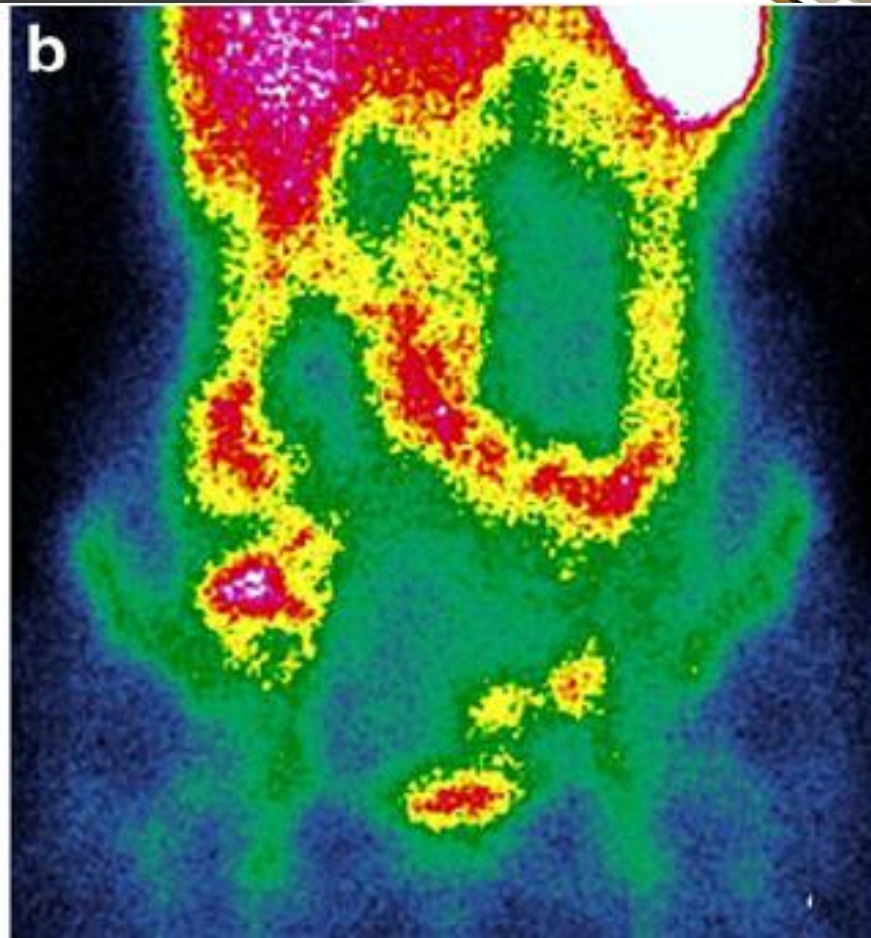
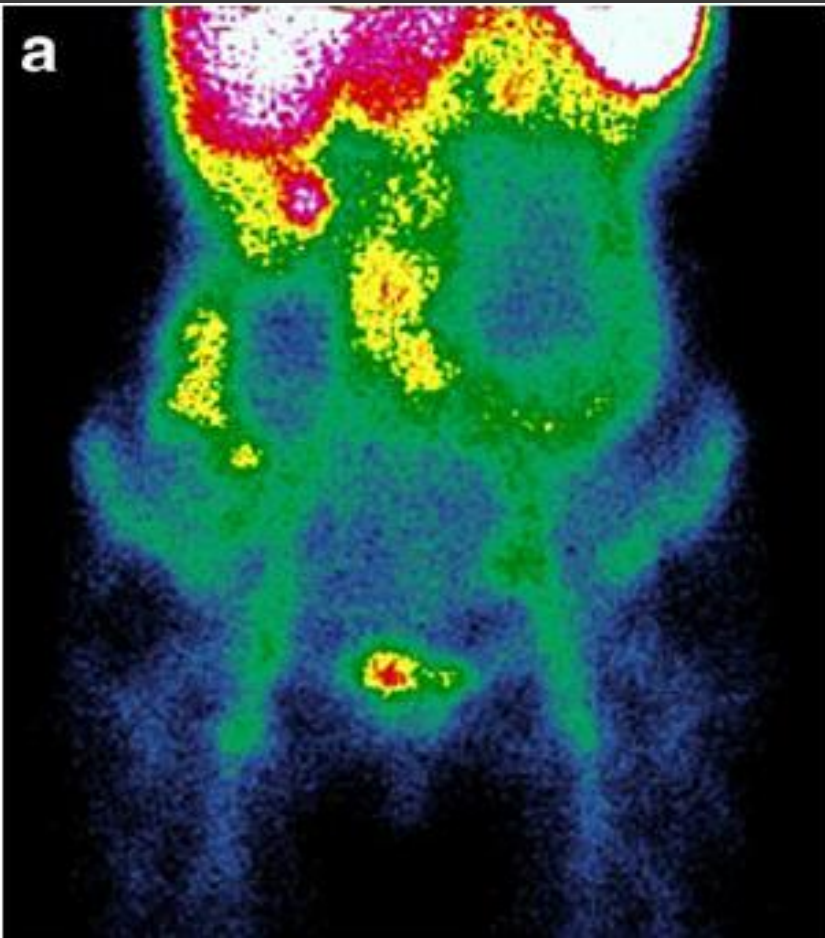




MRI scan



Radionuclide Imaging



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ZERO
ANTERIOR VIEWS

15

30

45

60

75

90

120

ZERO
POSTERIOR VIEWS

15

30

45

60

75

STATICS

90

120

Gastric emptying study

Normal
Gastric
Emptying

35861

ZERO
ANTERIOR VIEWS

15

30

45

60

75

90

120

ZERO
POSTERIOR VIEWS

15

30

45

60

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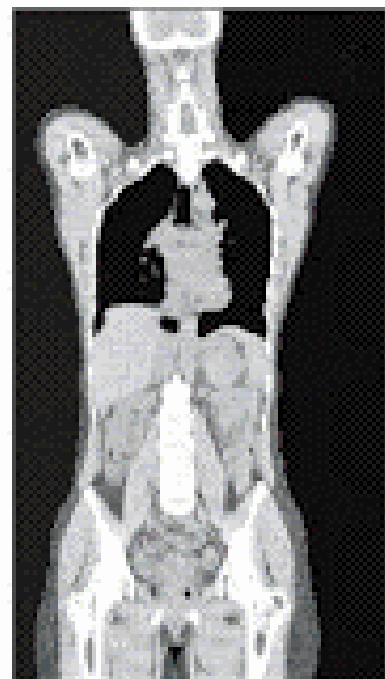
STATICS

90

120

Delayed
Gastric
Emptying

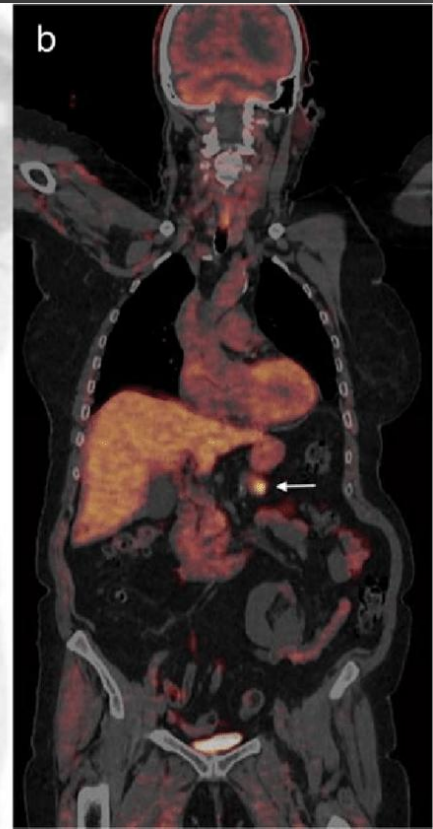
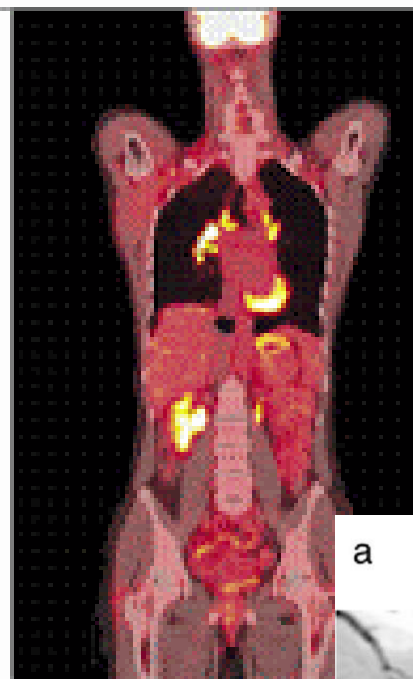
CT Scan
Organs and bones

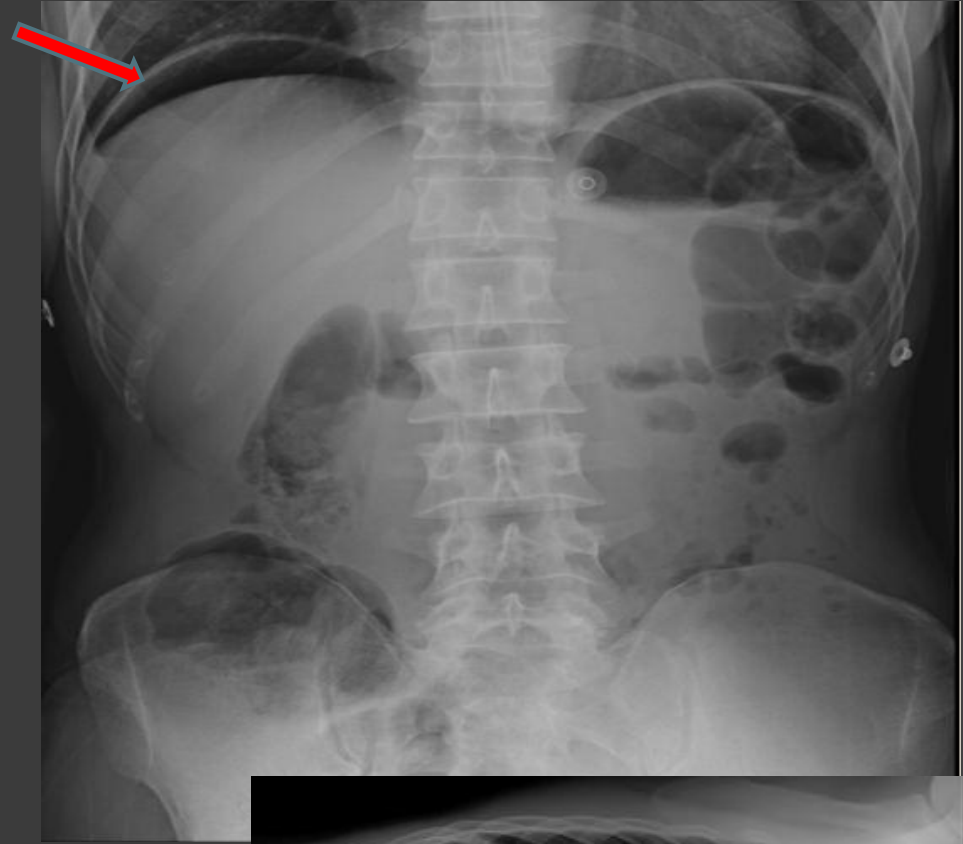
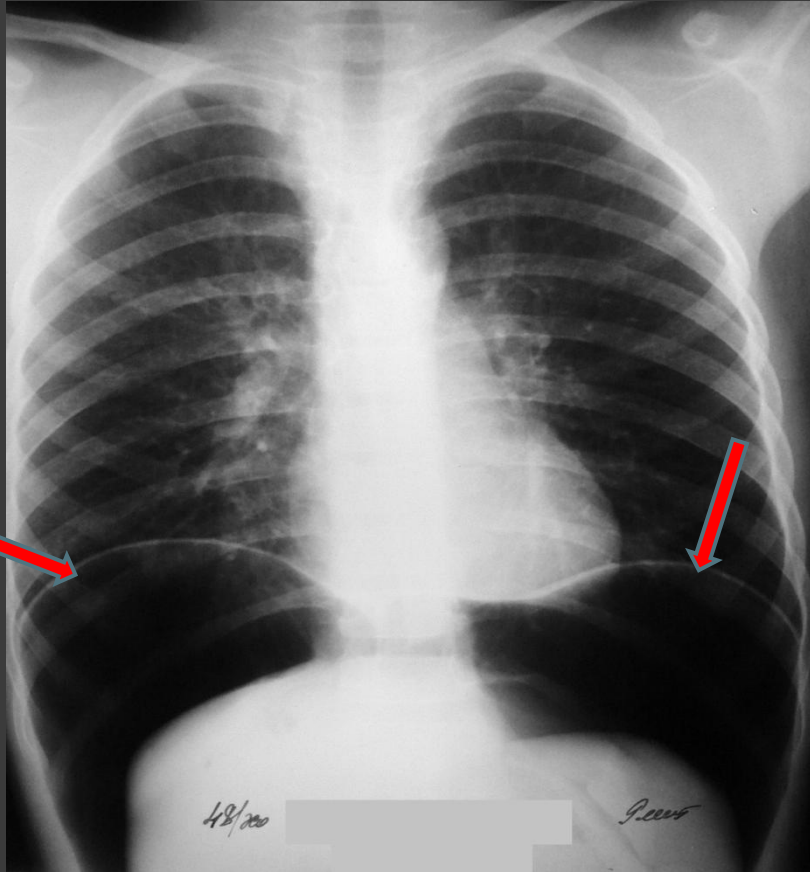


PET Scan
Cell activity



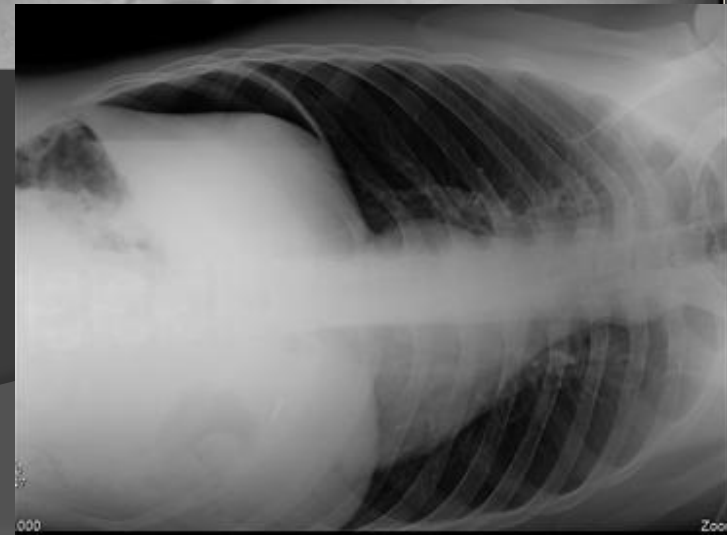
PET/CT Scan*
Exact location of high cell activity





Pneumoperitoneum

Air under the right hemidiaphragm → visceral perforation





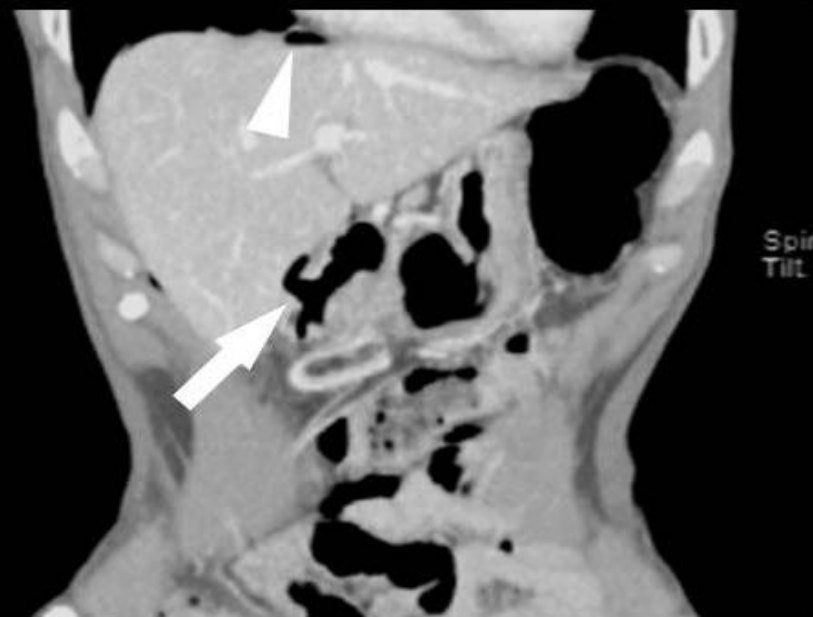
a



b



c

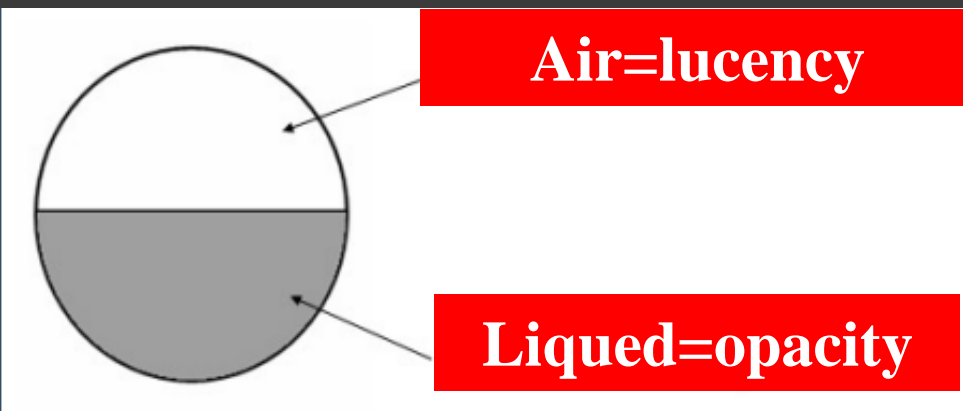


d

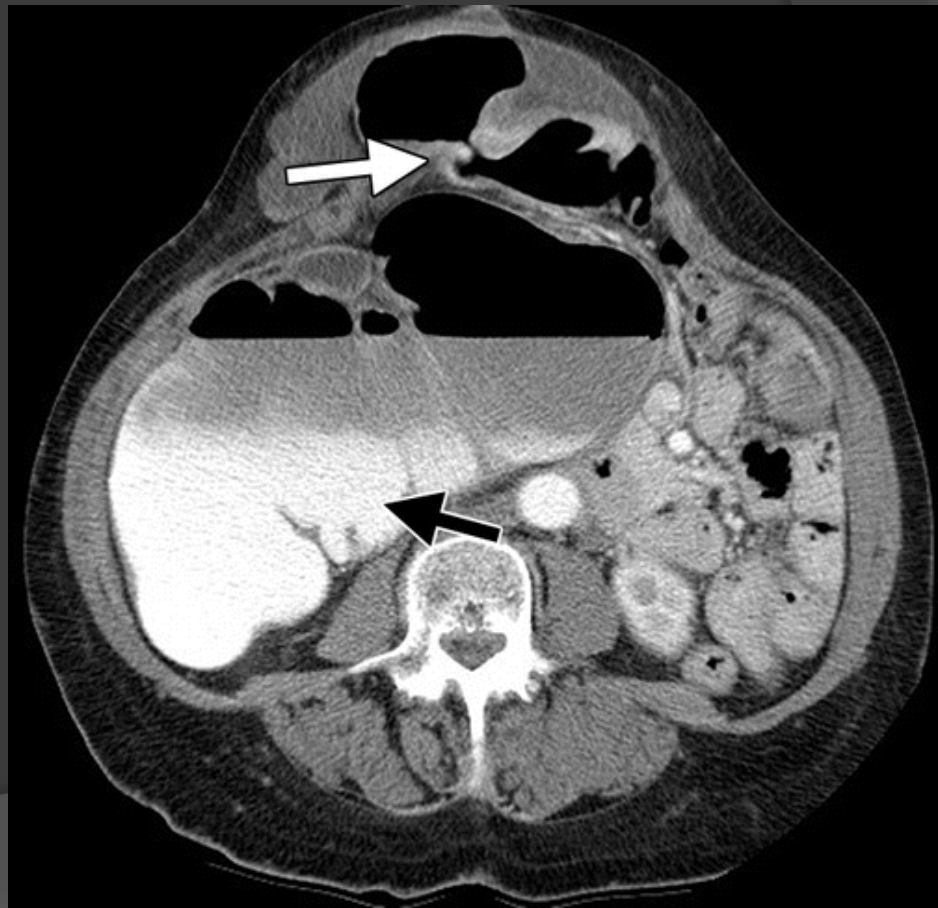
Perforated gastric ulcer.



Small bowel obstruction



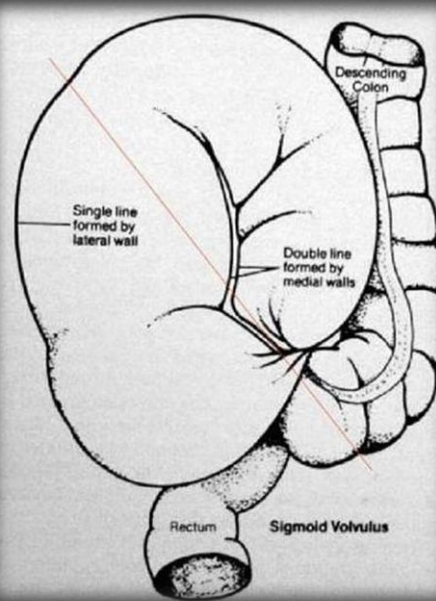
Large bowel obstruction





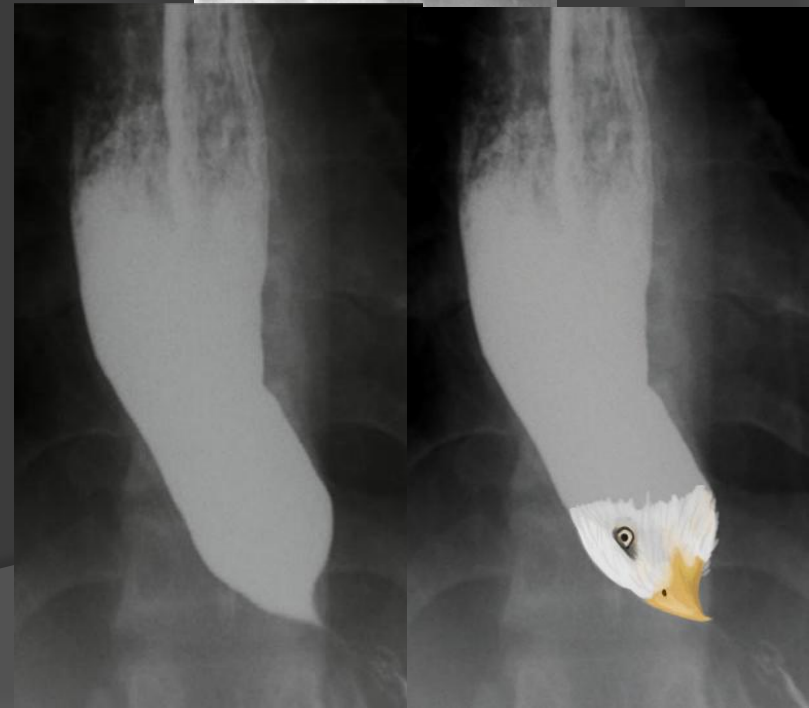


Sigmoid volvulus



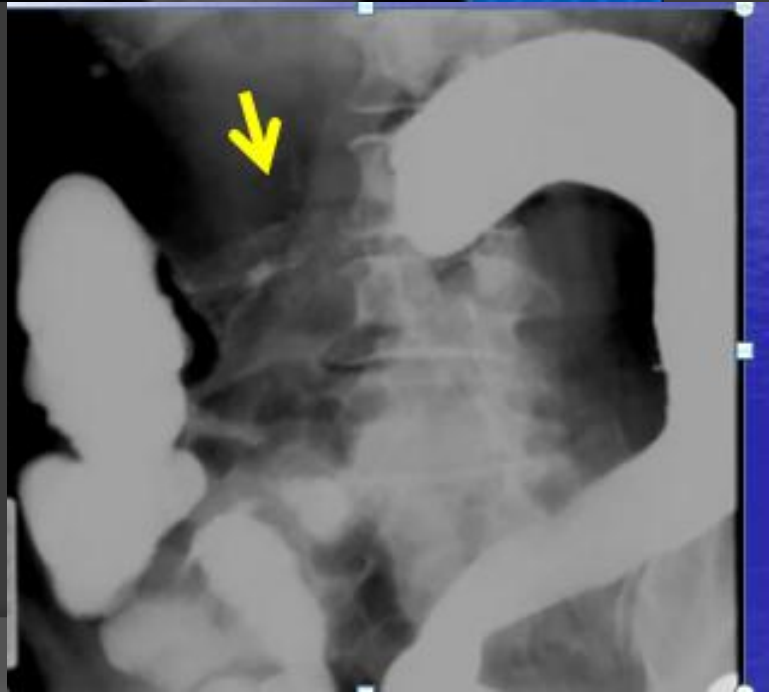
Achalasia

- An esophageal motility disorder characterized by incomplete lower esophageal sphincter (LES) relaxation, increased LES tone, and lack of peristalsis of the esophagus
- Acute tapering at the lower esophageal sphincter and narrowing at the gastro-esophageal junction, producing a "bird's beak" or "rat's tail" appearance.
- Dilatation of the esophagus above the narrowing is also present



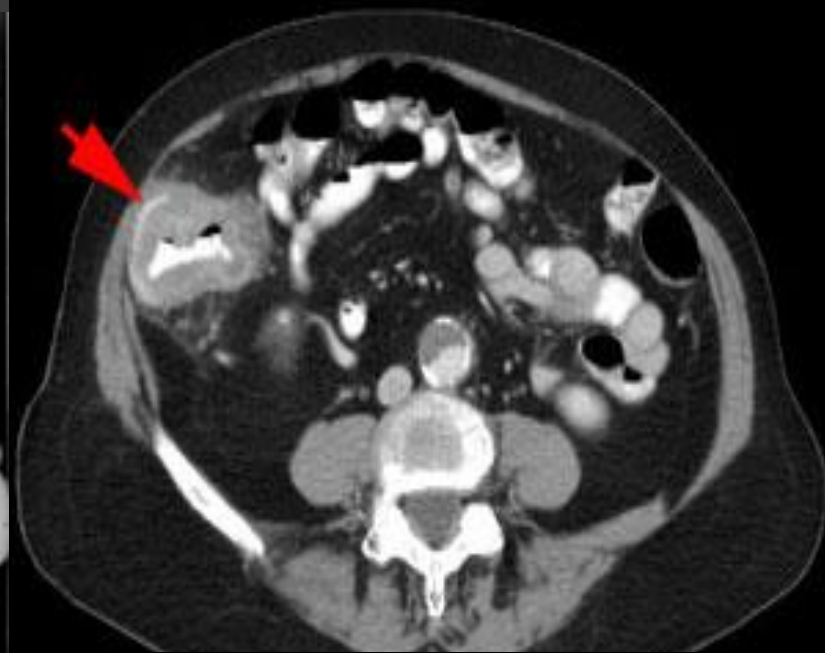
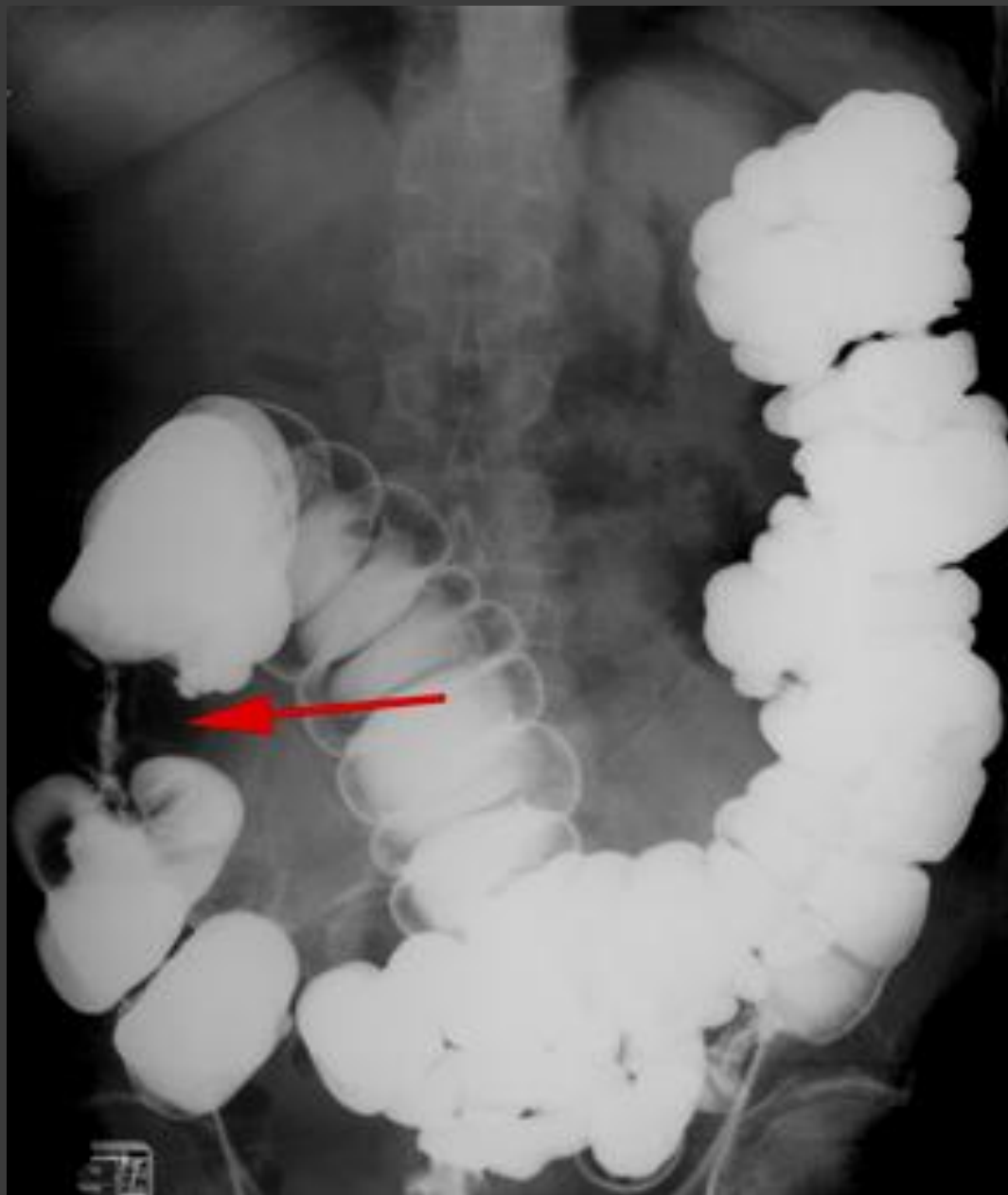


Colon cancer

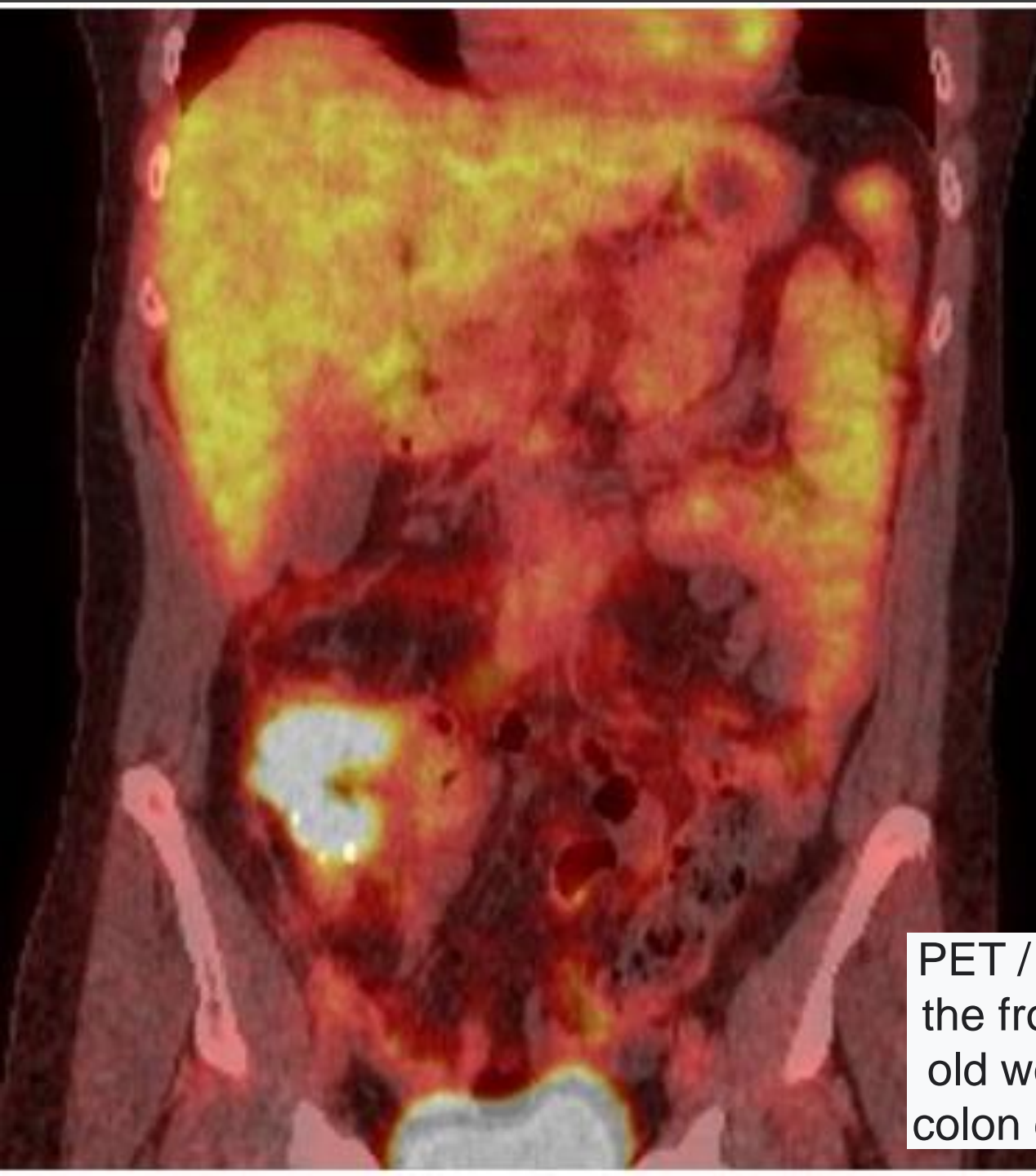


Colon cancer

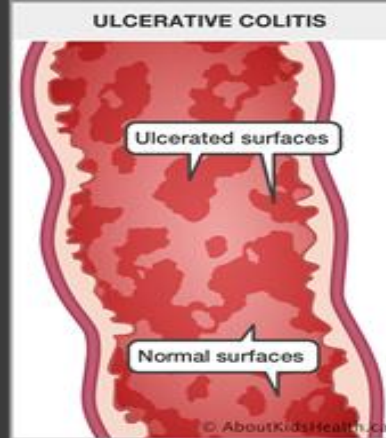
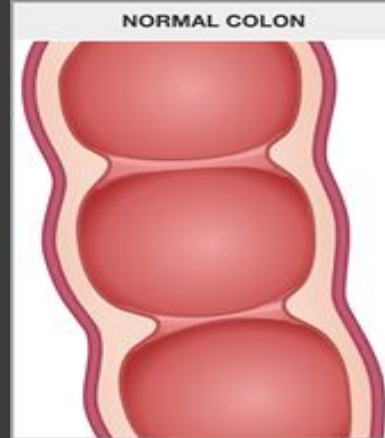




Colon Adenocarcinoma.



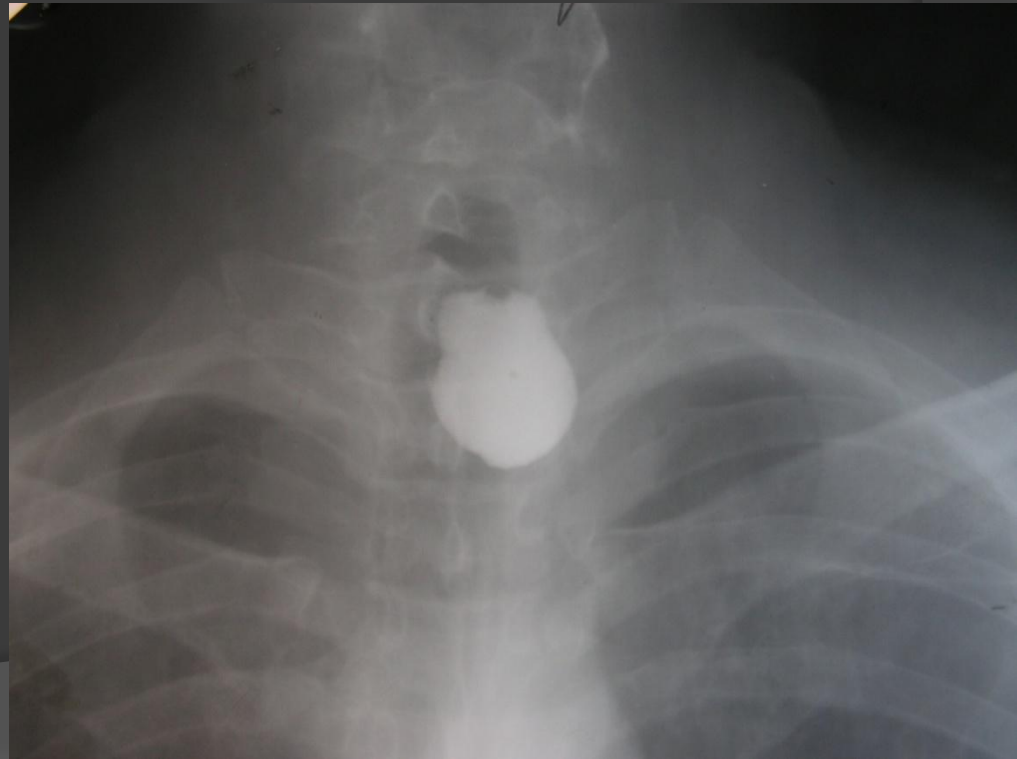
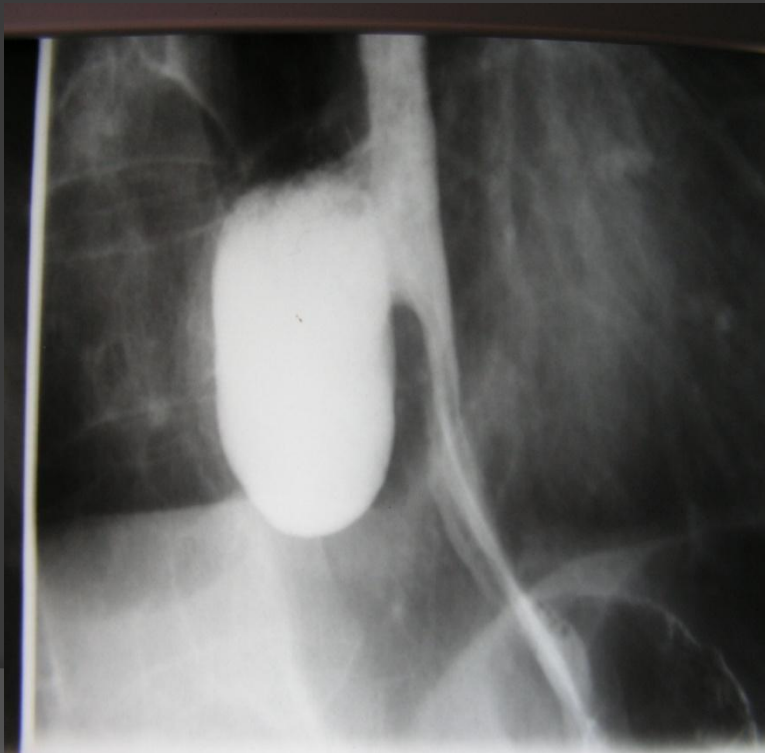
PET / CT scan with 18F-FDG in the frontal section of a 63-year-old woman showing ascending colon cancer with cecum spread



Esophageal diverticula

= protrusion of the inner lining of the mucosa through the outer muscular coat to form a small pouch with a narrow neck

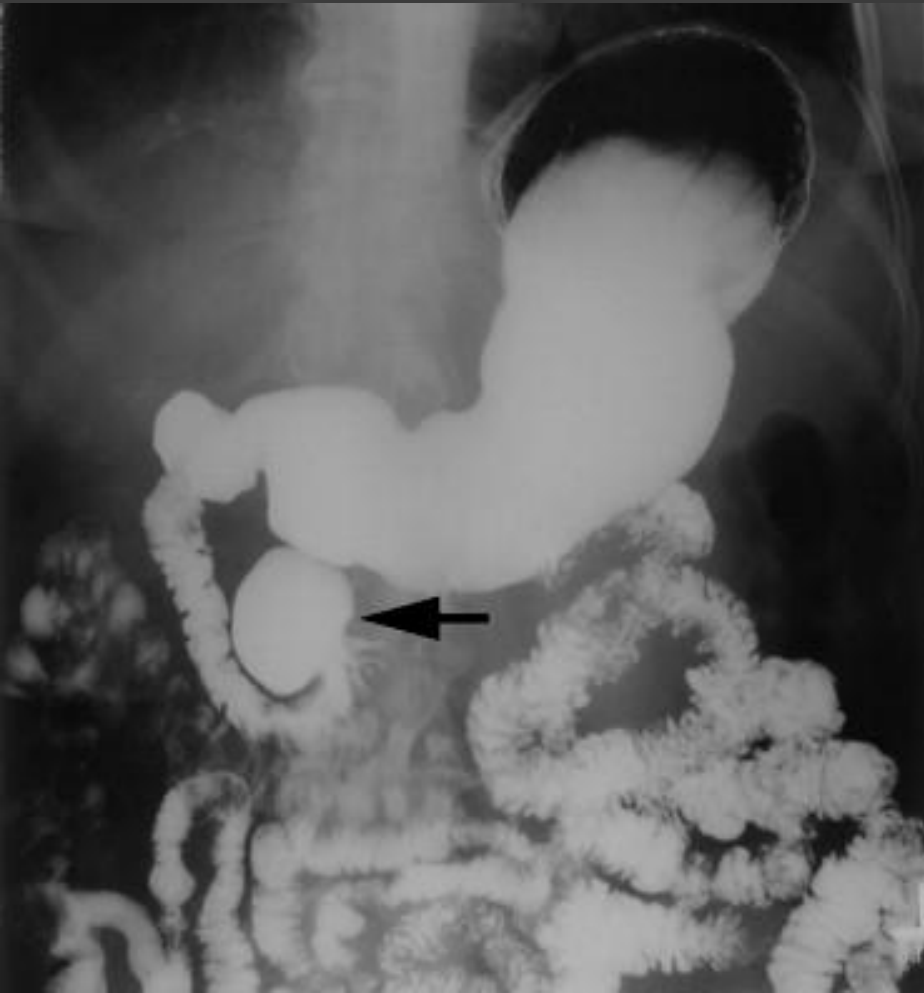
- **True diverticula** involve all layers, including muscularis propria and adventitia.
- **False diverticula** involve only the submucosa and mucosa without affecting the muscular layers or adventitia.
- **Traction esophageal diverticula** usually occur due to scarring from mediastinal or pulmonary tuberculosis

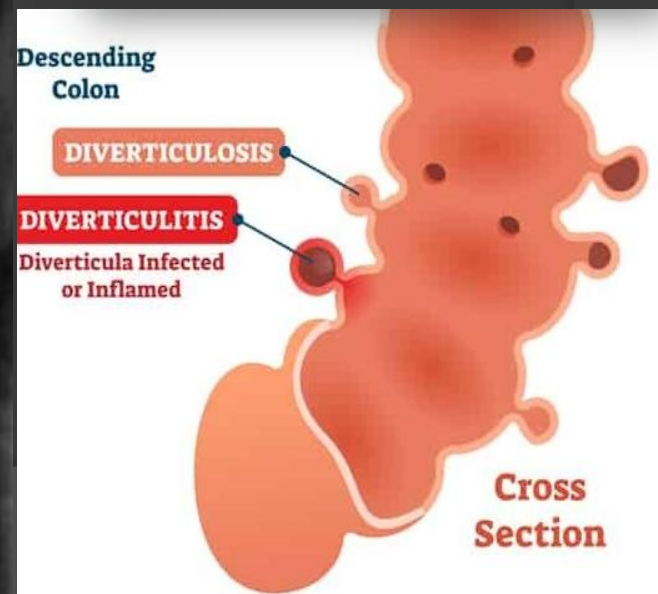
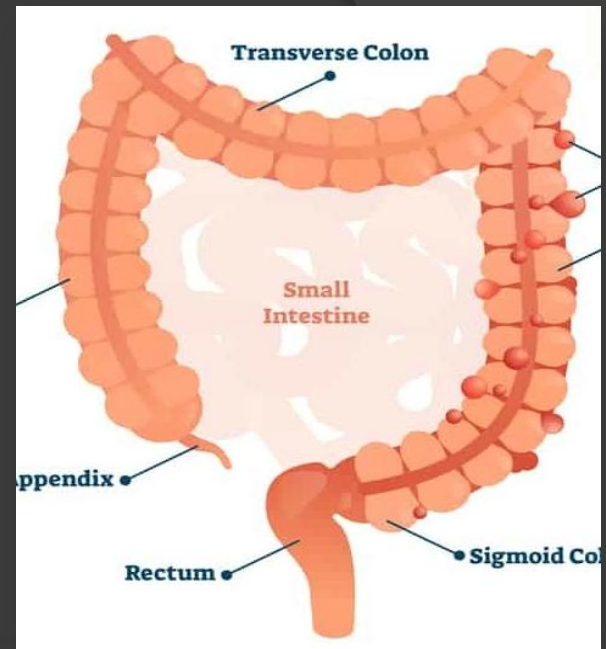


Esophageal diverticula



Duodenal diverticula

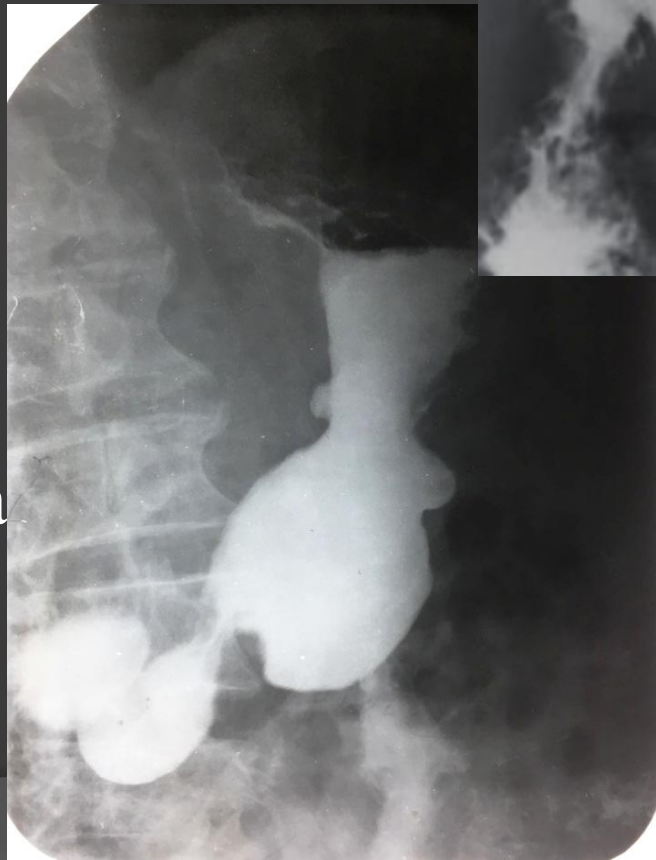




Gastric ulcers

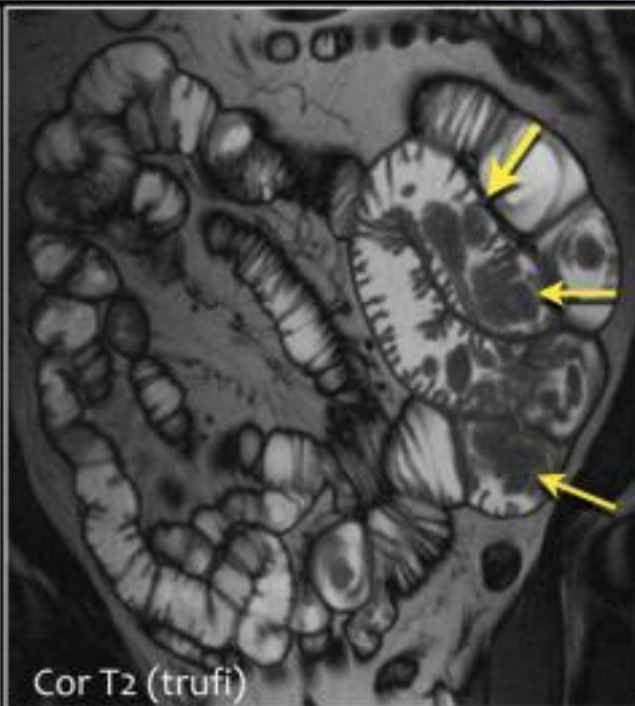
Radiological morphological signs

- Niche-image „plus filling”
- Marginal edema
- Convergence of plica gastrica





Gastric polyp

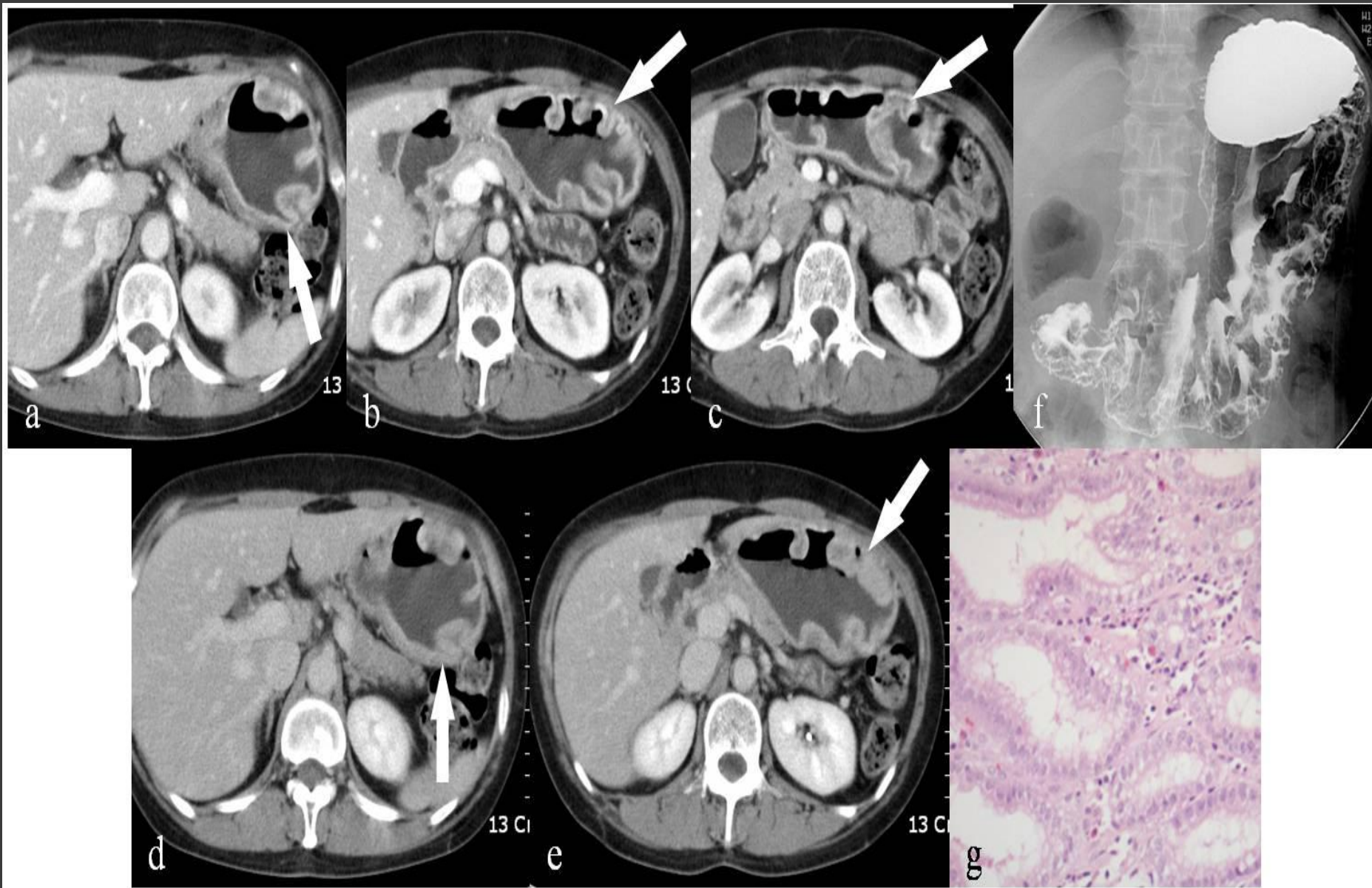


Cor T2 (trufi)

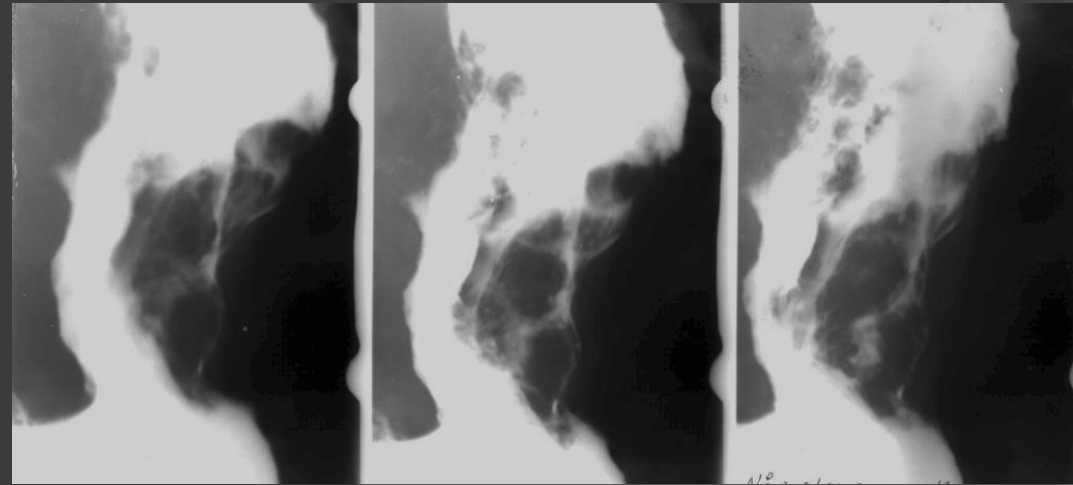
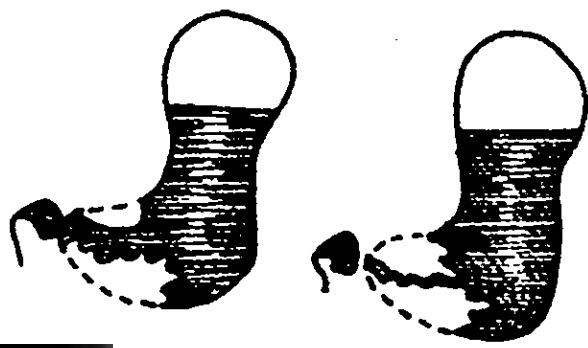
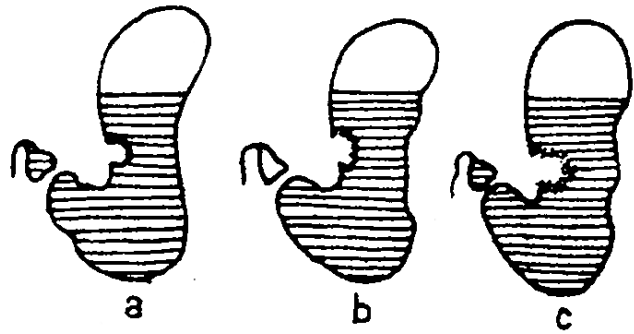
small bowel polyposis



Colonic polyp



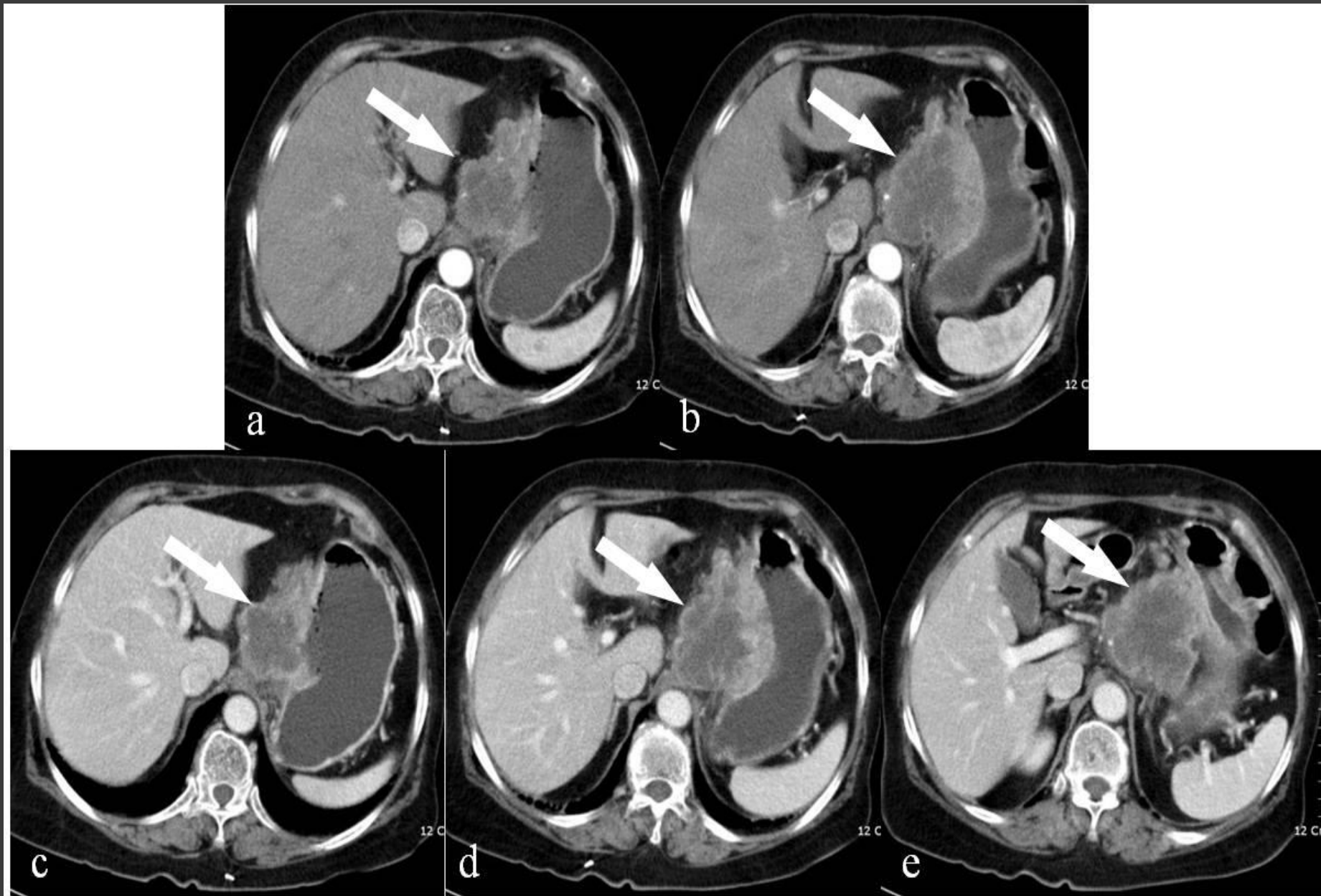
Hypertrophic gastritis.



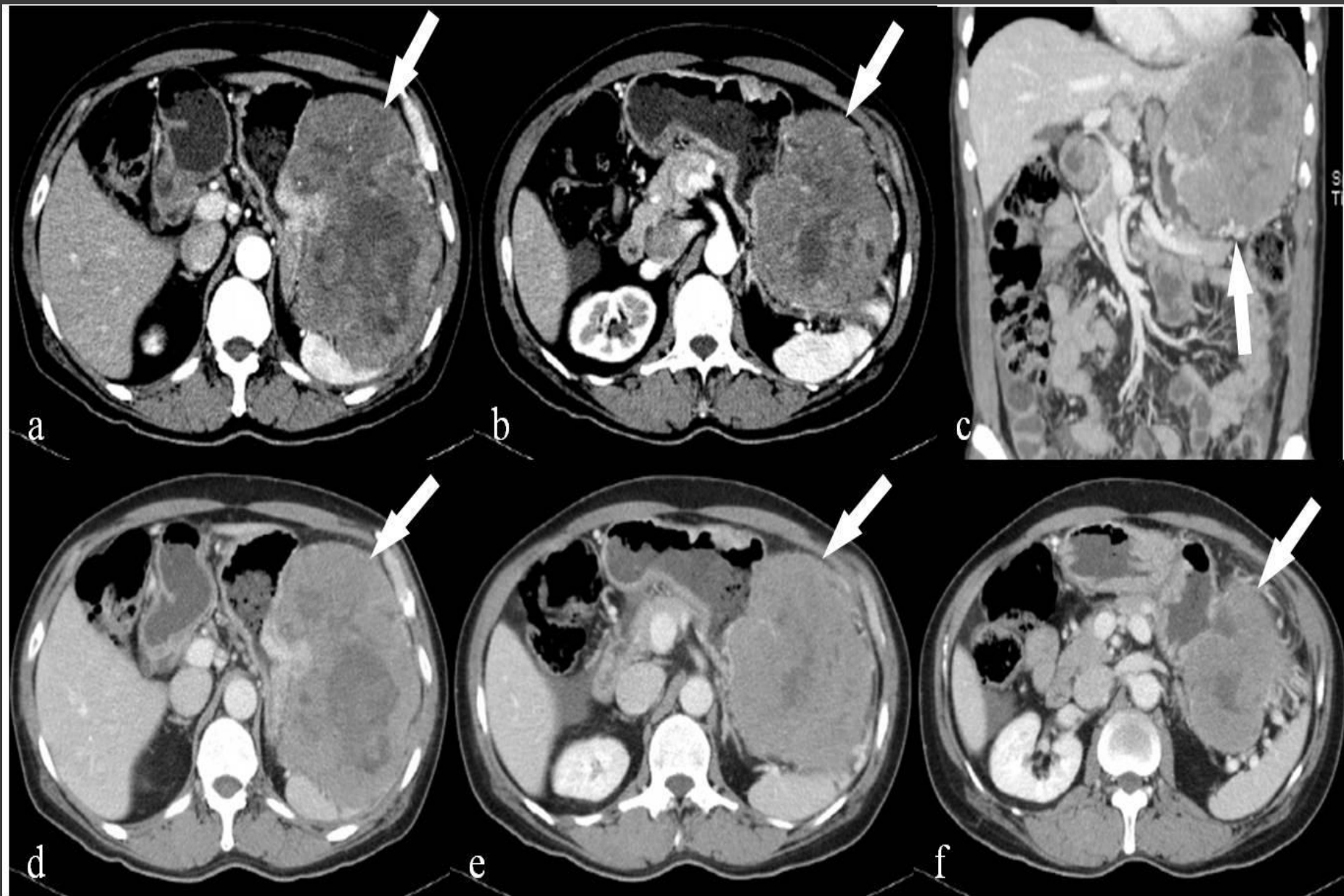
Gastric cancer



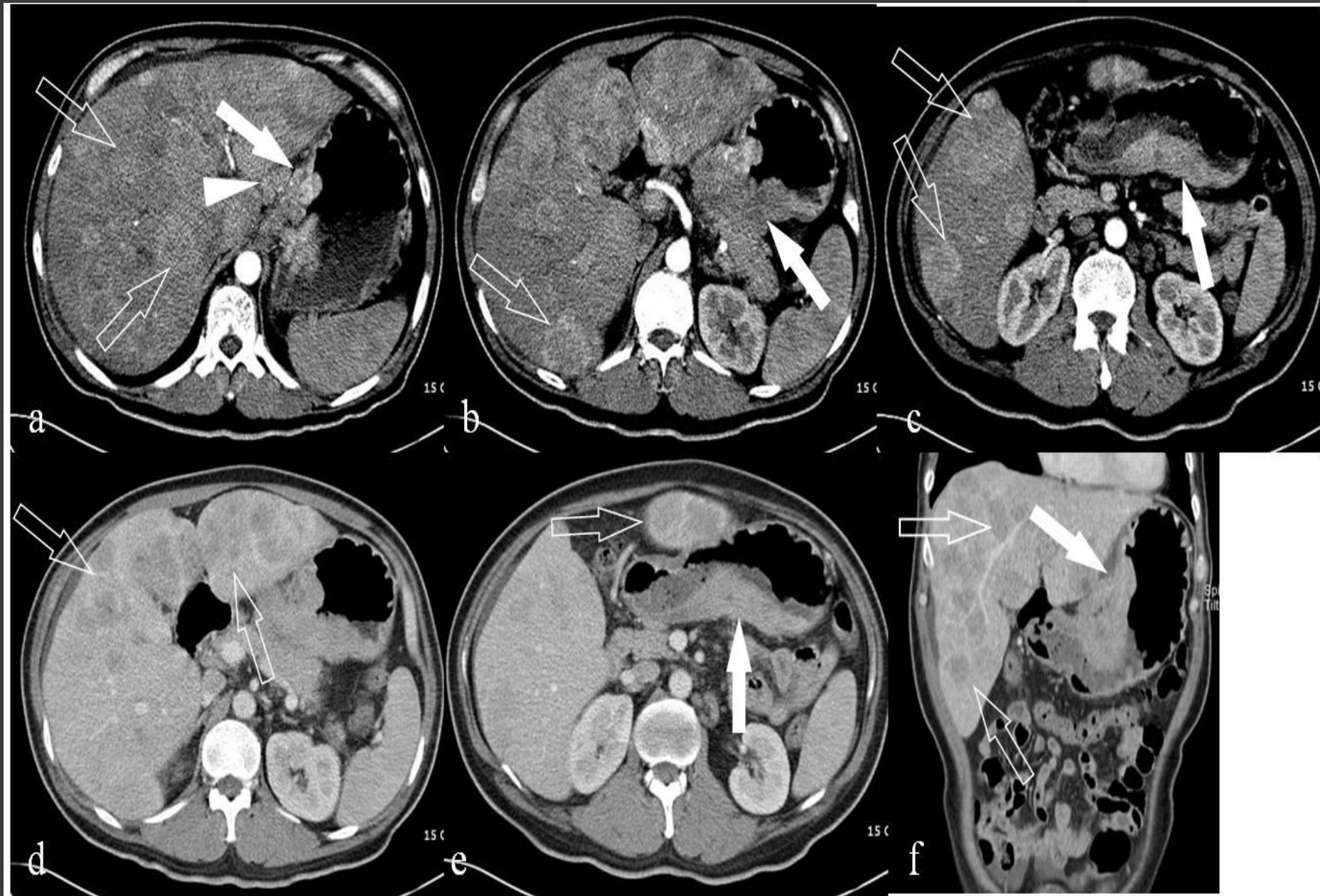
Gastric adenocarcinoma: axial contrast-enhanced CT (CECT) showing tumour arising from the lesser curvature of the stomach (asterisk) associated with enlarged regional gastrohepatic nodes



Exophytic adenocarcinoma.



High grade gastrointestinal stromal tumor.



Gastric tumor with spread

DIAPHRAGMATIC HERNIA

- Bochdalek hernia

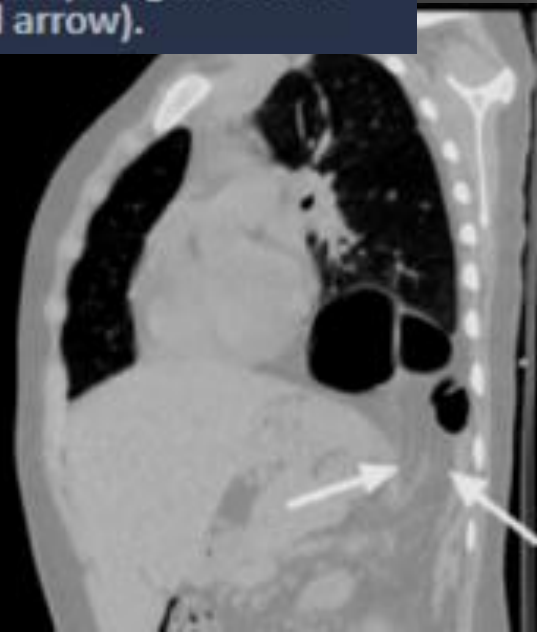
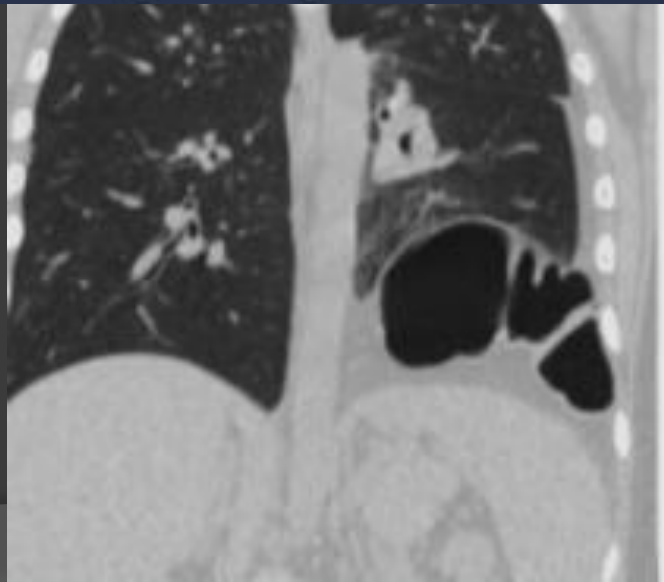
A Bochdalek hernia involves an opening on the left side of the diaphragm. The stomach and intestines usually move up into the chest cavity.

- Morgagni hernia

A Morgagni hernia involves an opening on the right side of the diaphragm. The liver and intestines usually move up into the chest cavity.

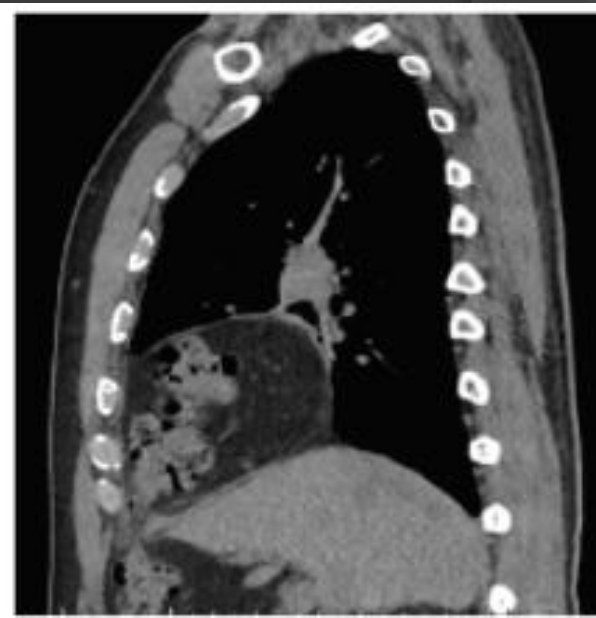
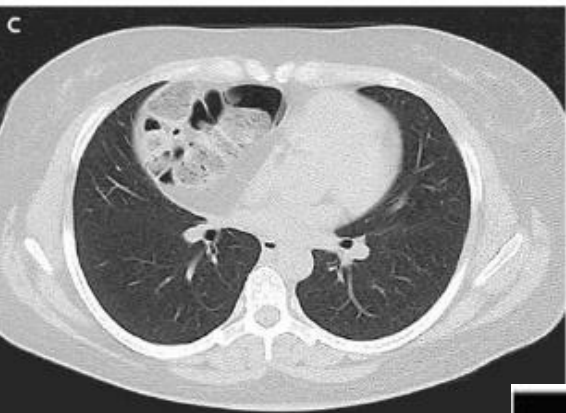


Bochdalek Hernia. Frontal view of the chest shows a large air-containing and walled structure in the region of the left lower lobe (white arrow). It is originating from below the diaphragm. The air-containing structure is seen posteriorly on the lateral view (red arrow).





Morgagni hernia.



Hepato-biliary system



Normal Gallbladder

Gallbladder, with sludge present



Gallbladder, with numerous stones present





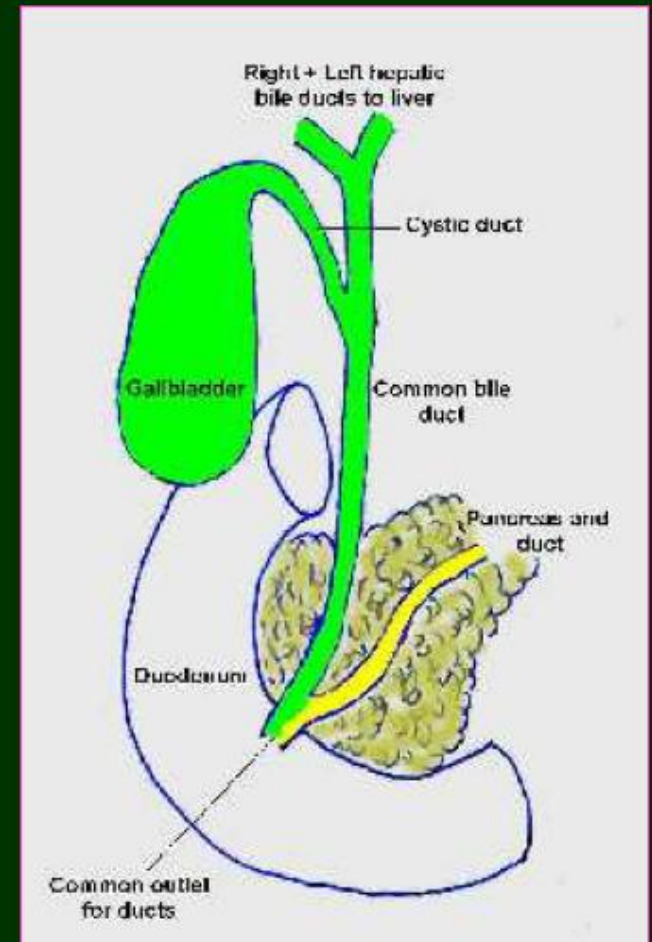
HEPATOBILIARY SCAN

- ❖ Tracers : Tc-99m IDA derivatives (Tc-99m DISIDA, Mebrofenin)
- ❖ Route : IV injection
- ❖ Mechanism : Carrier-mediated, non sodium dependent organic anion transport process
- ❖ Technique : -Fasting 4-6 hr
 - Dynamic study for at least 1 hour +/- delayed imaging
- ❖ Visualization : Liver and biliary system including gallbladder until excretion into small bowel (Normal → within 1 hour)

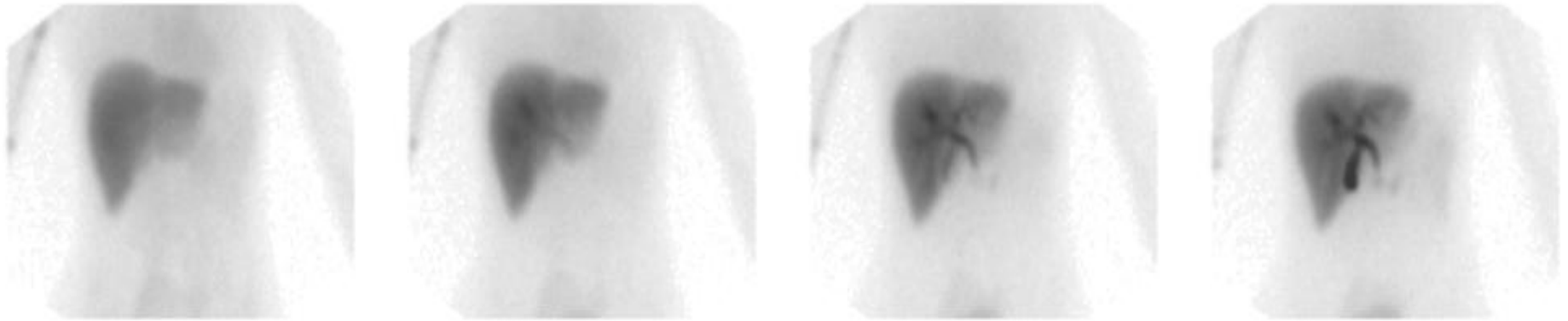
HEPATOBILIARY SCAN:

Indications

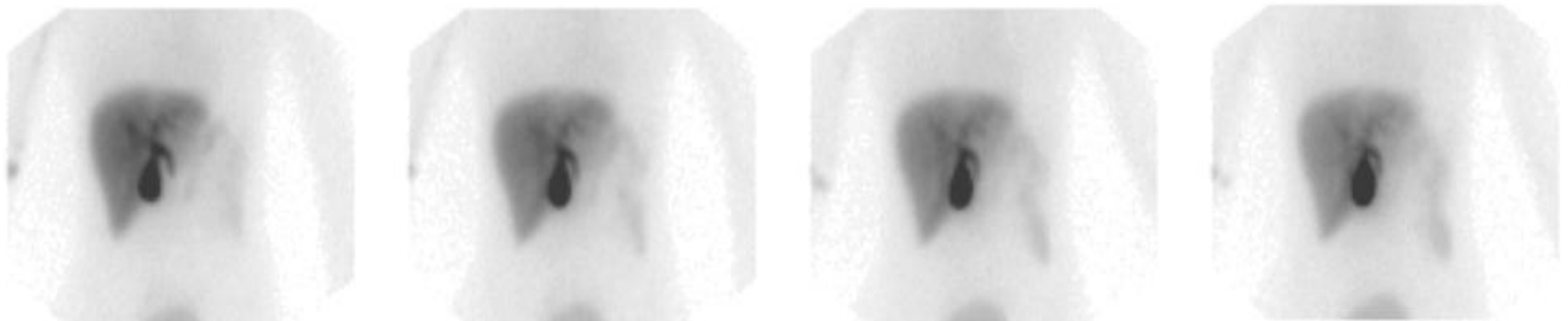
- ❖ Gallbladder disease
 - Acute cholecystitis*
- ❖ Biliary tract obstruction
 - DDx biliary atresia vs neonatal hepatitis
- ❖ Biliary leakage



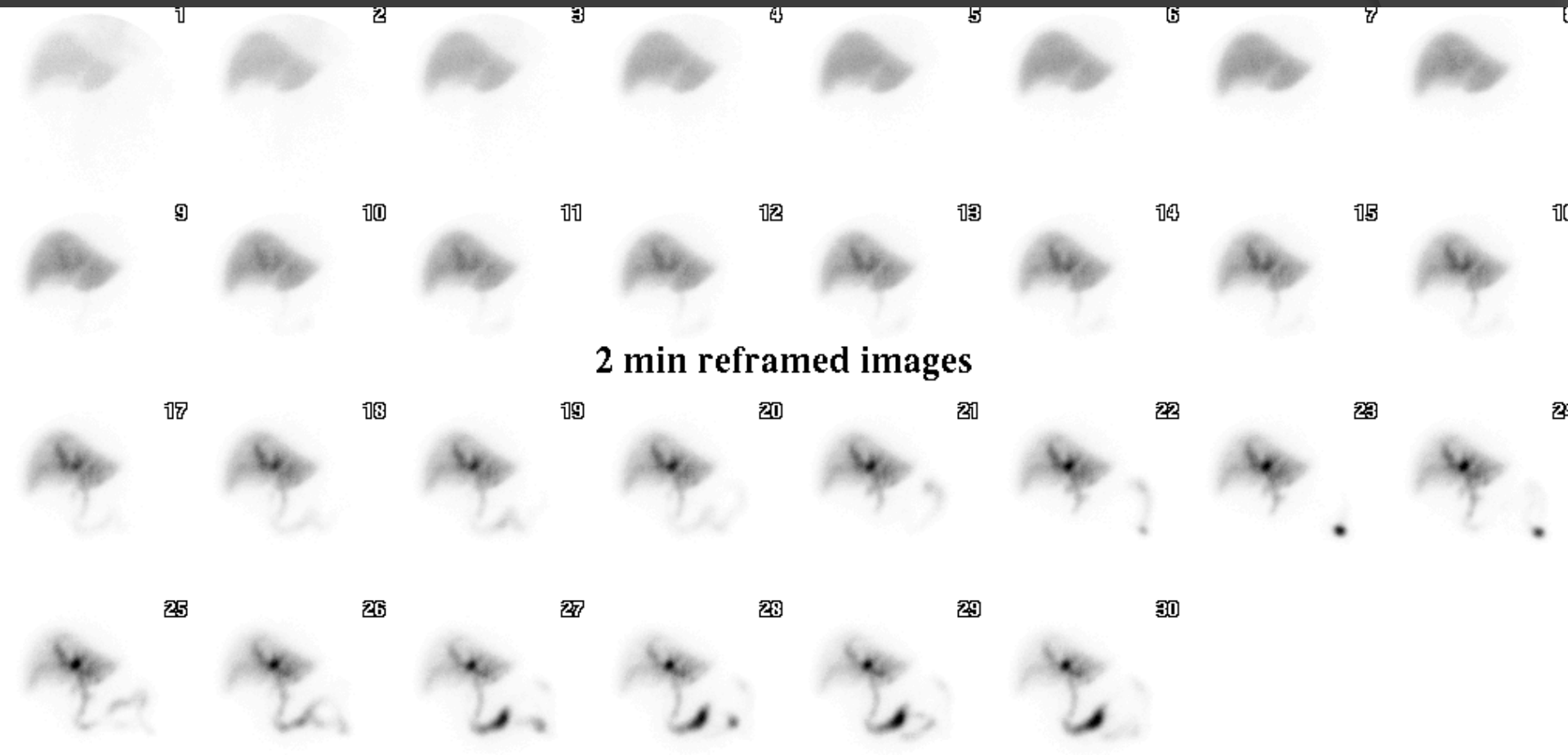
Normal Cholescintigraphy (HIDA scan)



5 minutes per frame



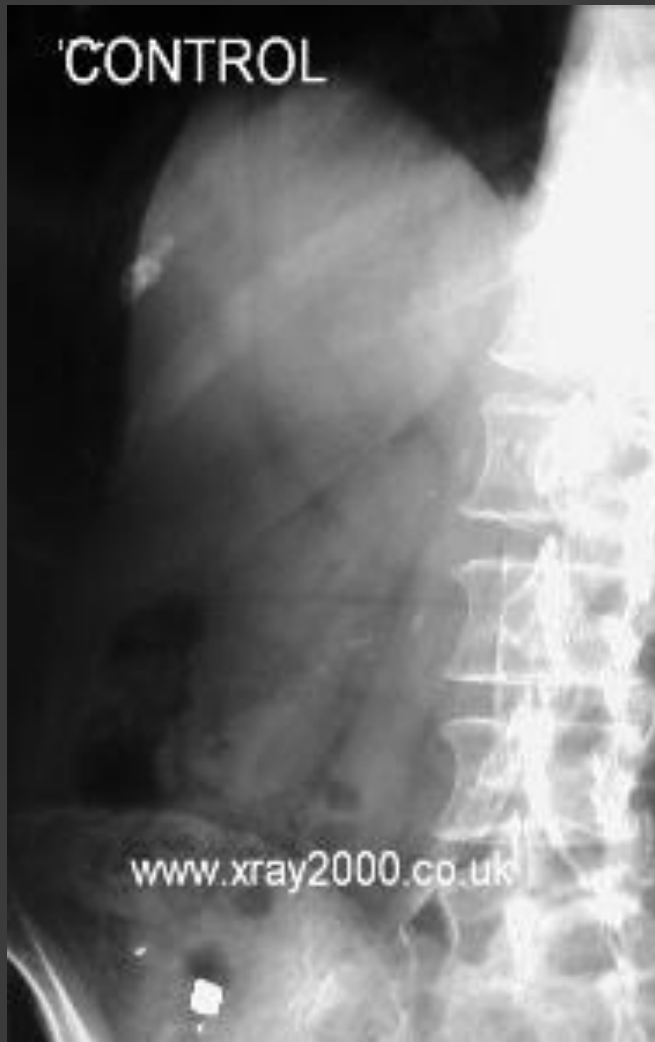
Cholescintigraphy



Acute cholecystitis

Oral Cholecystography (OCG)

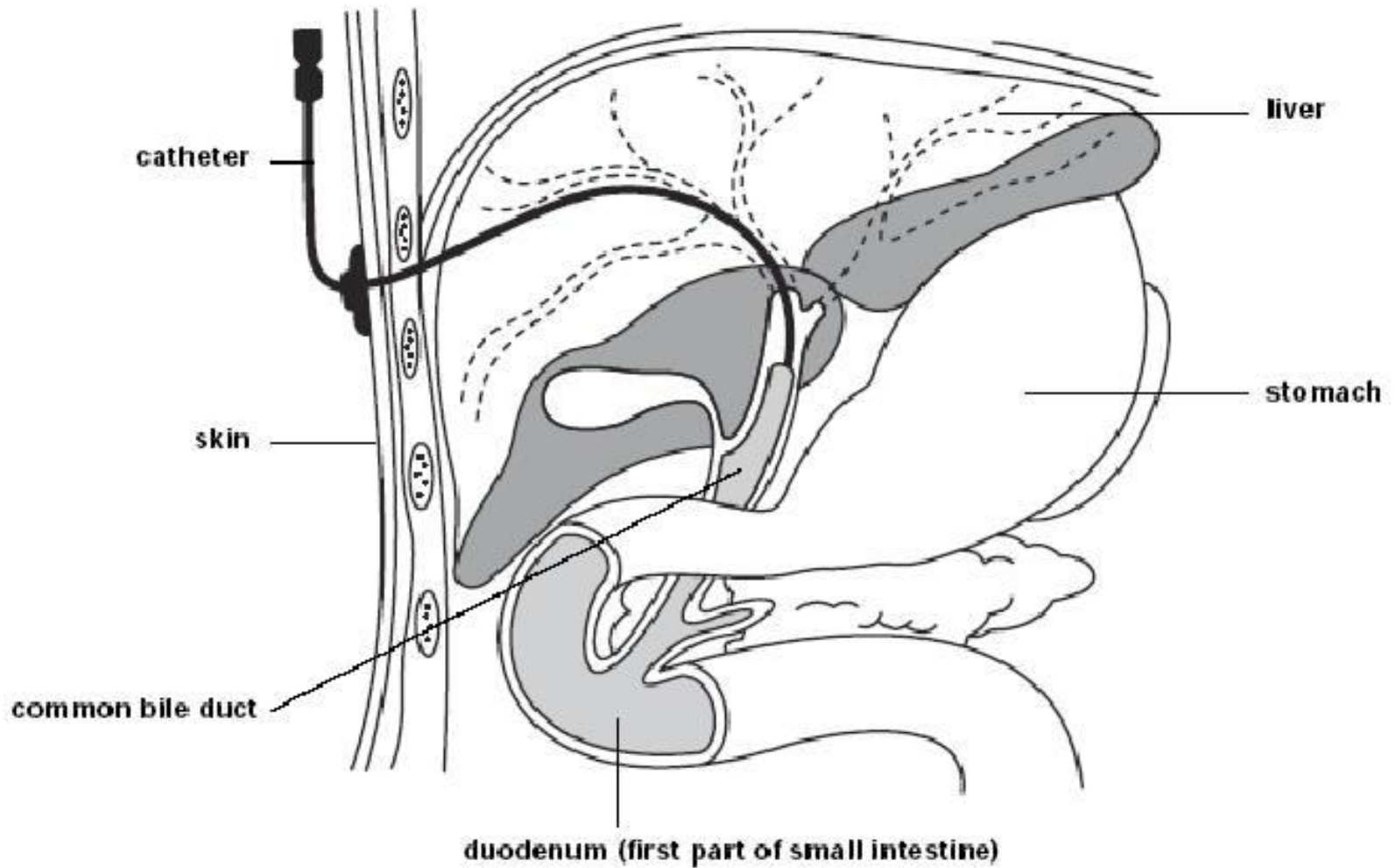
- OCG used to be the imaging modality of choice for detecting cholelithiasis. It is now used as an adjunct to ultrasound. It is obtained when the pt has the symptoms of cholelithiasis, but a negative ultrasound.
- It is more useful than ultrasound for visualizing large stones, and also is useful for counting the number of stones present.
- Contraindications: Pts with bilirubin $> 3\text{mg/dL}$, or in pregnancy.



OCG

Percutaneous Transhepatic Cholangiogram (PTC)

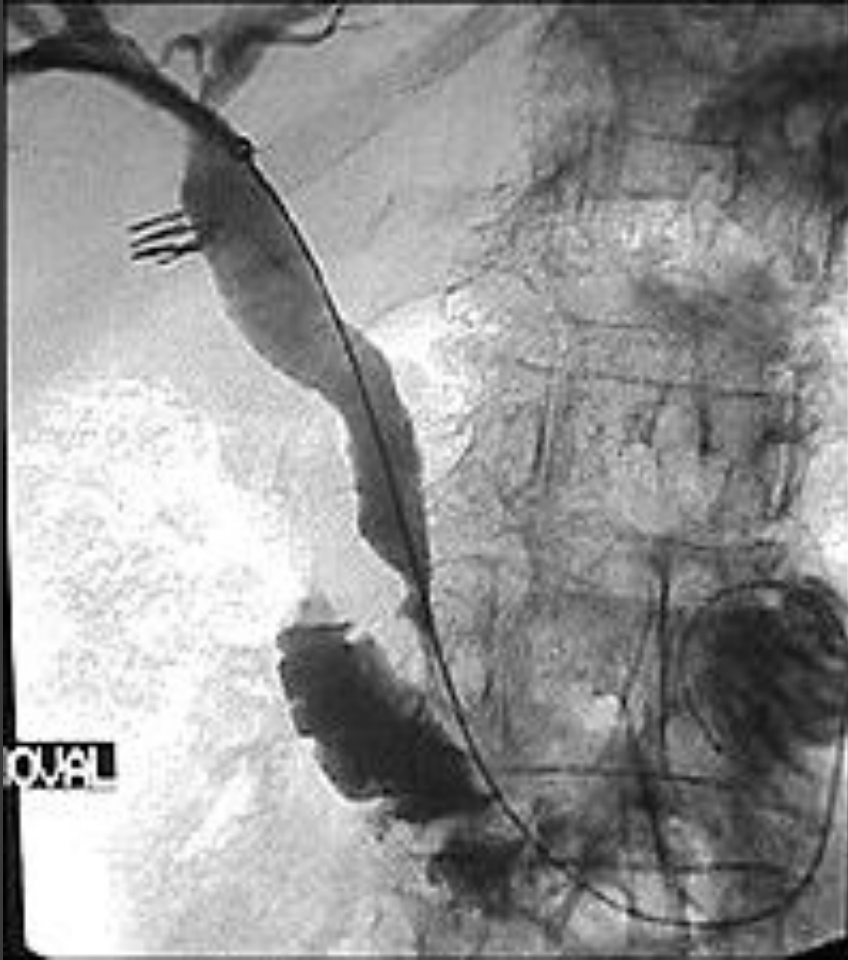
- PTC is indicated when percutaneous intervention is needed and ERCP either is inappropriate or has failed.
- Can be used to drain biliary obstructions.



PTC



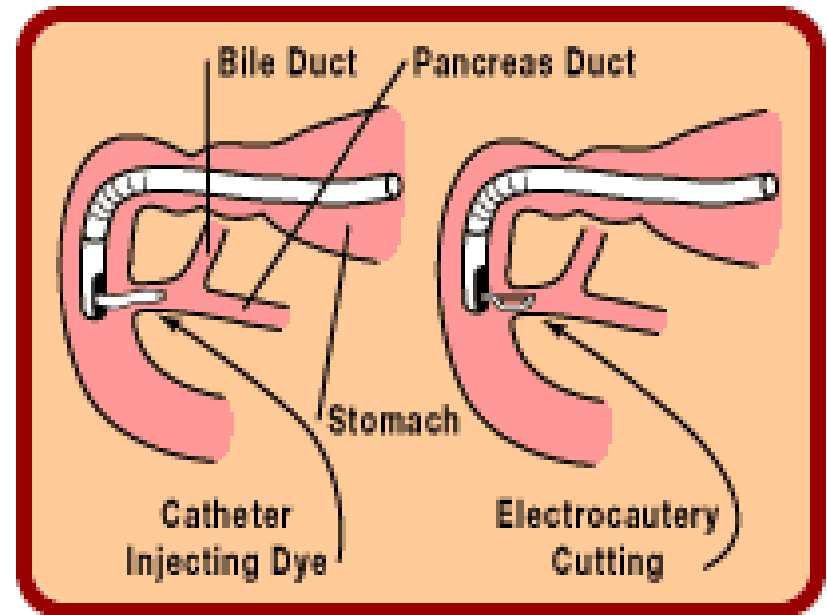
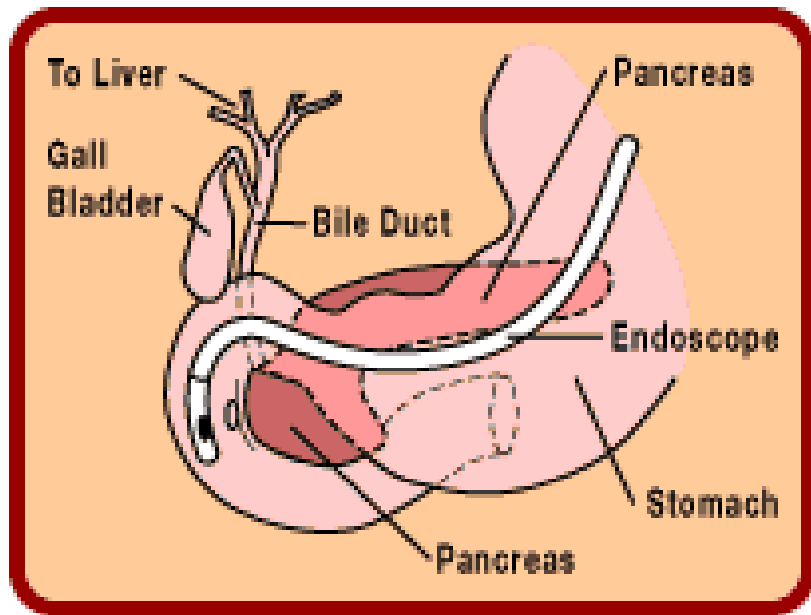
- PTC after injection of dye, showing a large gallstone trapped in the duct.



- PTC: The same duct as before, after removal of the stone through the drainage catheter.

Endoscopic Retrograde Cholangiopancreatography (ERCP)

- ERCP is the primary method of direct cholangiography, and has therapeutic potential. It also allows for examination of the upper GI tract, the papilla of Vater, and the pancreatic duct. Biopsies of multiple sites can be taken using this technique.
- ERCP causes less discomfort than PTC, but acute pancreatitis is a common complication (which is rarely seen in PTC).



ERCP: The endoscope is introduced and is threaded around to the sphincter of Oddi. There, dye can be injected into the ducts. Instruments can also be inserted through the scope to remove stones, insert drains, remove tissue samples, or perform other treatments.

ERCP

- The most important indication for ERCP is obstructive jaundice, as it can demonstrate the cause and extent of the obstruction.
- ERCP is the preferred method of examination of patient with possible choledocholithiasis, because the stones can be extracted with balloons or gaskets after sphincterotomy is performed.



ERCP: showing slightly dilated common bile duct with calculus and normal pancreatic duct

ERCP showing stones

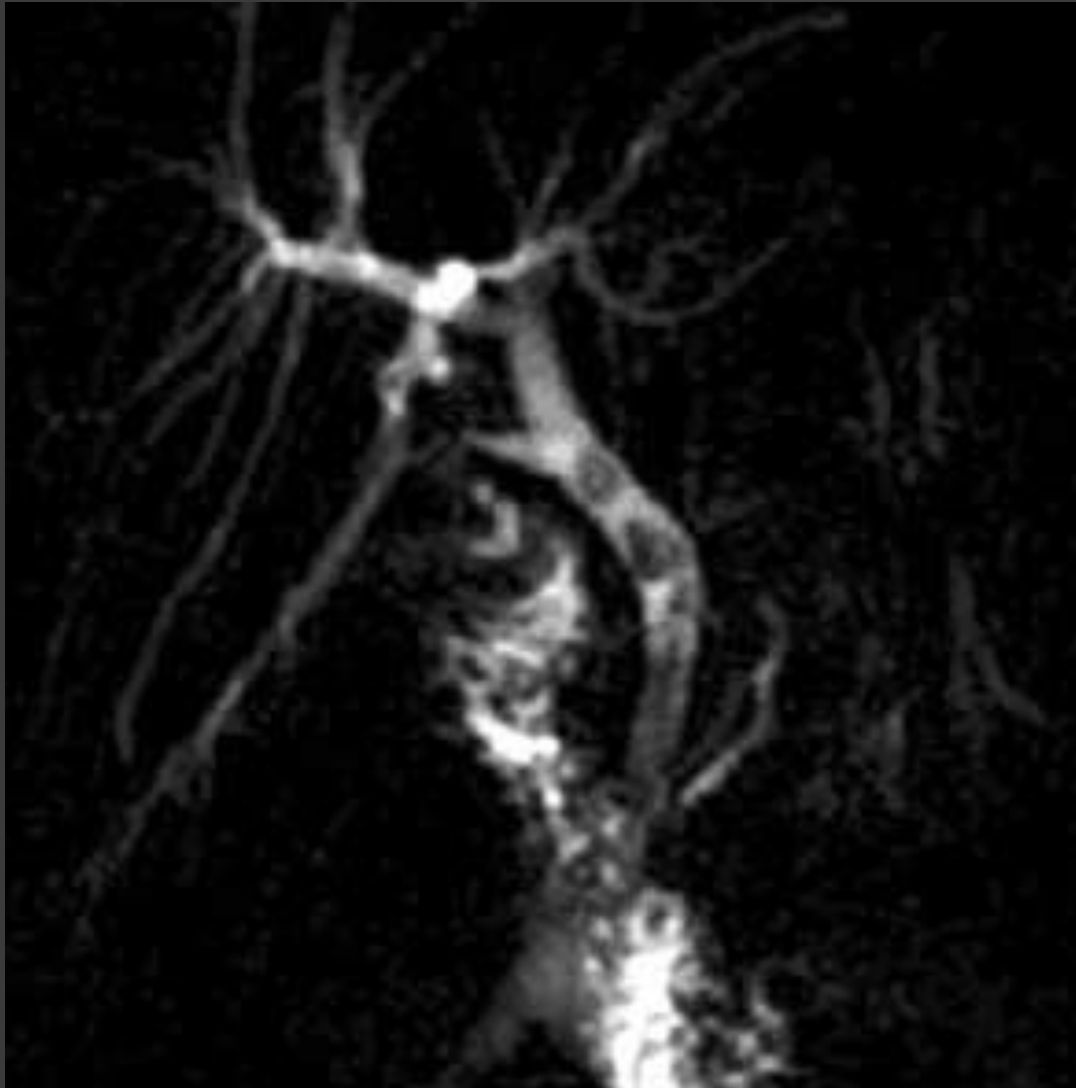


Magnetic Resonance Cholangiopancreatography (MRCP)

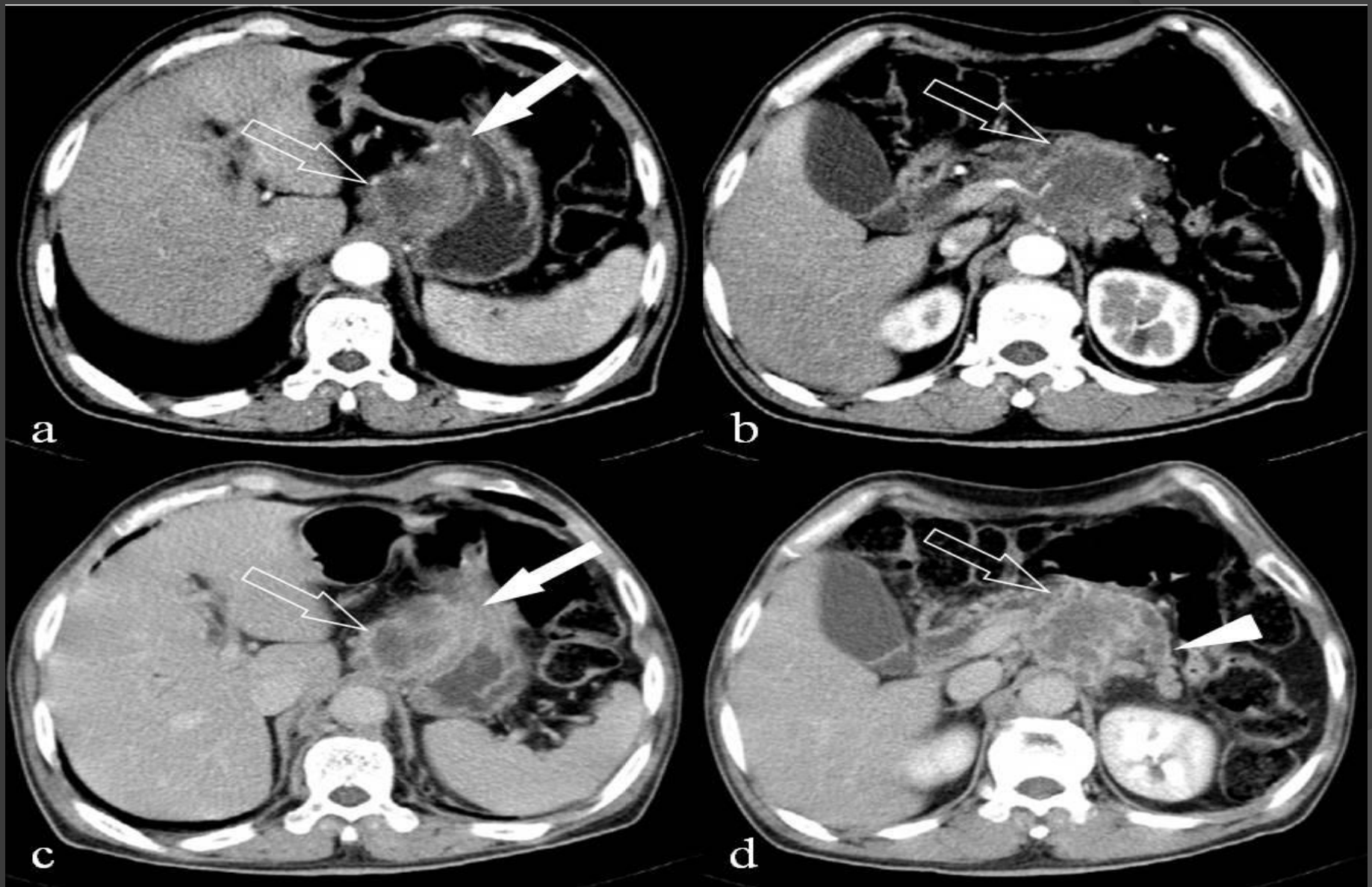
- MRCP is becoming a more viable imaging technique, as MRI technology improves. However, CT and ultrasound are faster, easier, and more readily available, so they are used more frequently than MRCP.
- MRCP is emerging as a new tool for non-invasive evaluation of the pancreatic and biliary ductal systems.
- MRCP is gradually replacing PTC and ERCP for diagnostic purposes.



MRCP



MRCP with stones in the duct



Direct gastric metastasis of primary pancreatic cancer.