SURGICAL DISEASES. RADIO-IMAGISTIC INVESTIGATIONS

USMF"N.TESTEMITANU"

DEPARTAMENT OF RADIOLOGY AND MEDICAL IMAGING

GASTROINTESTINAL IMAGING

IMAGING MODALITIES

1. Plain Radiograph of the abdomen
2. Barium study
3. Fluoroscopy
4. Ultrasonography
5. Computerized tomography
6. Radionuclide imaging
7. Magnetic Rezonance Imaging (MRI)
8. Angiography (aorta, celiac trunk, mesenteric arteries)

GASTROINTESTINAL TRACT

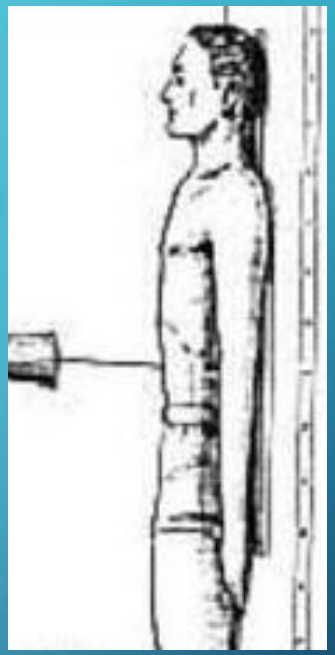
- Oral cavity
- Pharynx
- Esophagus
- Stomach
- Small bowel
- Large bowel (Colon)
- Rectum

Accessory organs

- Parotid glands
- Liver
- Gallblader and billiary ducts
- Pancreas

Plain Abdominal X-ray

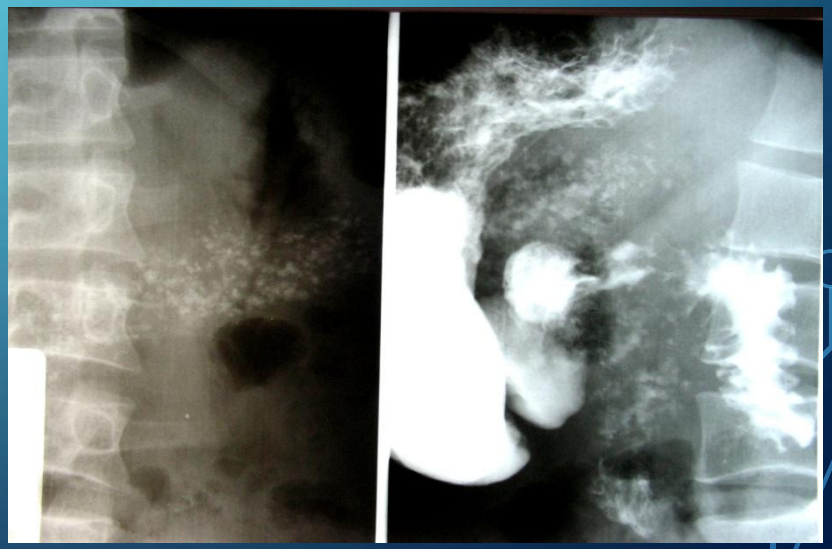
Indications



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

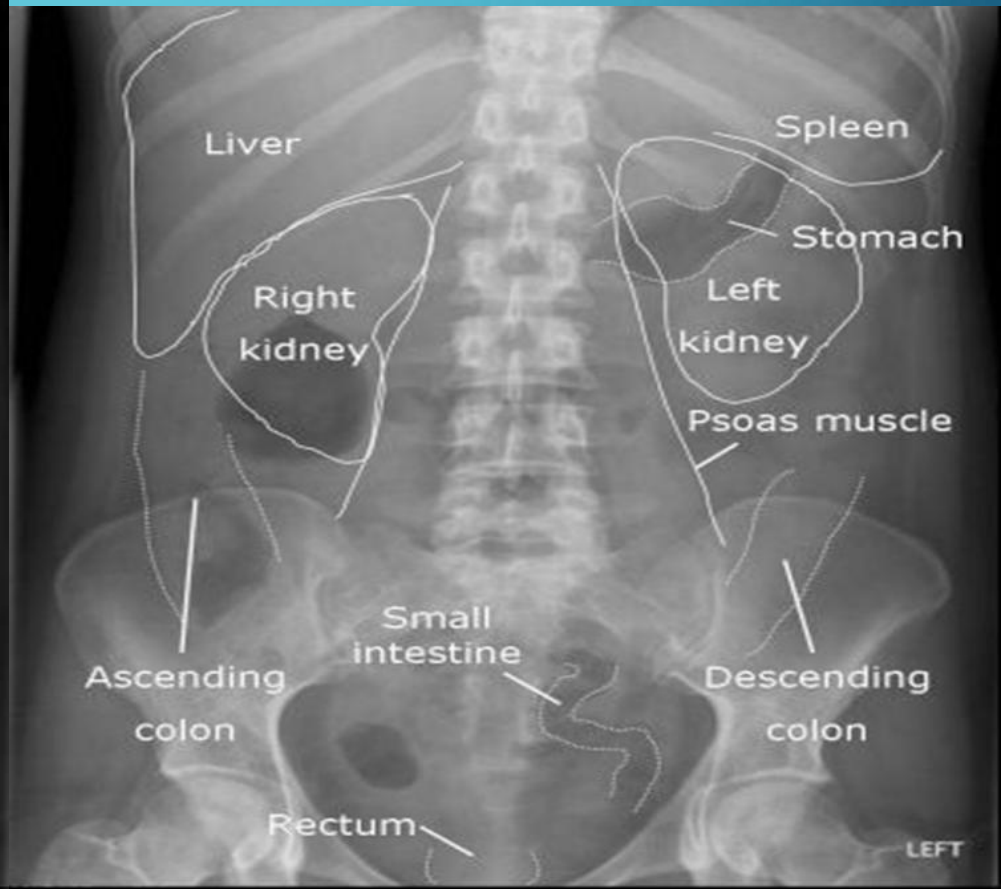
5 basic densities on x rays:

- Gas - - - - - - - - - - - - - > Black
- Fat - - - - - - - - - - - - - > Dark grey
- Soft tissue/fluid - - - - > Light grey
- Bone/calcification - - - > White
- Metal - - - - - - - - - - - - > Intense white



WHAT TO EXAMINE?

- Air (bowel gas)
- Bone density
- Calcifications
- Soft tissues



AIR:

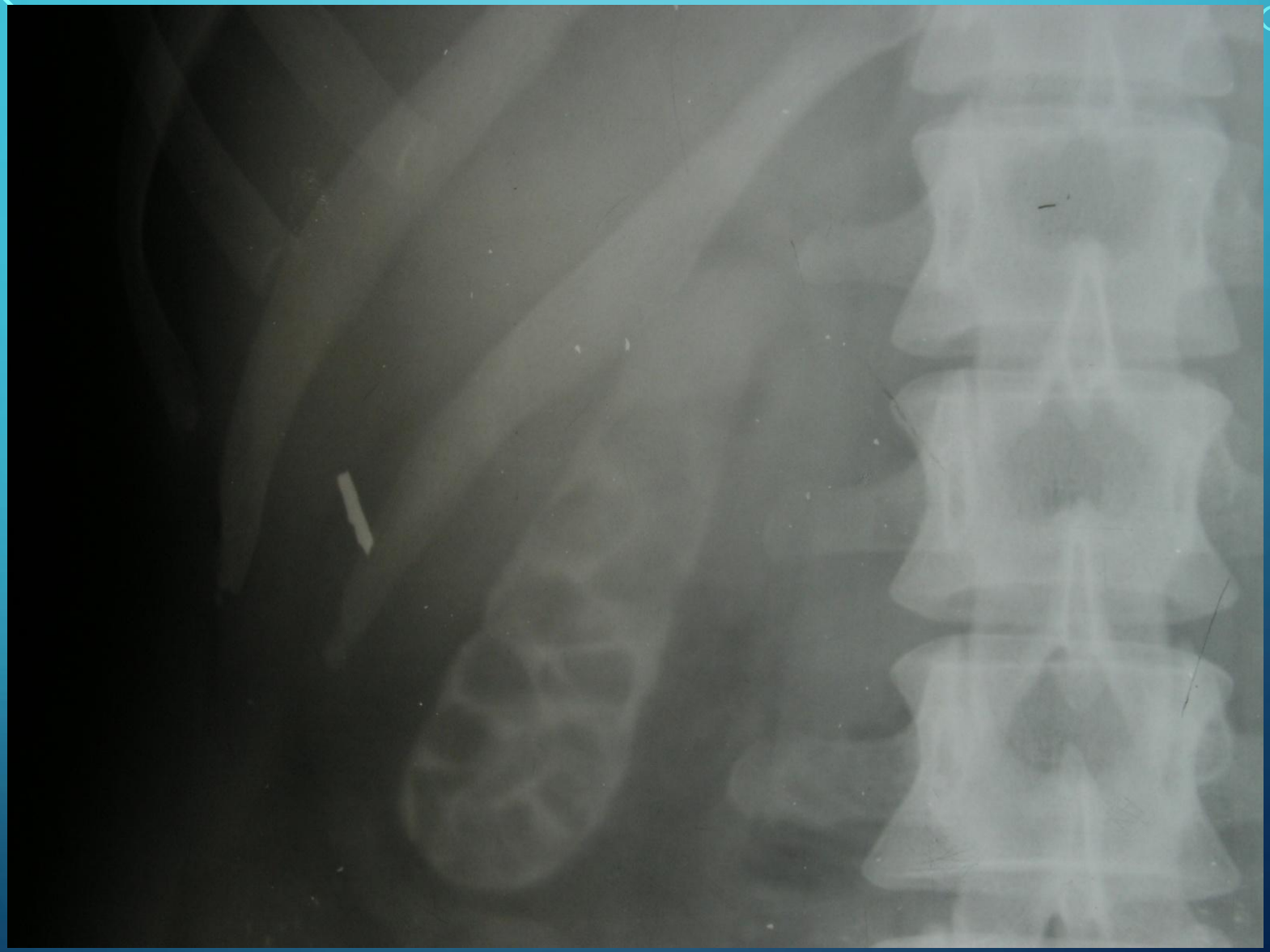
- Look at the stomach:
  - If the stomach contains air it may be visible in the left upper quadrant of the abdomen. The lowest part of the stomach crosses the midline.
- Look at the diaphragms:
  - Are they raised or flattened?
  - Are the costophrenic angles clear?
- Is there any free intra-abdominal air? (better evaluated if erect or decubitus)

AIR:

Free air under the diaphragm ➔ visceral perforation

Crescentic gaz under the right hemidiaphragm ➔ visceral perforation

CALCIFICATIONS:



Calcifications, stones

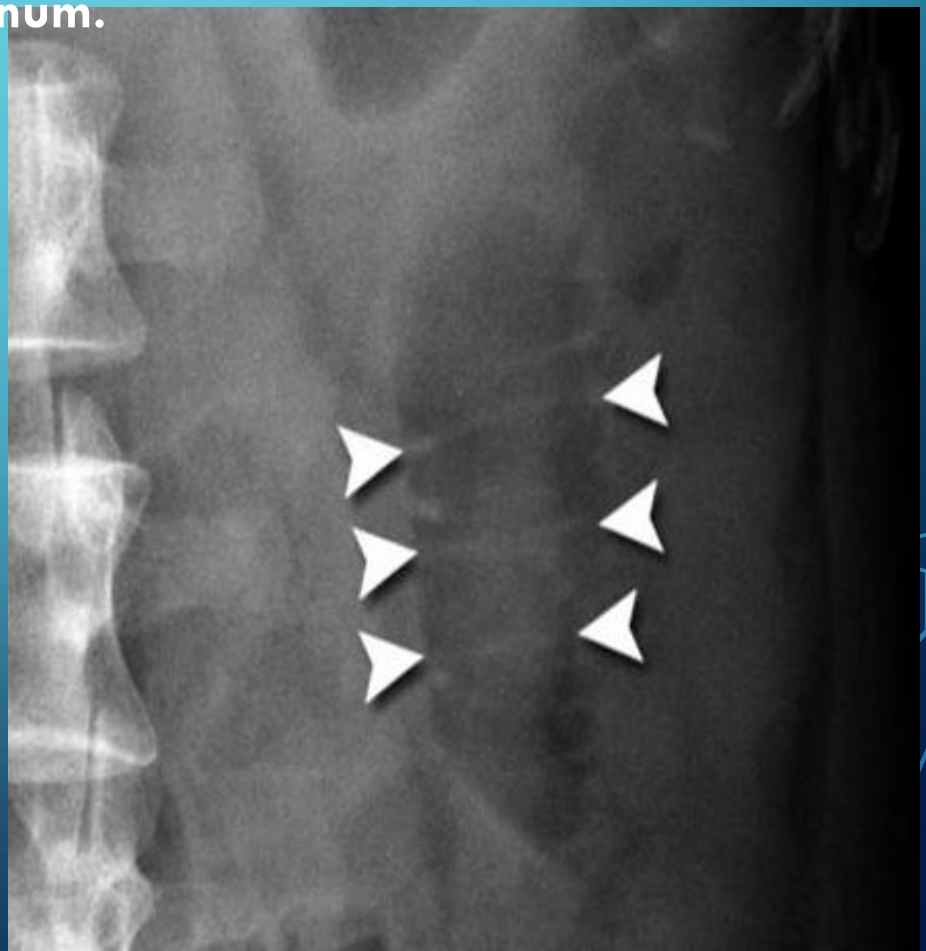
Bowel gas pattern

- Look at the bowel gas pattern:
  - Where are the bowel loops located (central vs. peripheral)?
  - What is the distribution of the gas in the abdomen?
  - Is there too much intraluminal gas?

- What is the intraluminal caliber of the small and large bowel?
- Are there any dilatations of the small and/or large bowel?
- Are there any air-fluid levels?

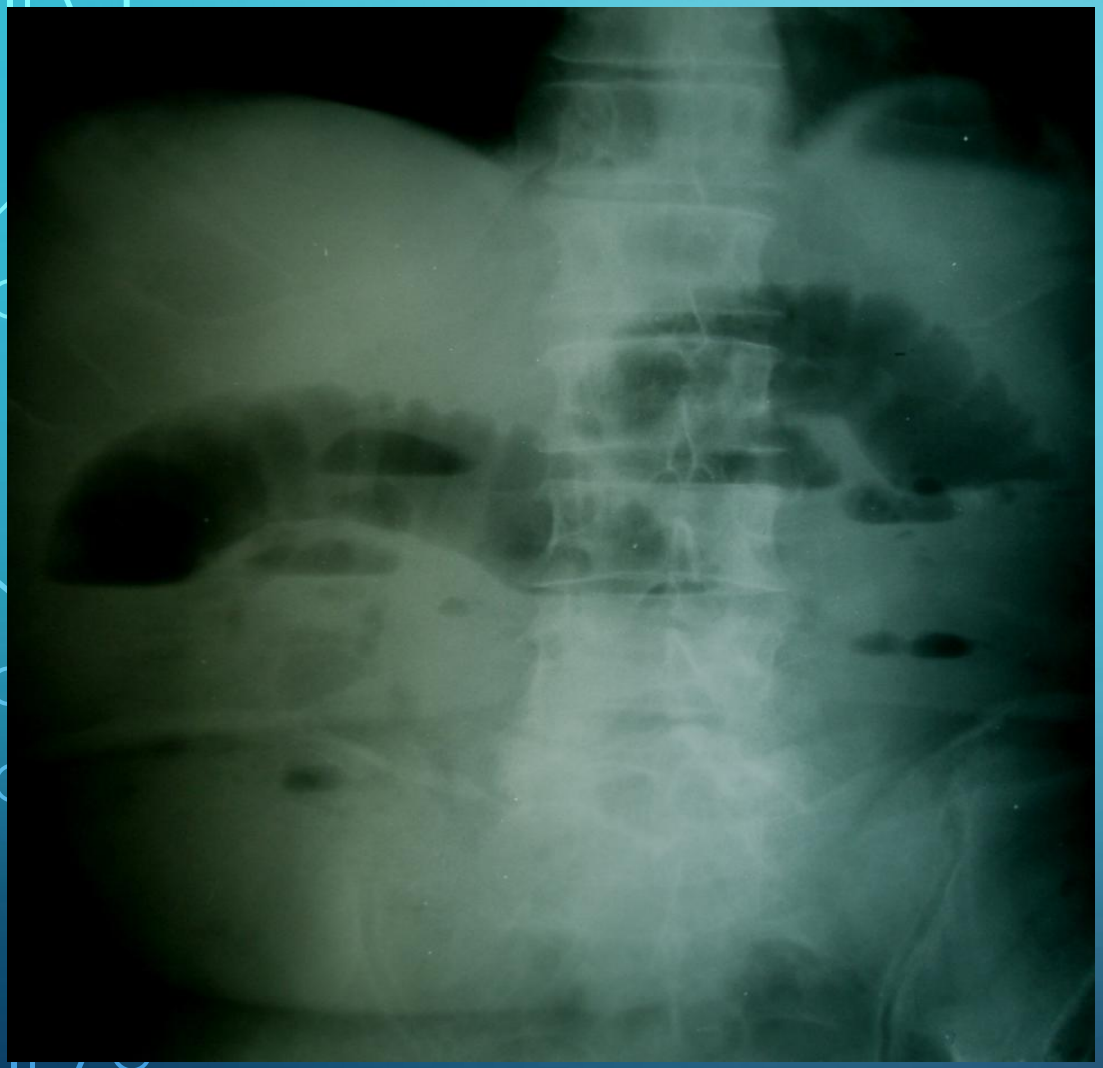
SMALL BOWEL

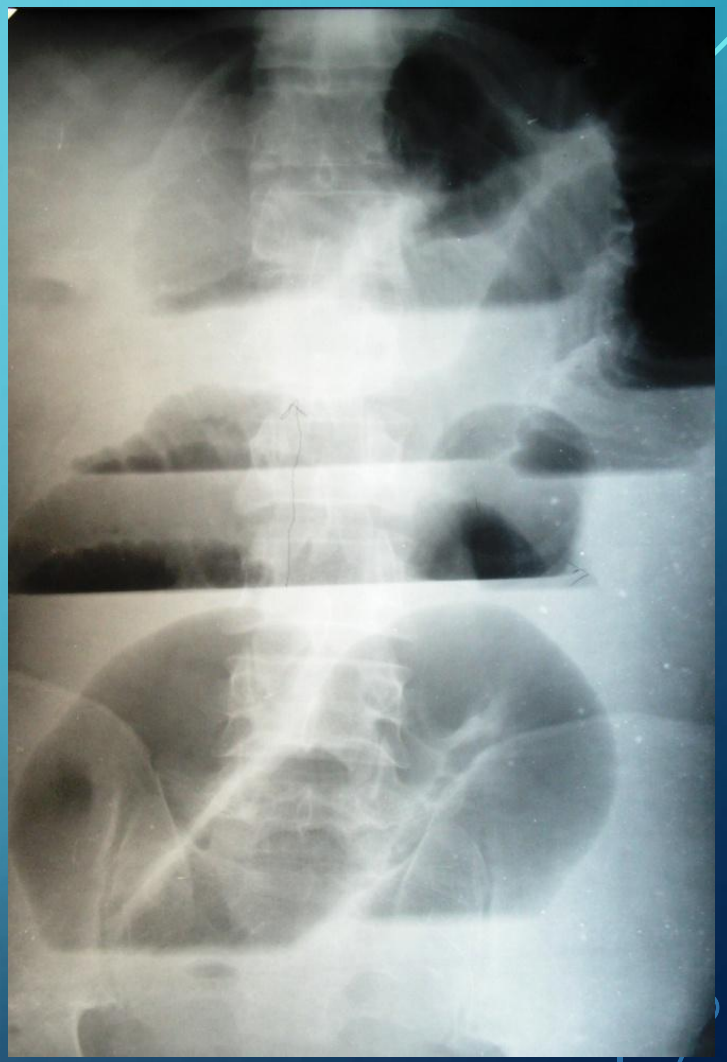
- Central position in the abdomen
- Valvulae conniventes - mucosal folds that cross the full width of the bowel. Usually they become visible when the small bowel is more distended, particularly in the jejunum.



LARGE BOWEL

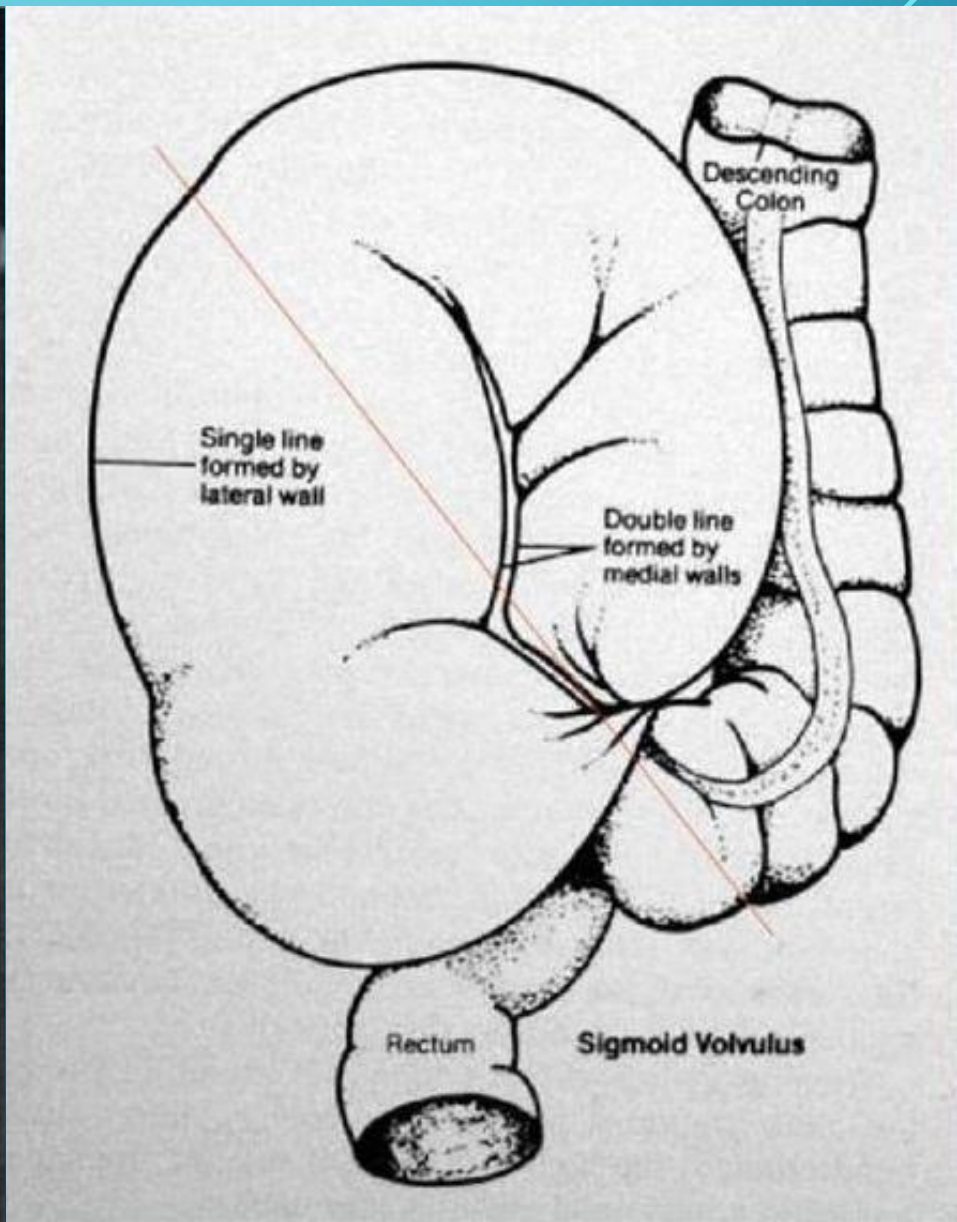
- **Peripheral position in the abdomen** (although the location of the transverse and sigmoid colon may vary)
- **Haustra** - small pouches, giving the colon its segmented appearance. **Haustra don't reach around the entire circumference of the intestine, in contrast to circular folds of the small bowel (valvulae conniventes).**
- Loss of haustra is a sign of chronic ulcerative colitis.
- Large bowel also contains feces (in contrast to the small intestine)





Upright abdominal X-ray demonstrating a bowel obstruction. Note multiple air fluid levels

SIGMOID VOLVULUS



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.

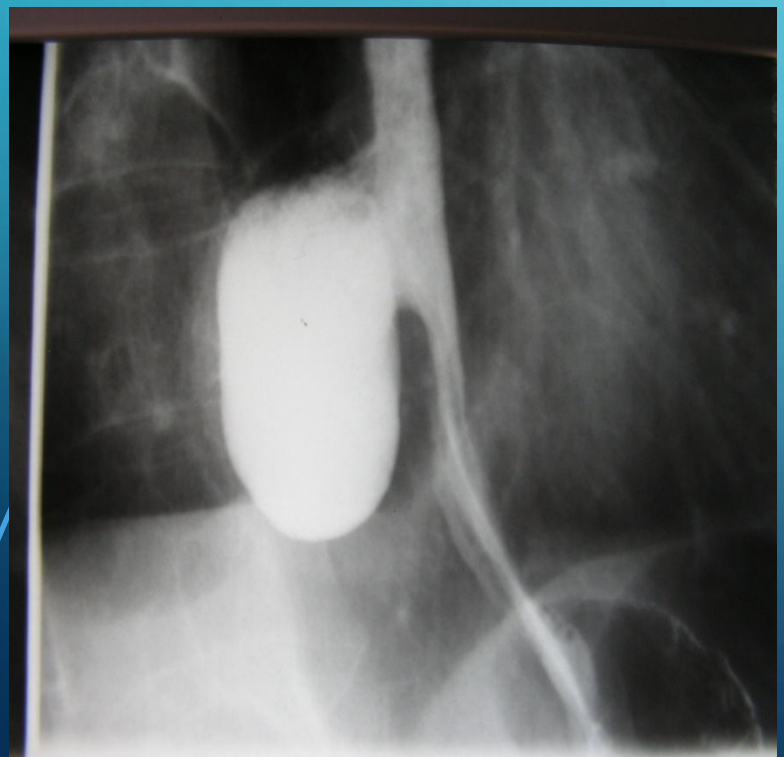
ACHALASIA

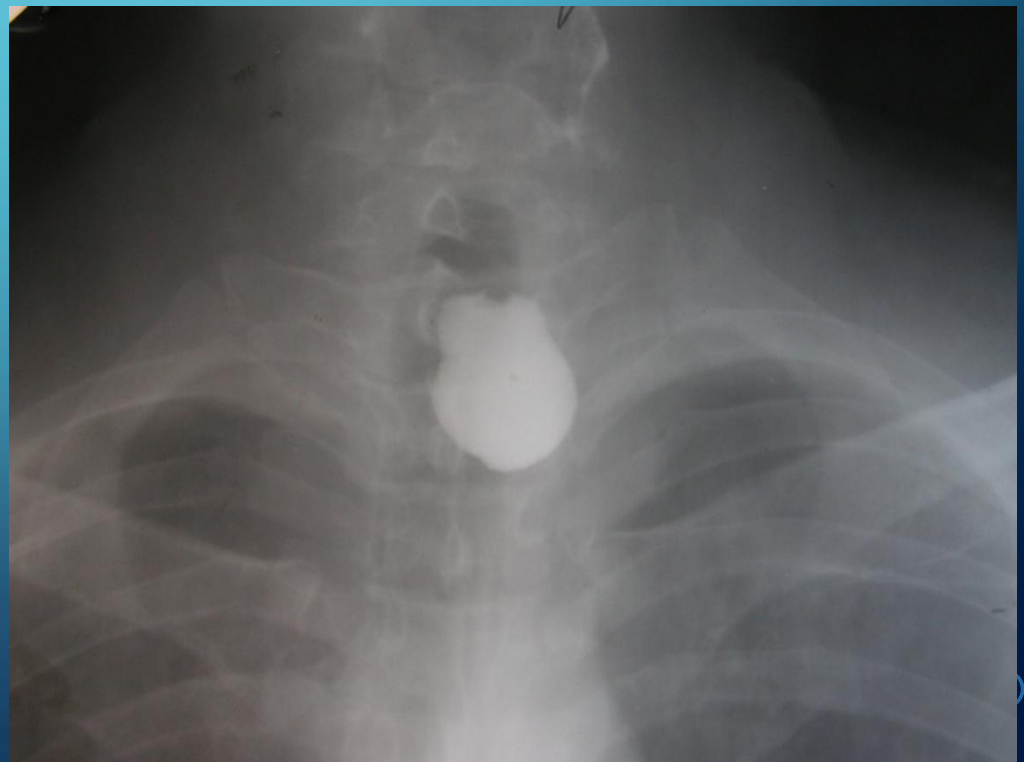
- An esophageal motility disorder characterized by incomplete lower esophageal sphincter (LES) relaxation, increased LES tone, and lack of peristalsis of the esophagus
- Acute tapering at the lower esophageal sphincter and narrowing at the gastro-esophageal junction, producing a "bird's beak" or "rat's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

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

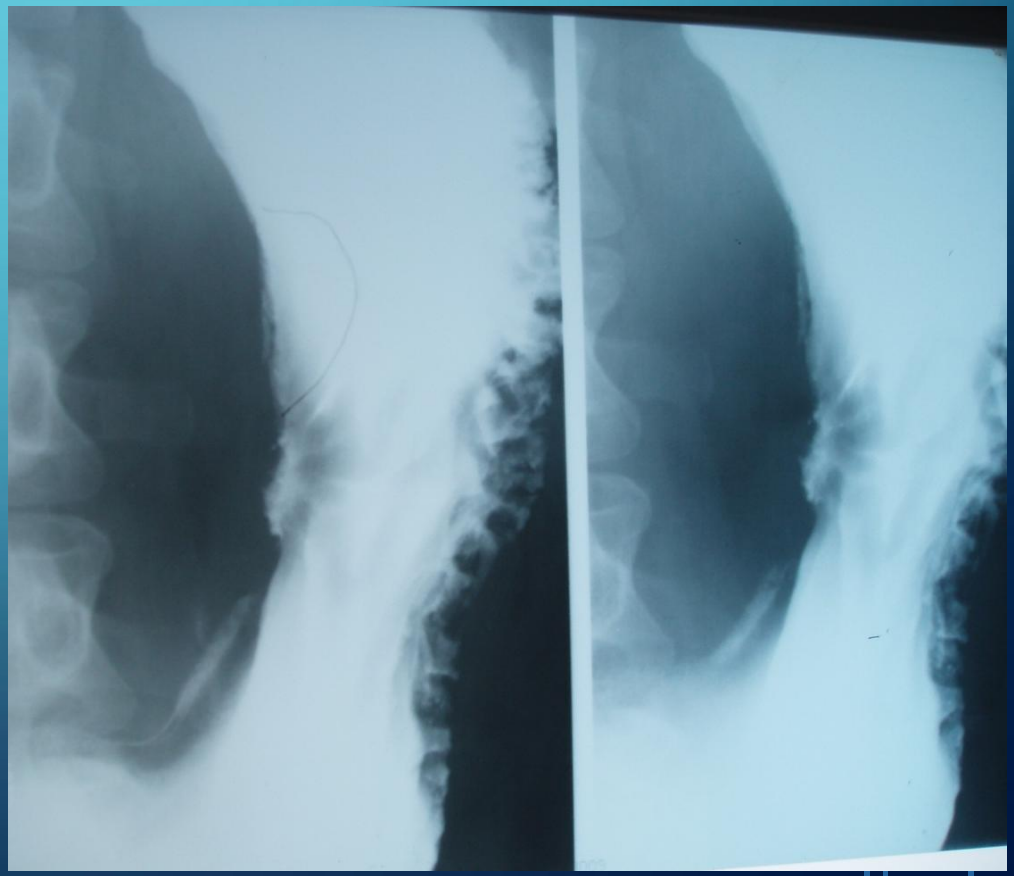
Gastric polyp

Gastric diverticulum

GASTRIC ULCERS

Radiological morphological sings

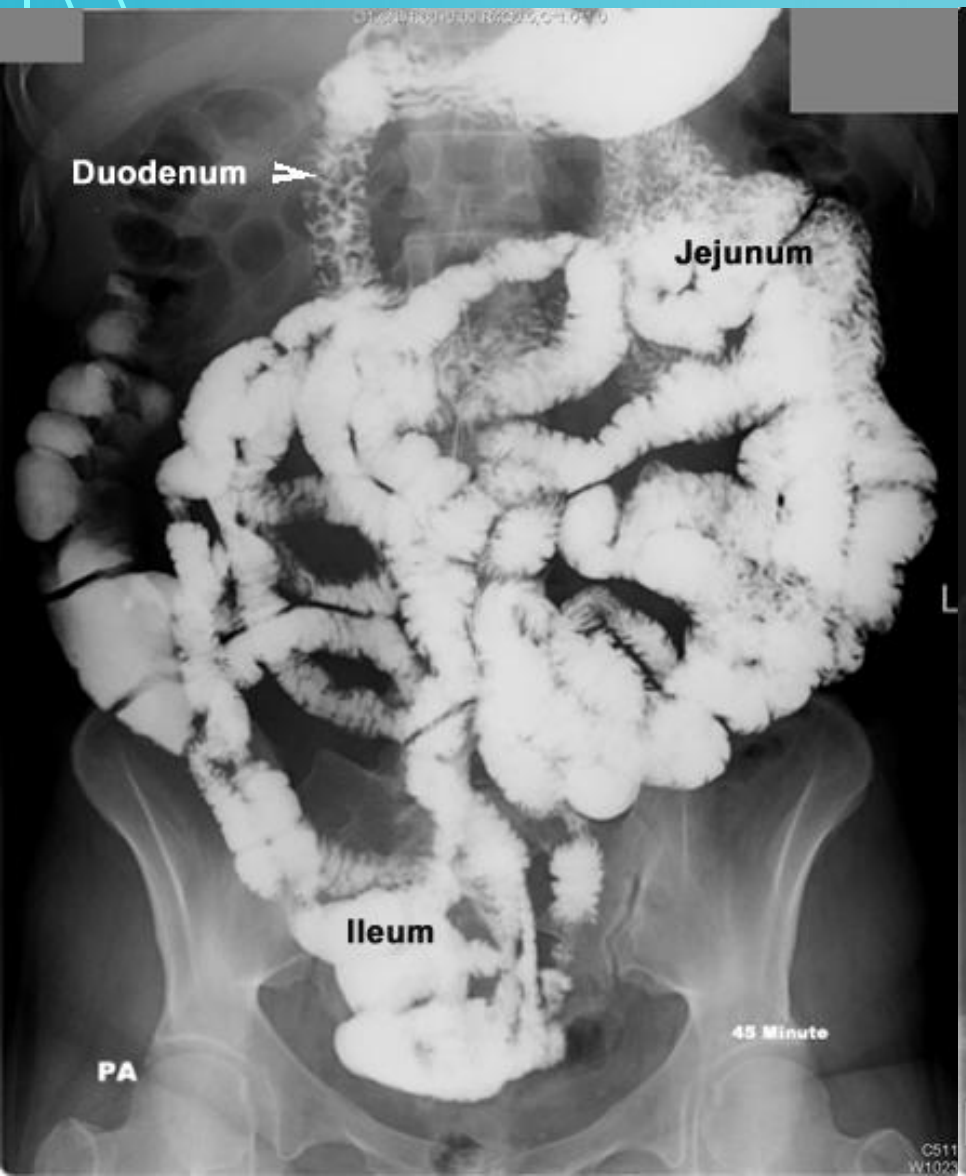
- Niche-image ,,plus filling”
- Marginal edema
- Convergence of plica gastrica



Barium follow-through

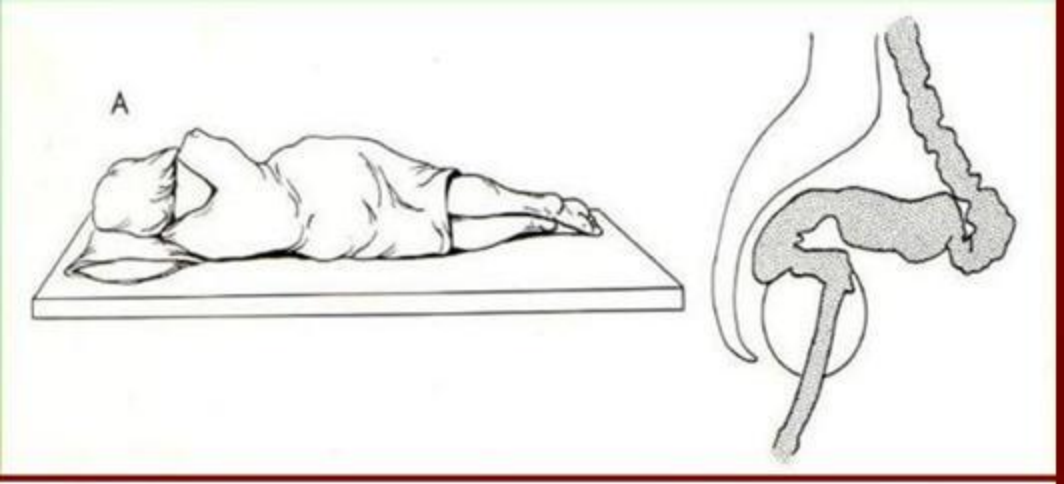
- X-ray images are taken as the contrast moves through the intestine, commonly at 0 minutes, 20 minutes, 40 minutes and 90 minutes.
- The test is completed when the Barium is visualised in the terminal ileum and Caecum, which marks the beginning of the large bowel. This is one of the most common places 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, ulverative colitis, bowel cancer. For example, Crohn's disease shows up as intermittent sections of strictured bowel.

Barium follow-through

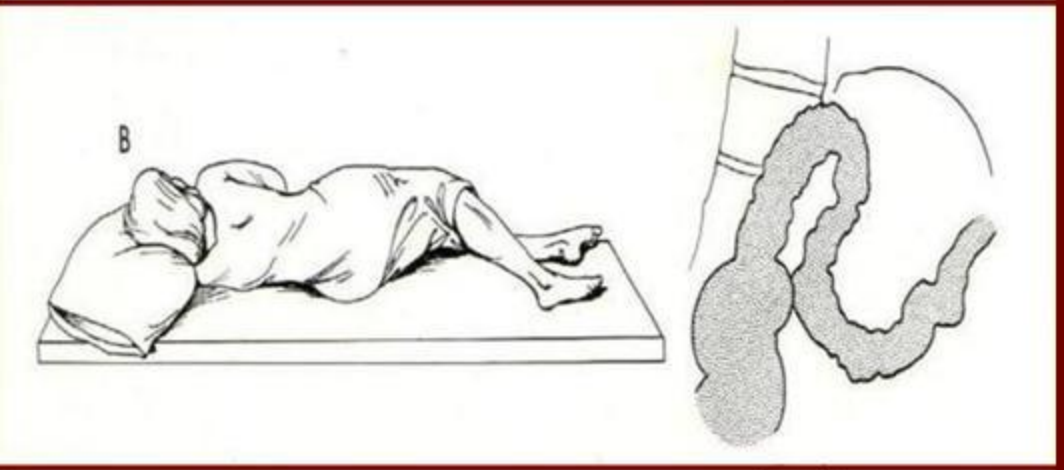


BARIUM ENEMA (IRIGOGRAPHY)

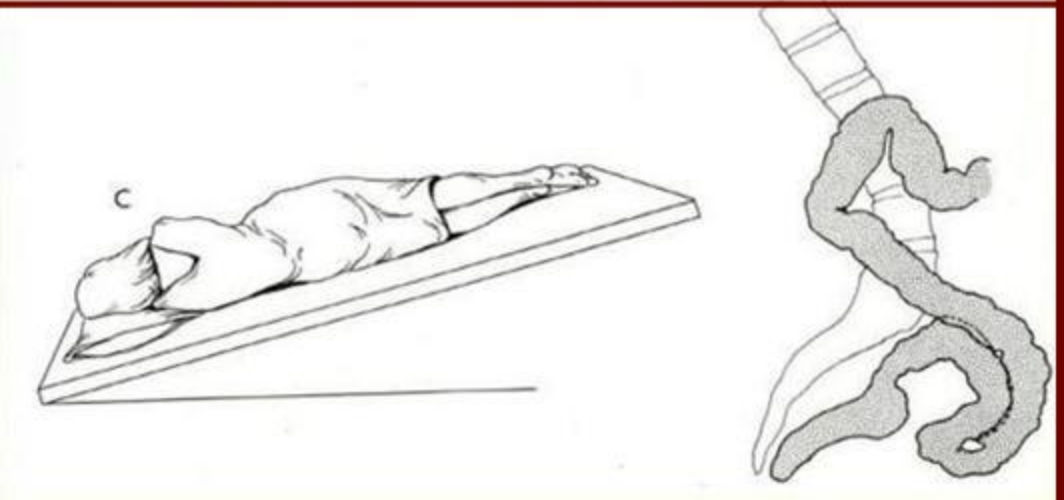
- Also known as a **lower gastrointestinal series**
- X-ray pictures are taken while barium sulfate fills the colon via the rectum.
- A large balloon at the tip of the enema tube may be inflated to help keep the barium sulfate inside.
- The flow of the barium sulfate is monitored by the health care provider 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.



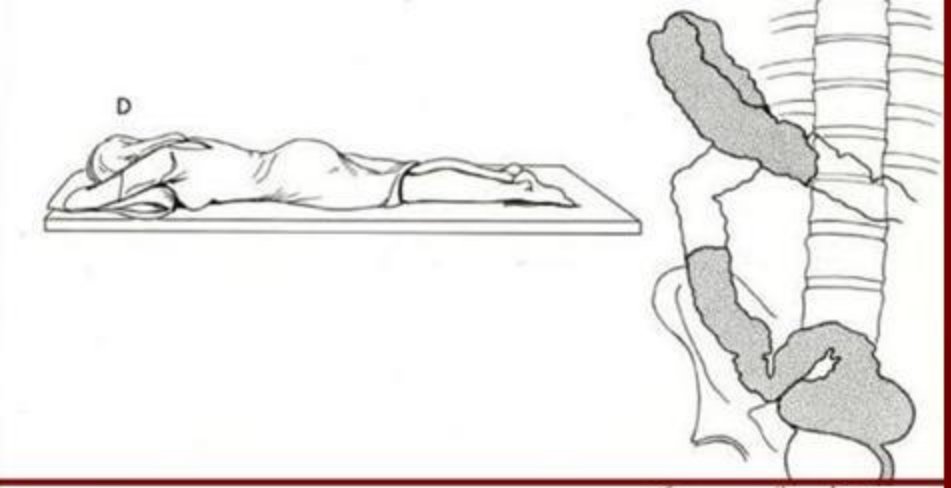
- **A - Left lateral position:**
  contrast filling of the **rectum** and **rectosigmoid**

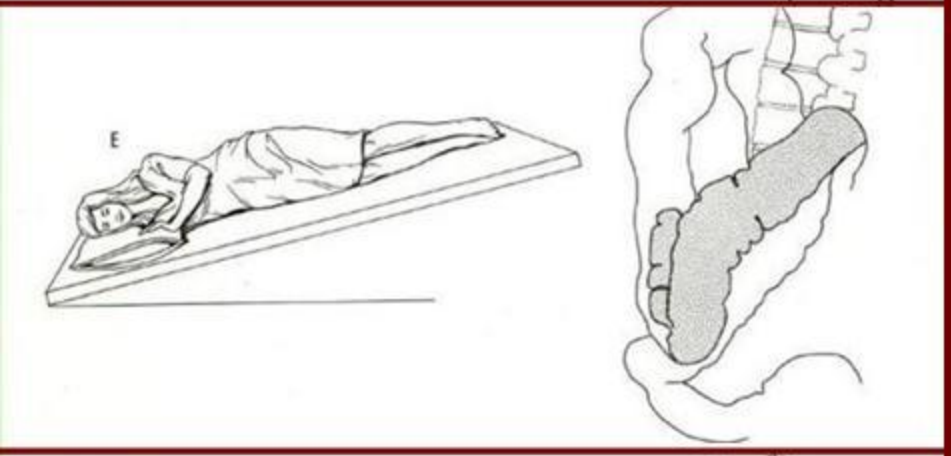


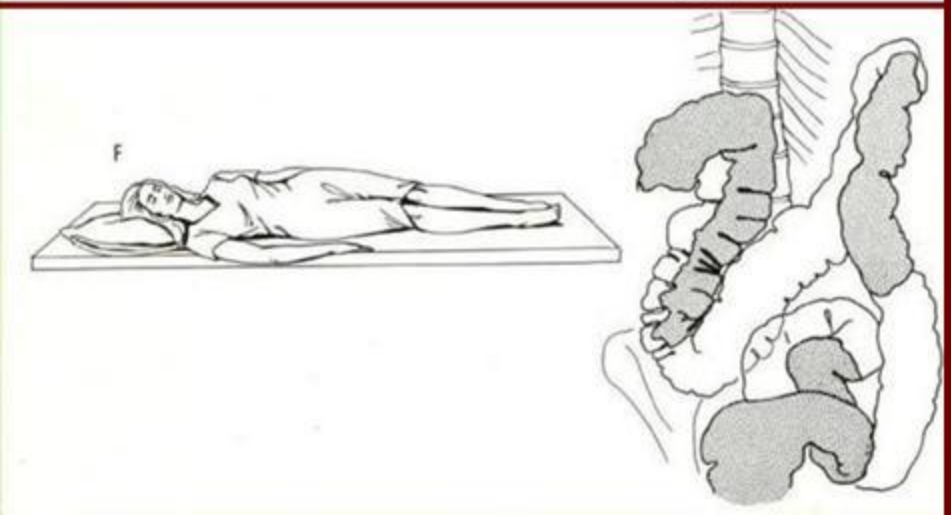
- **B - Left posterior oblique position:**
  contrast filling of the **sigmoid**



- **C - Left lateral with 15° Trendelenburg position:**
  contrast flow to **descending colon** and **splenic flexure**







- **D - turning clockwise from C to prone position:**
  contrast filling of the **transverse colon**

- **E - turning clockwise from D to right lateral with 15° Trendelenburg position :**
  contrast filling of the **hepatic flexure**

- **F - turning clockwise from E to supine position:**
  contrast filling of the **hepatic flexure and ascending colon**

INDICATIONS

- Hirschprung's disease
- Fatique / 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 (inflamatory 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 ULTRASONOGRAPHY

- 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 variaty of conditions such a cholecystitis, apendicitis, 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.

Advantages:

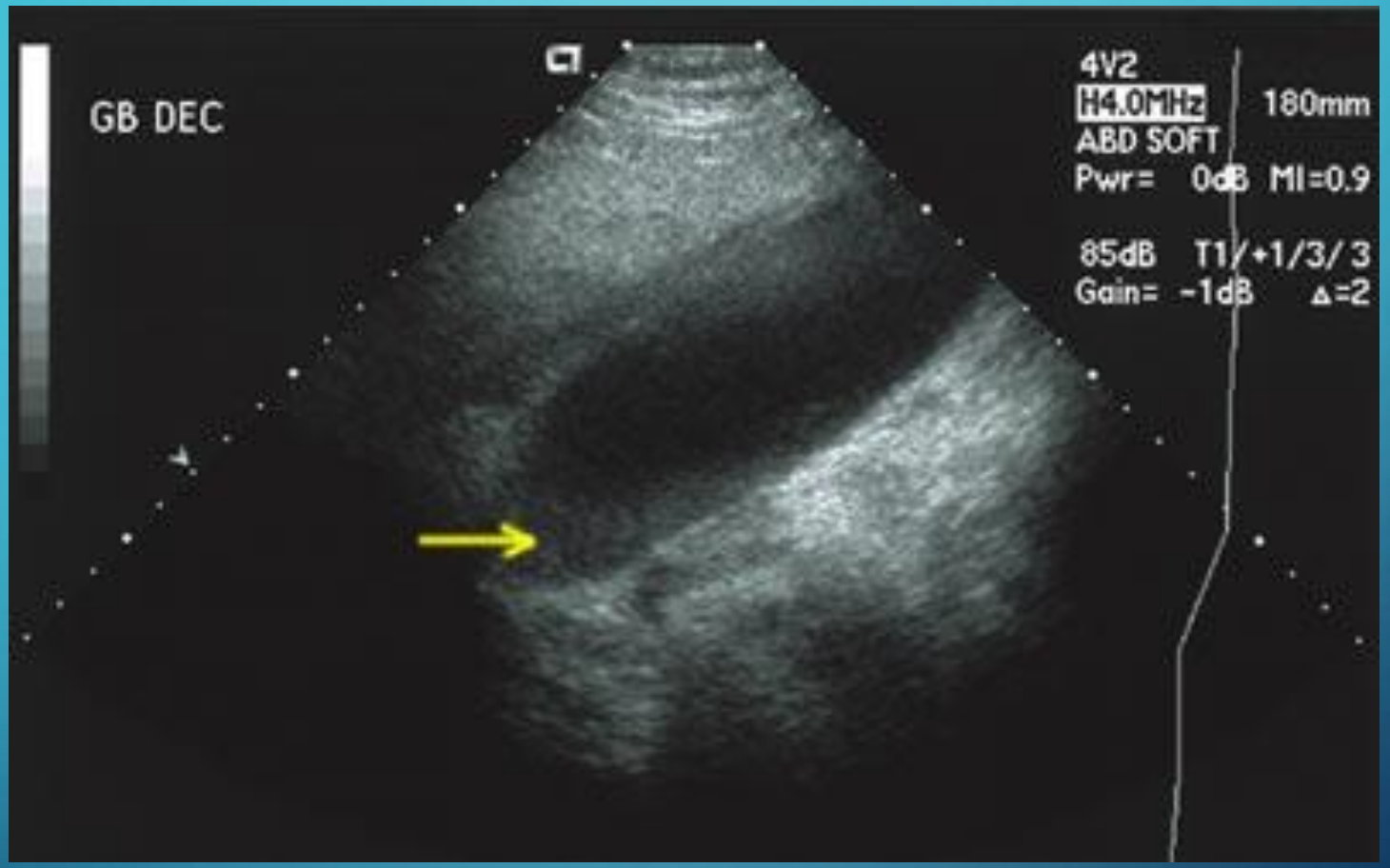
- can be performed quickly, including at the bed-side
- involves no exposure to X-rays, making it also useful in pregnant patients
- inexpensive compared to other imaging modalities such as CT or MRI-based techniques

Disadvantages:

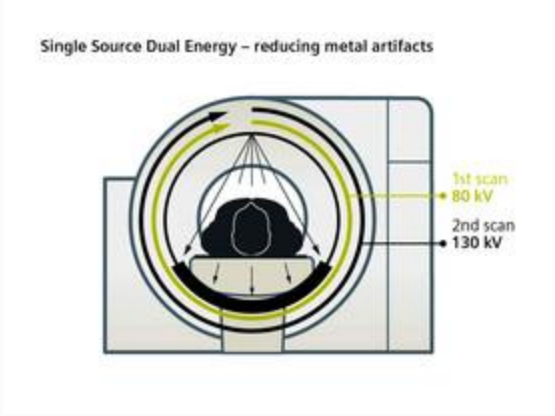
- troublesome imaging if a lot of gas is present inside the bowels of if there is a lot of abdominal fat
- Is highly operator-dependent (i.e. the quality of the imaging depends on the experience of the person performing it).

NORMAL GALLBLADDER

GALLBLADDER, WITH NUMEROUS STONES PRESENT



GALLBLADDER, WITH SLUDGE PRESENT (ARROW)



SIEMENS

SOMATOM
Definition AS

Computed tomography (CT)

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.**

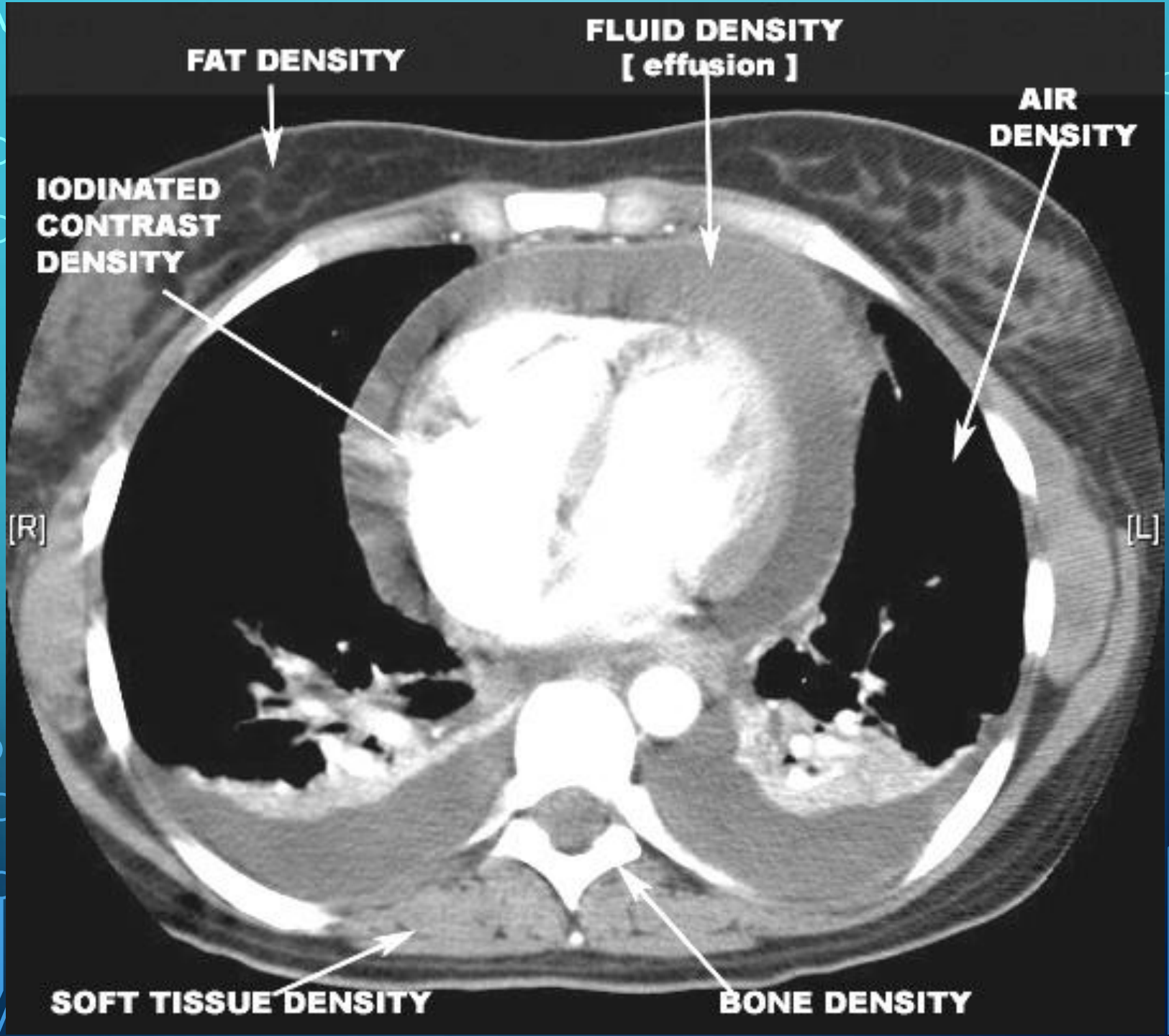
CONTRAST ENHANCED CT

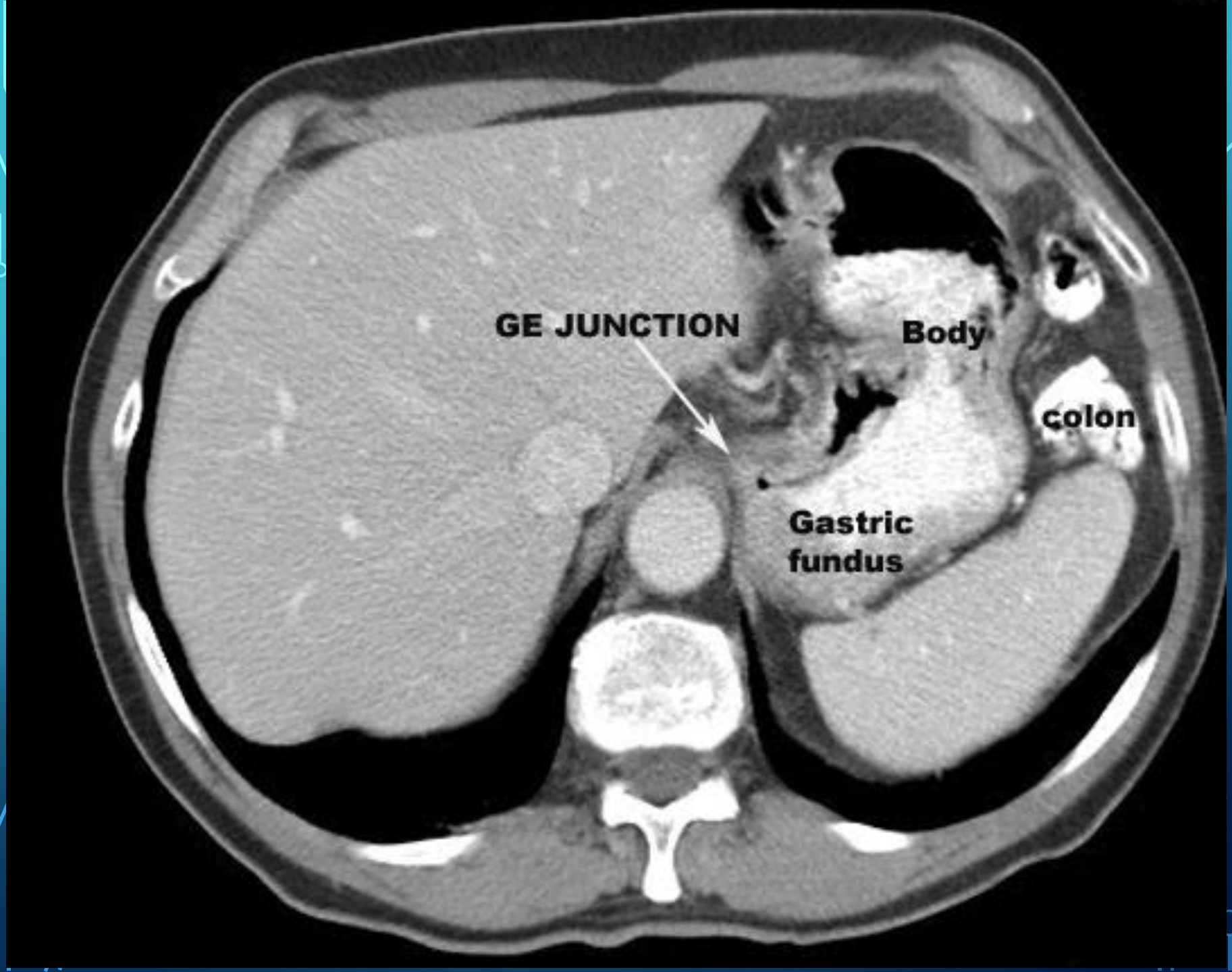
- **Intravenous iodinated contrast** is used in CT to help highlight blood vessels and to enhance the tissue structure of various abdominal organs
- suspension of Barium sulfate causes severe artifacts on CT.
- Iodinated contrast agents may be also used *per os*

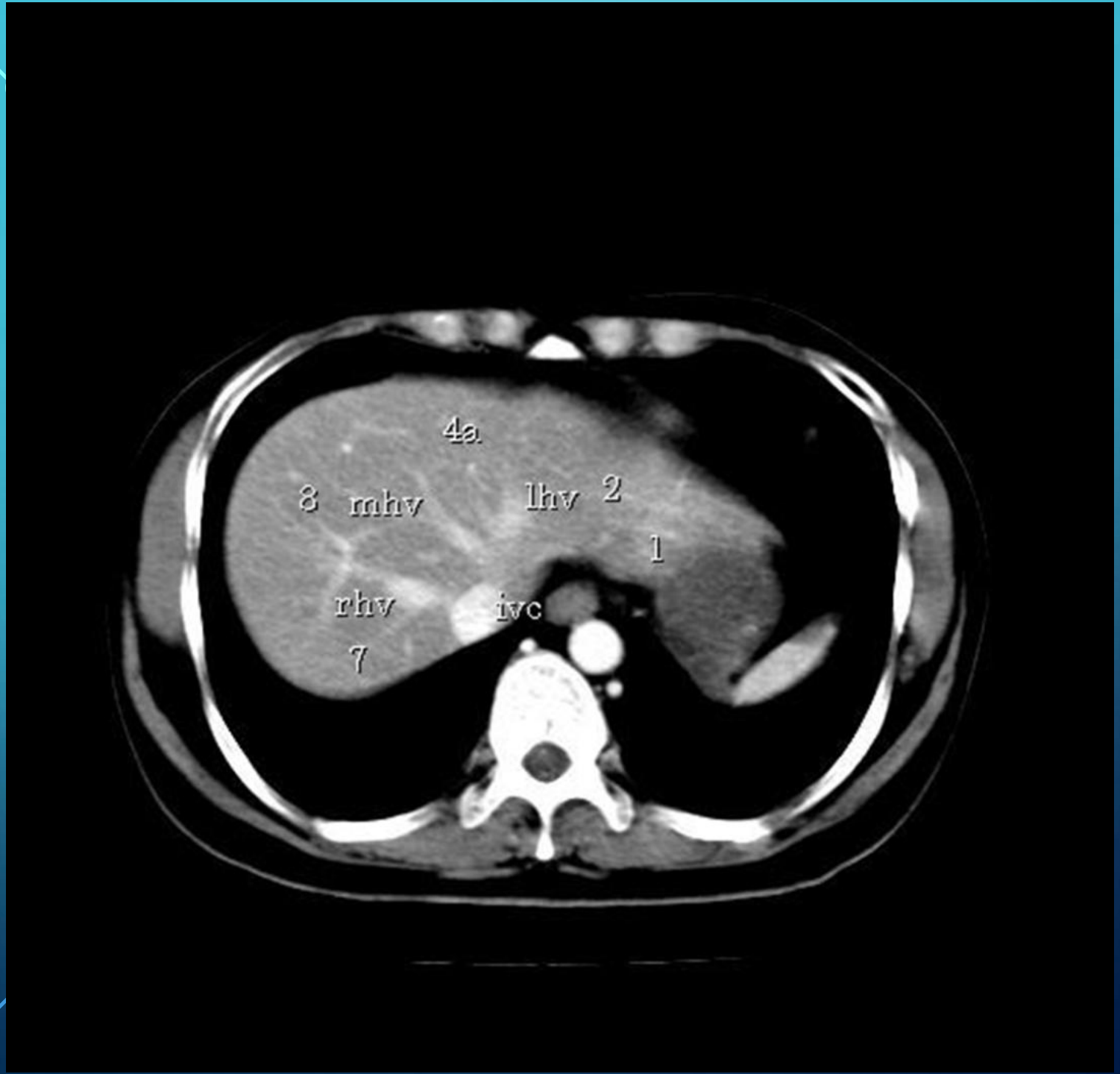
CT of abdomen **without contrast.** Note the lack of distinction between abdominal organs.

CT scan of abdomen **with intravenous contrast.**

Notice how much better you can see the kidneys and blood vessels.


FAT DENSITY
FLUID DENSITY
[effusion]
AIR
DENSITY
IODINATED
CONTRAST
DENSITY
[R]
[L]
SOFT TISSUE DENSITY
BONE DENSITY


GE JUNCTION
Body
colon
Gastric
fundus


4a
8
mhv
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rhv
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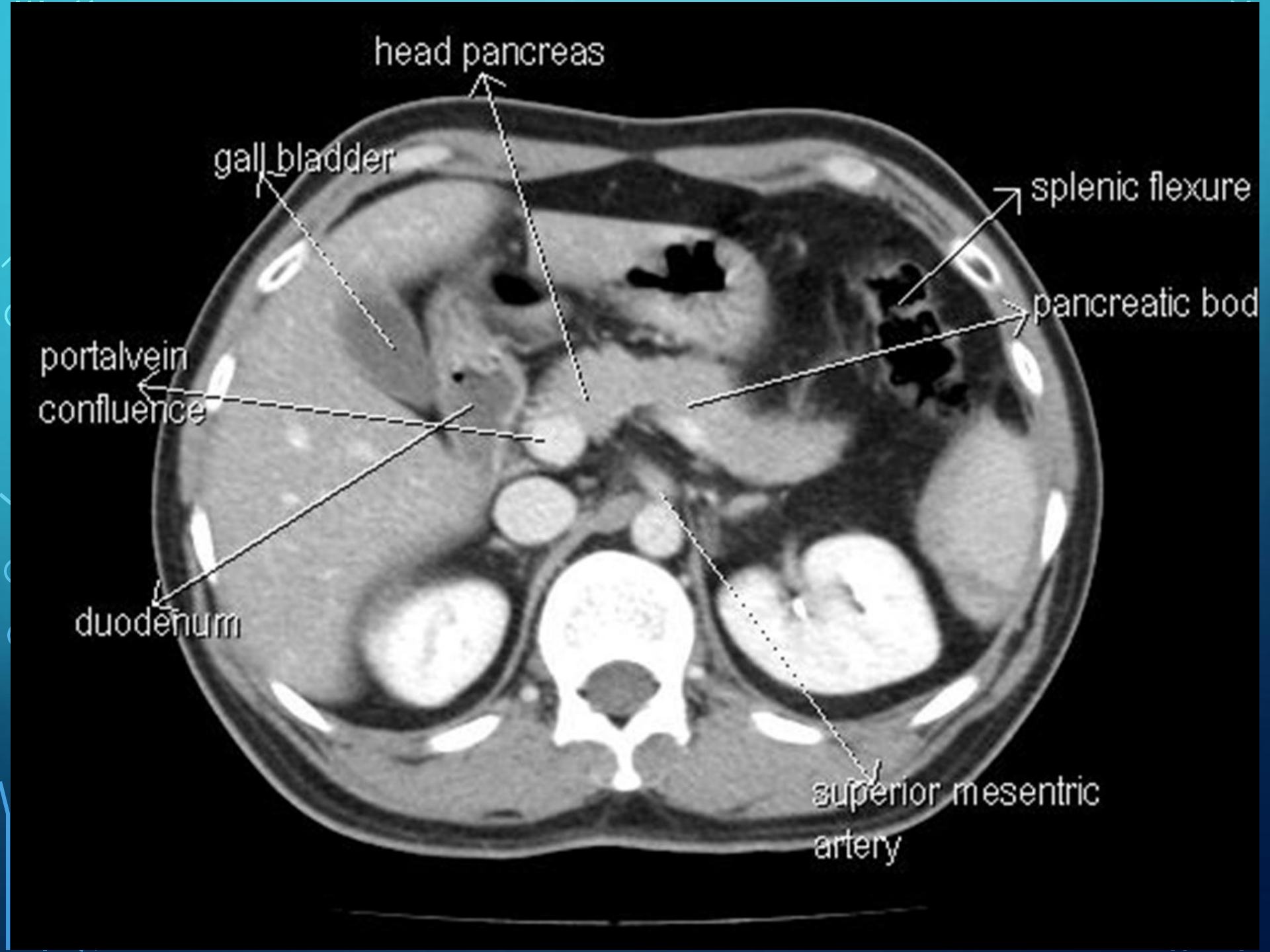
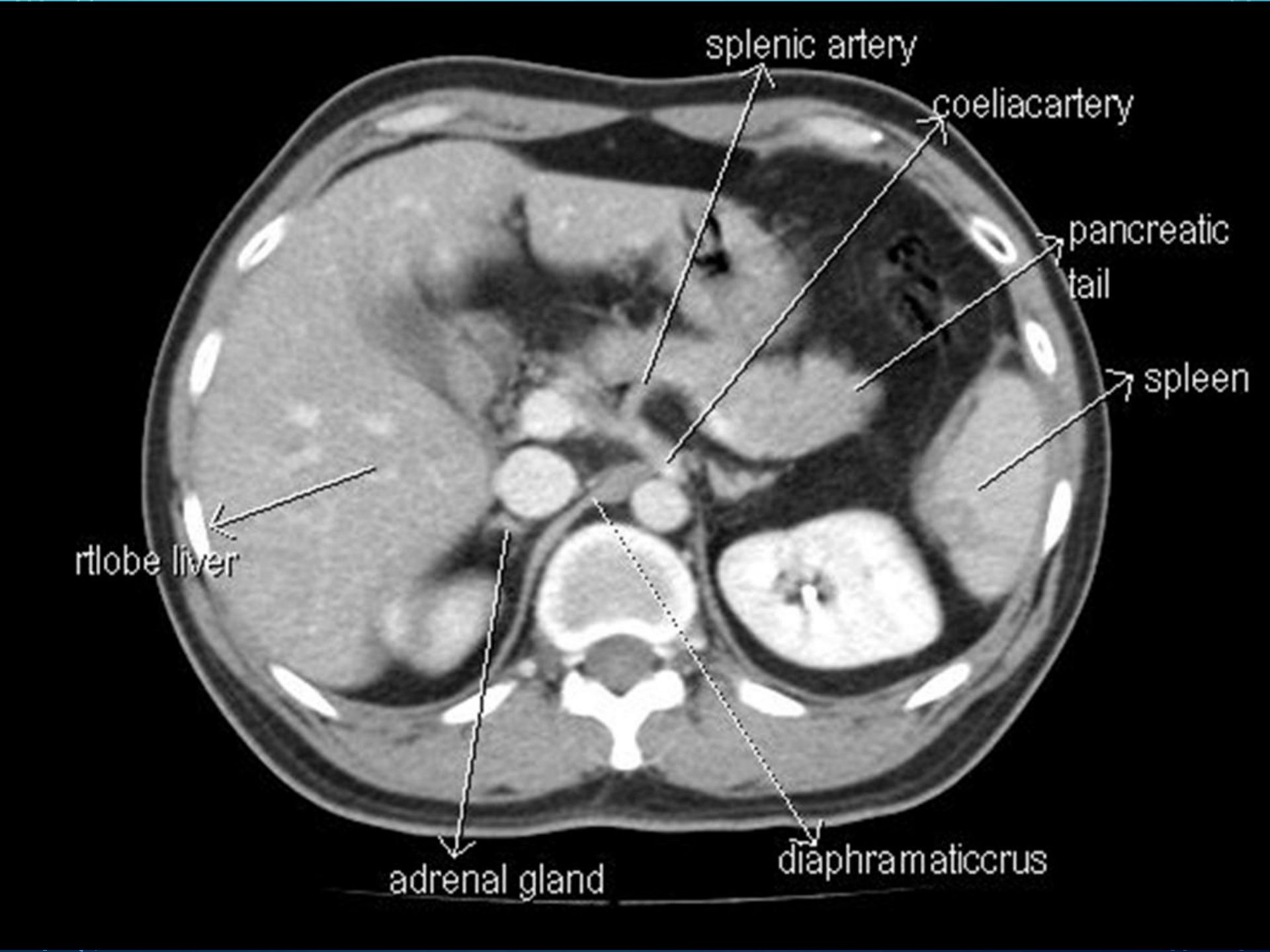
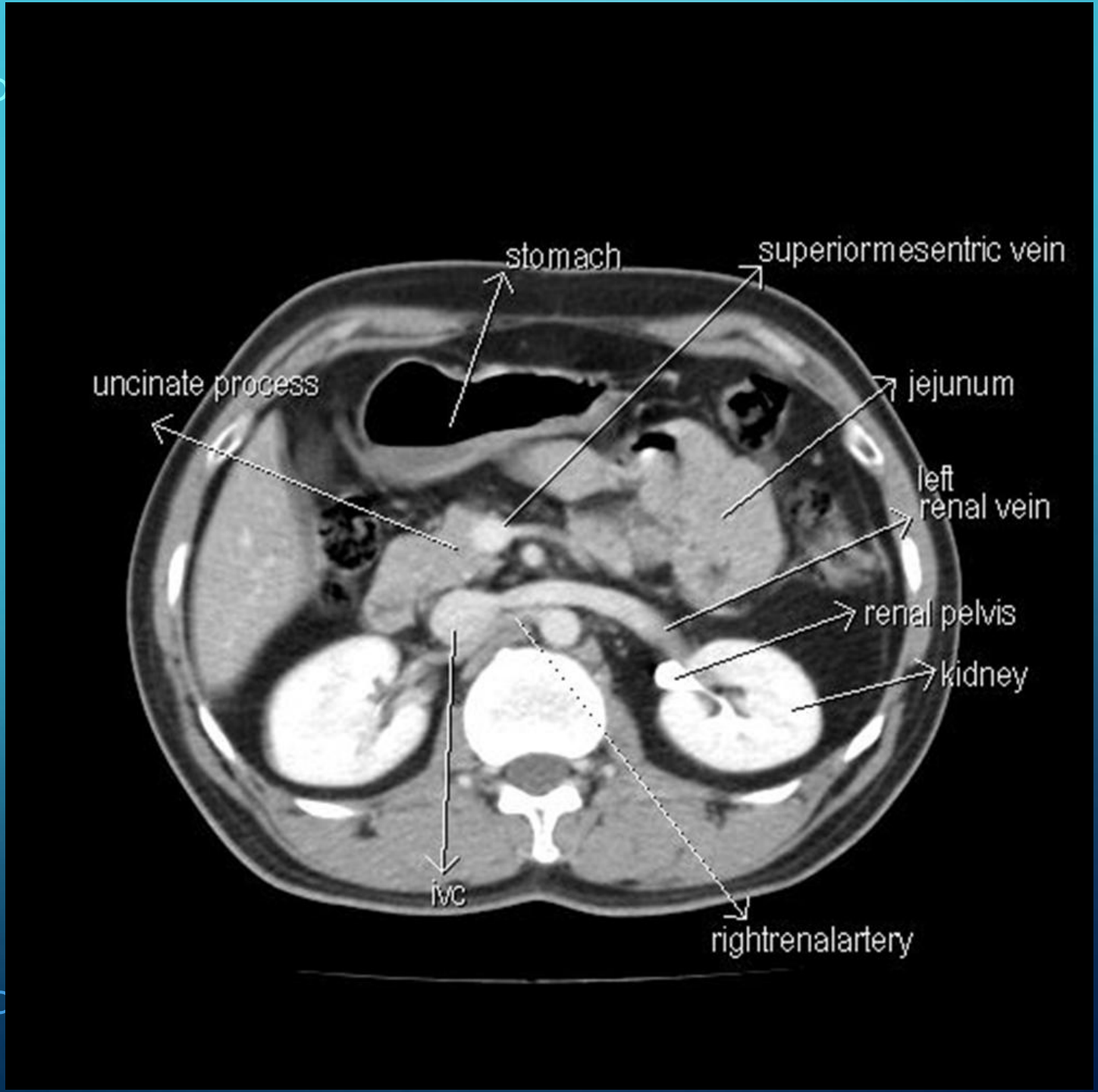
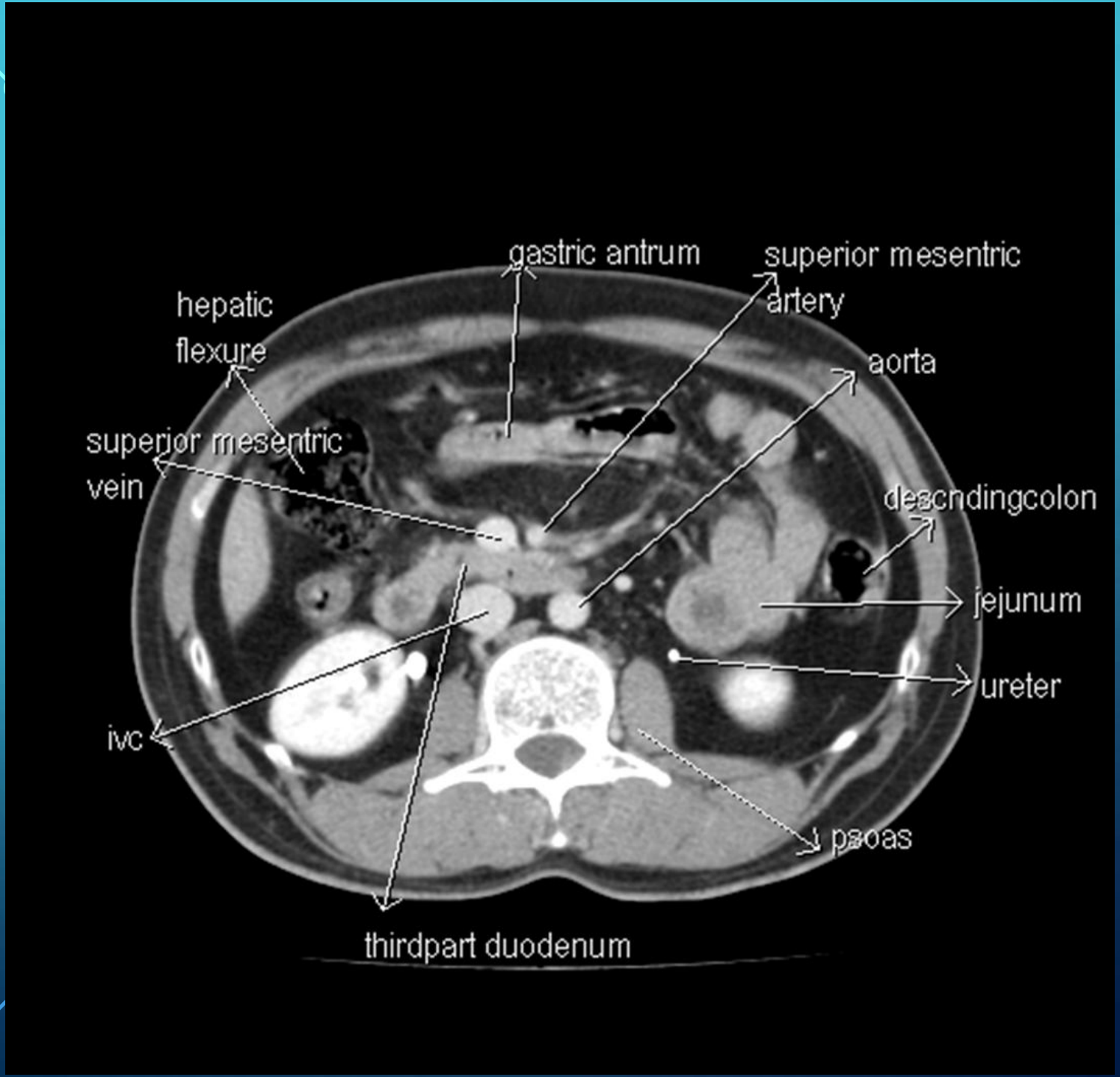
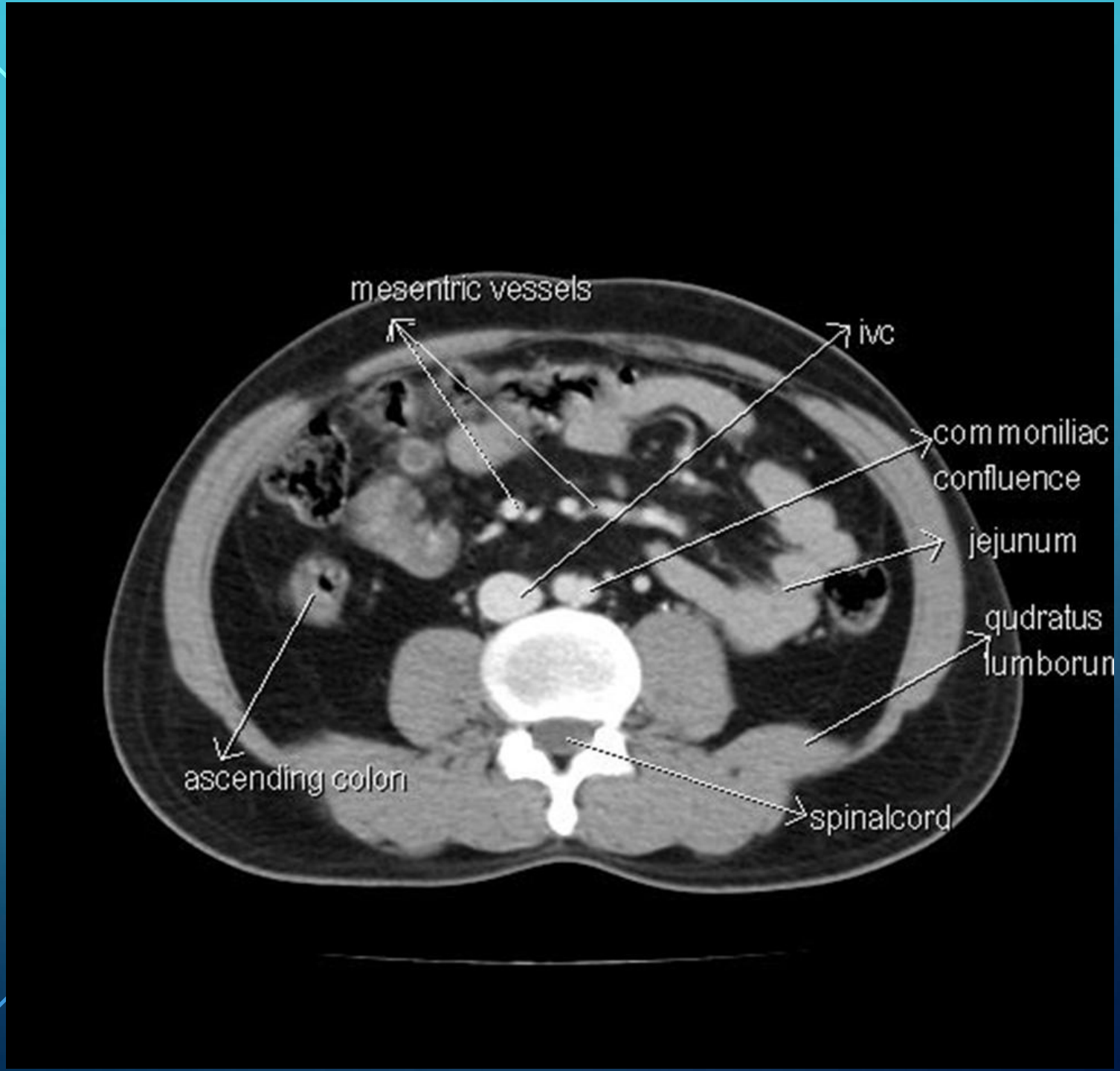
7

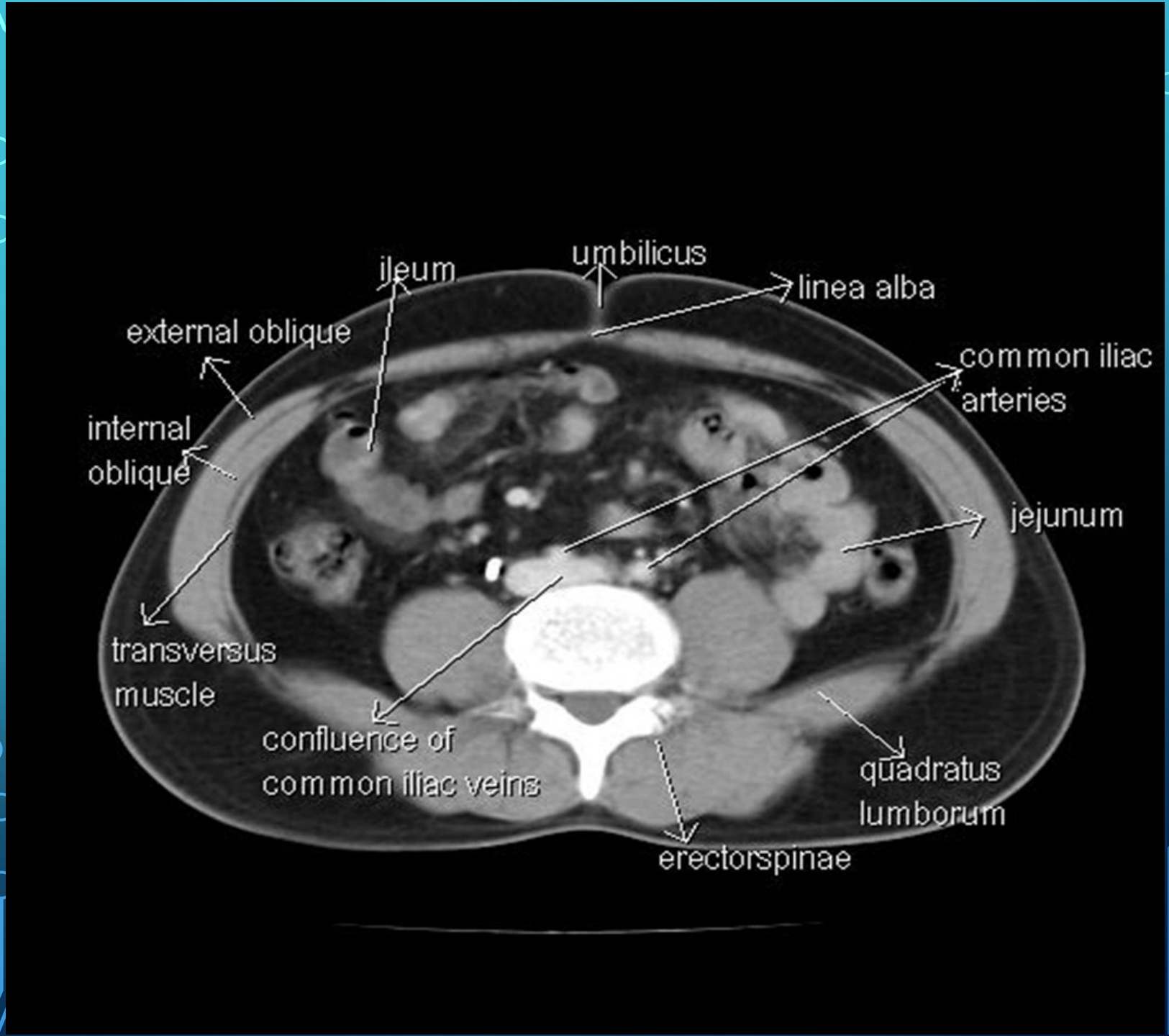

head pancreas
gall bladder
splenic flexure
pancreatic bod
portalvein
confluence
duodenum
superior mesentric
artery

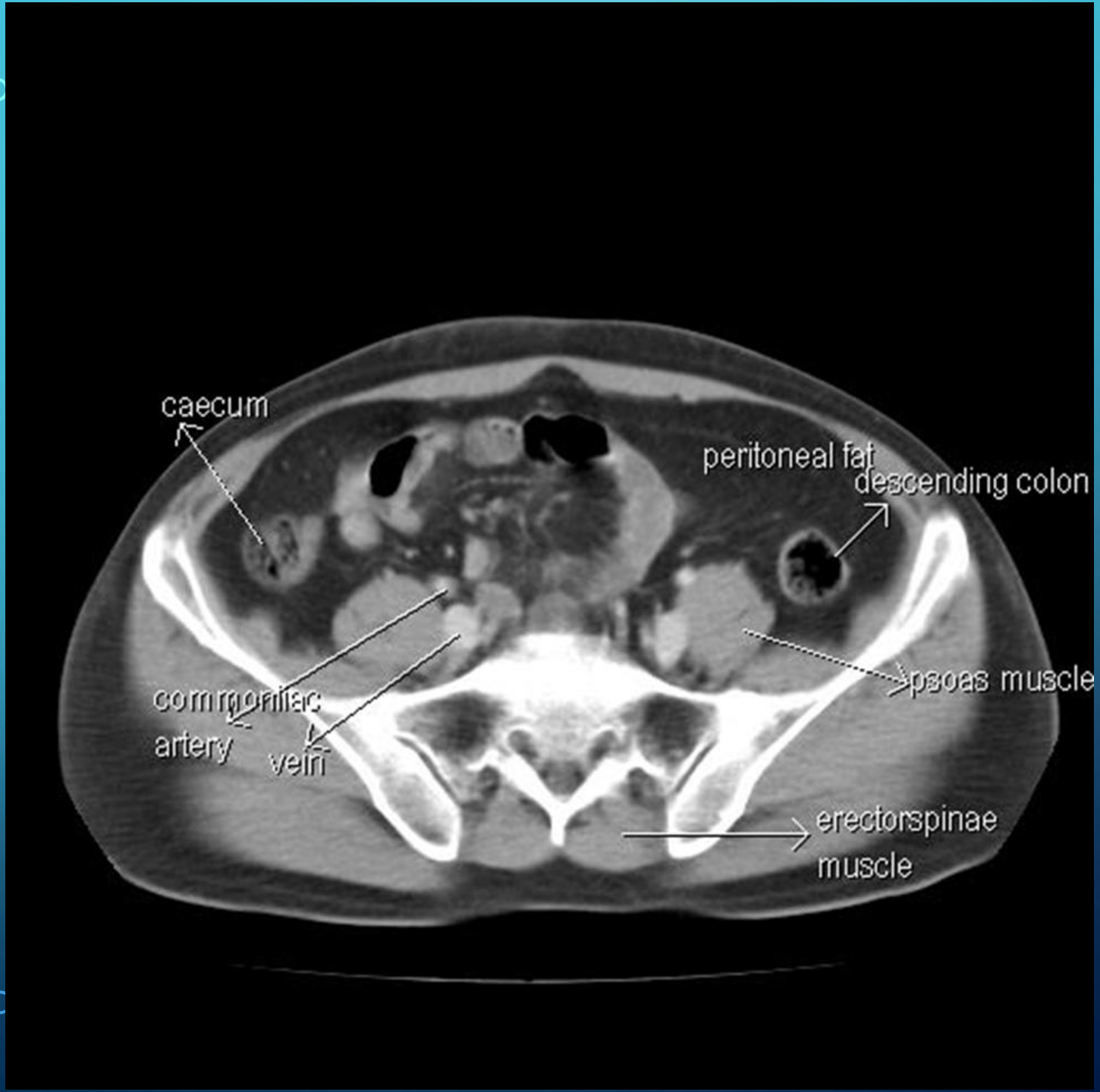

splenic artery
coeliacartery
pancreatic tail
spleen
rtlobe liver
adrenal gland
diaphramaticcrus

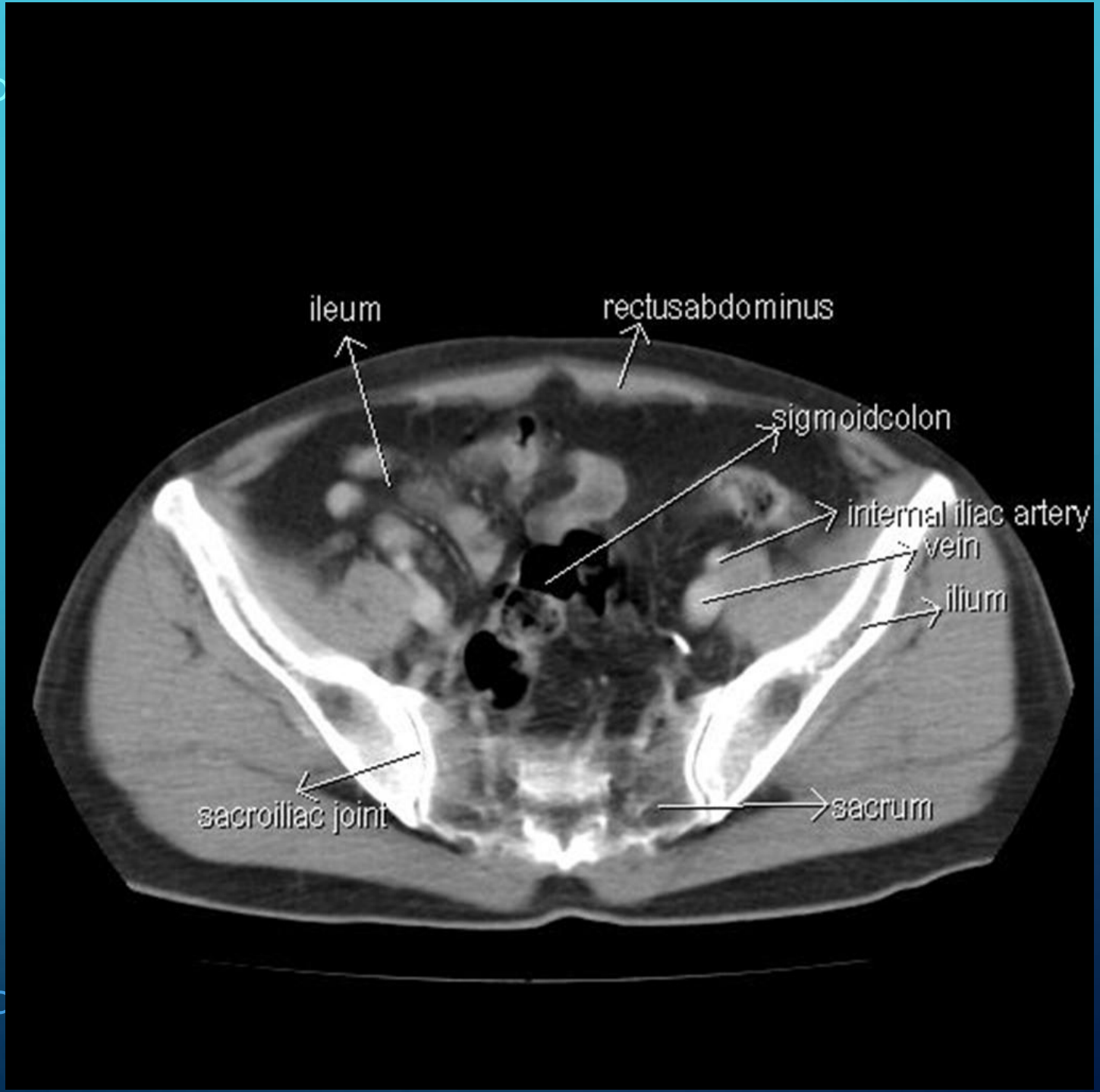

stomach
superiormesentric vein
uncinate process
jejunum
left
renal vein
renal pelvis
kidney
ivc
rightrenalartery

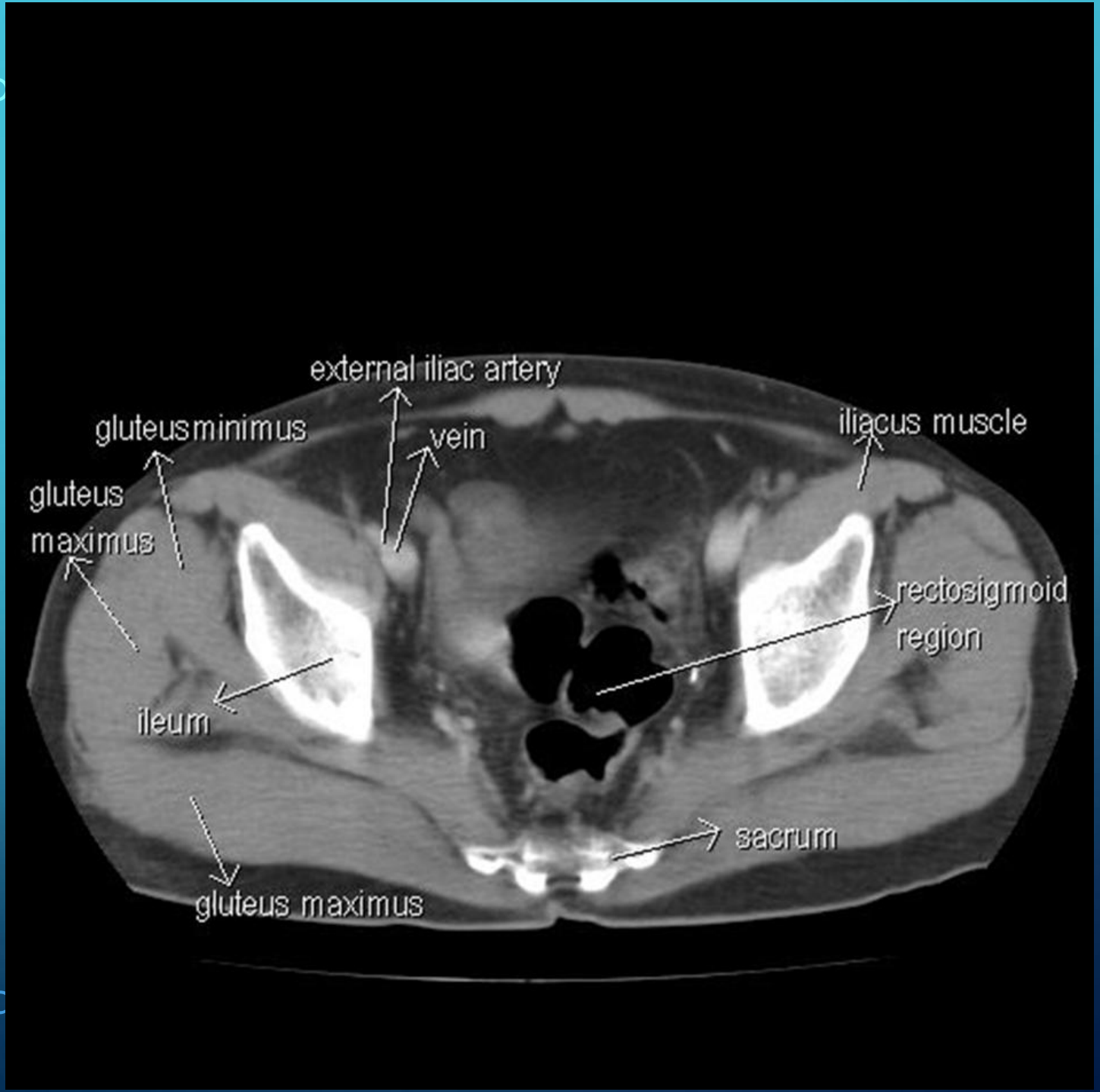

gastric antrum
superior mesentric artery
hepatic flexure
aorta
superior mesentric vein
descndingcolon
jejunum
ureter
ivc
psoas
thirdpart duodenum


mesentric vessels
ivc
commoniliac
confluence
jejunum
qudratus
lumborum
ascending colon
spinalcord


ileum
umbilicus
linea alba
external oblique
common iliac arteries
internal oblique
jejunum
transversus muscle
confluence of common iliac veins
quadratus lumborum
erectorspinae


caecum
peritoneal fat
descending colon
psoas muscle
common iliac artery
vein
erectorspinae muscle


ileum
rectusabdominus
sigmoidcolon
internal iliac artery
vein
ilium
sacroiliac joint
sacrum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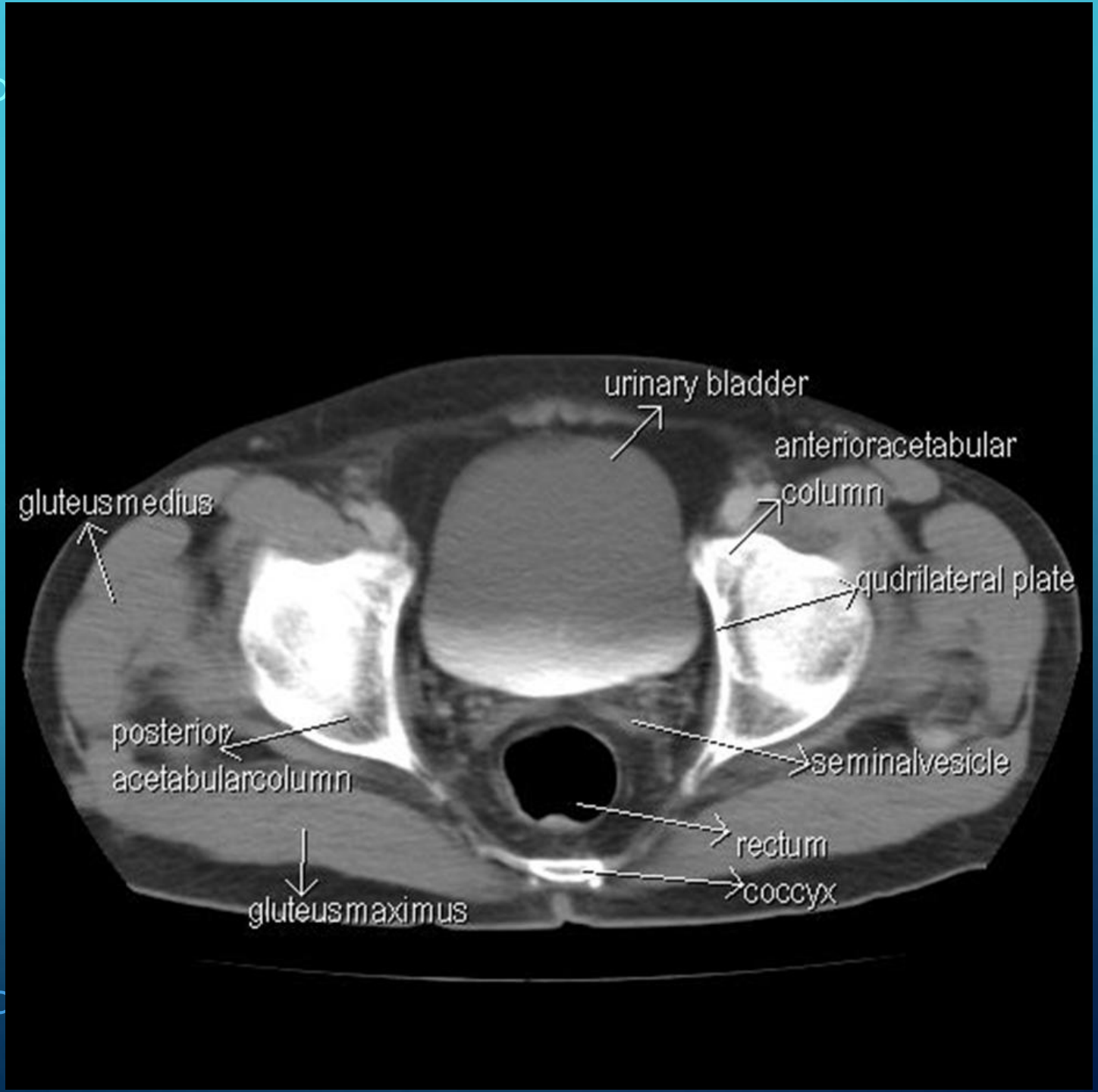
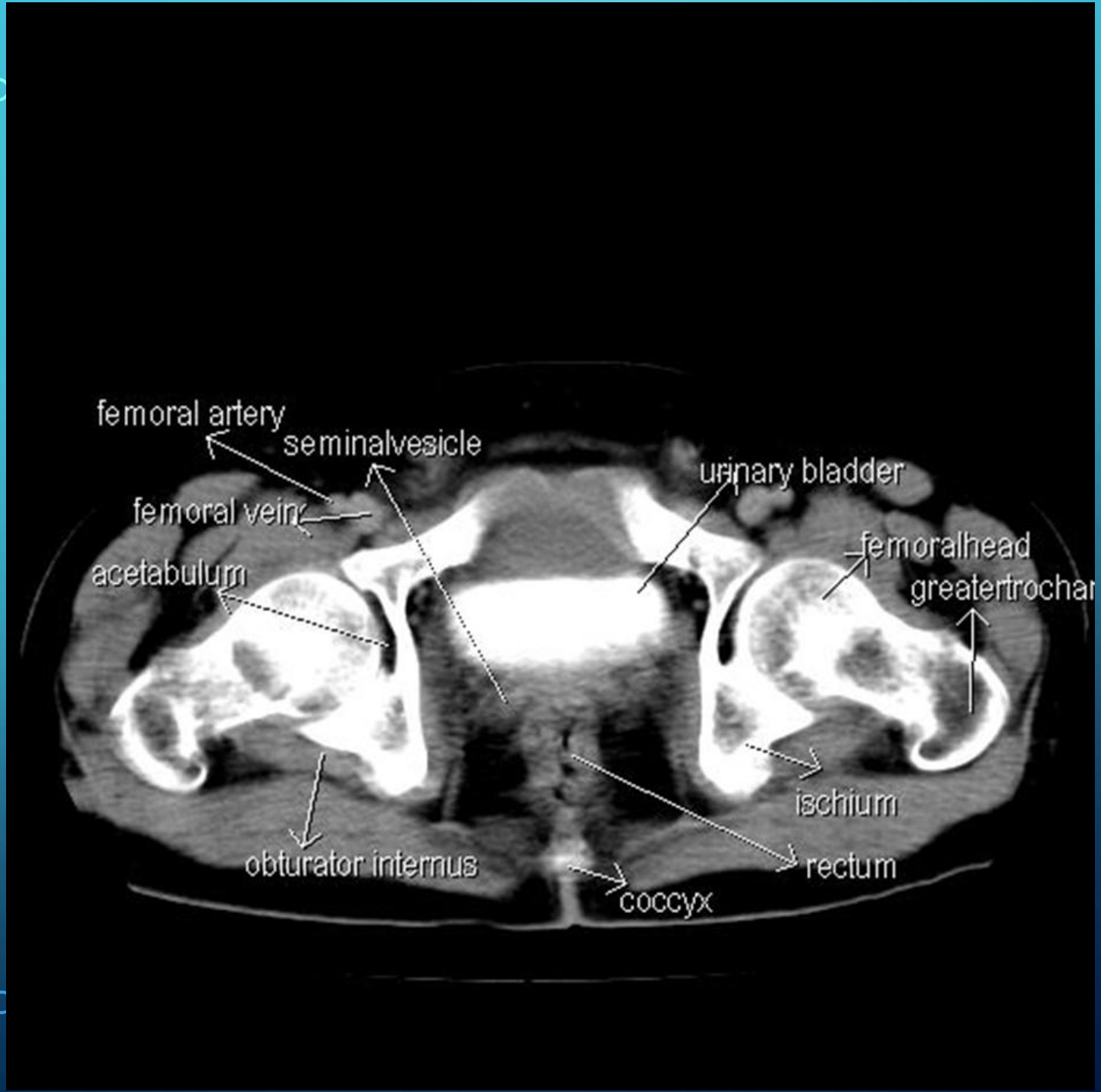
gluteus minimus
vein
iliacus muscle
gluteus maximus
rectosigmoid region
ileum
sacrum
gluteus maximus


urinary bladder
anterioracetabular column
gluteus medius
qudrilateral plate
posterior acetabular column
seminal vesicle
rectum
coccyx
gluteus maximus


femoral artery
seminalvesicle
urinary bladder
femoral vein
femoralhead
acetabulum
greatertrochan
ischium
obturator internus
rectum
coccyx

DIAPHRAGMATIC HERNIA

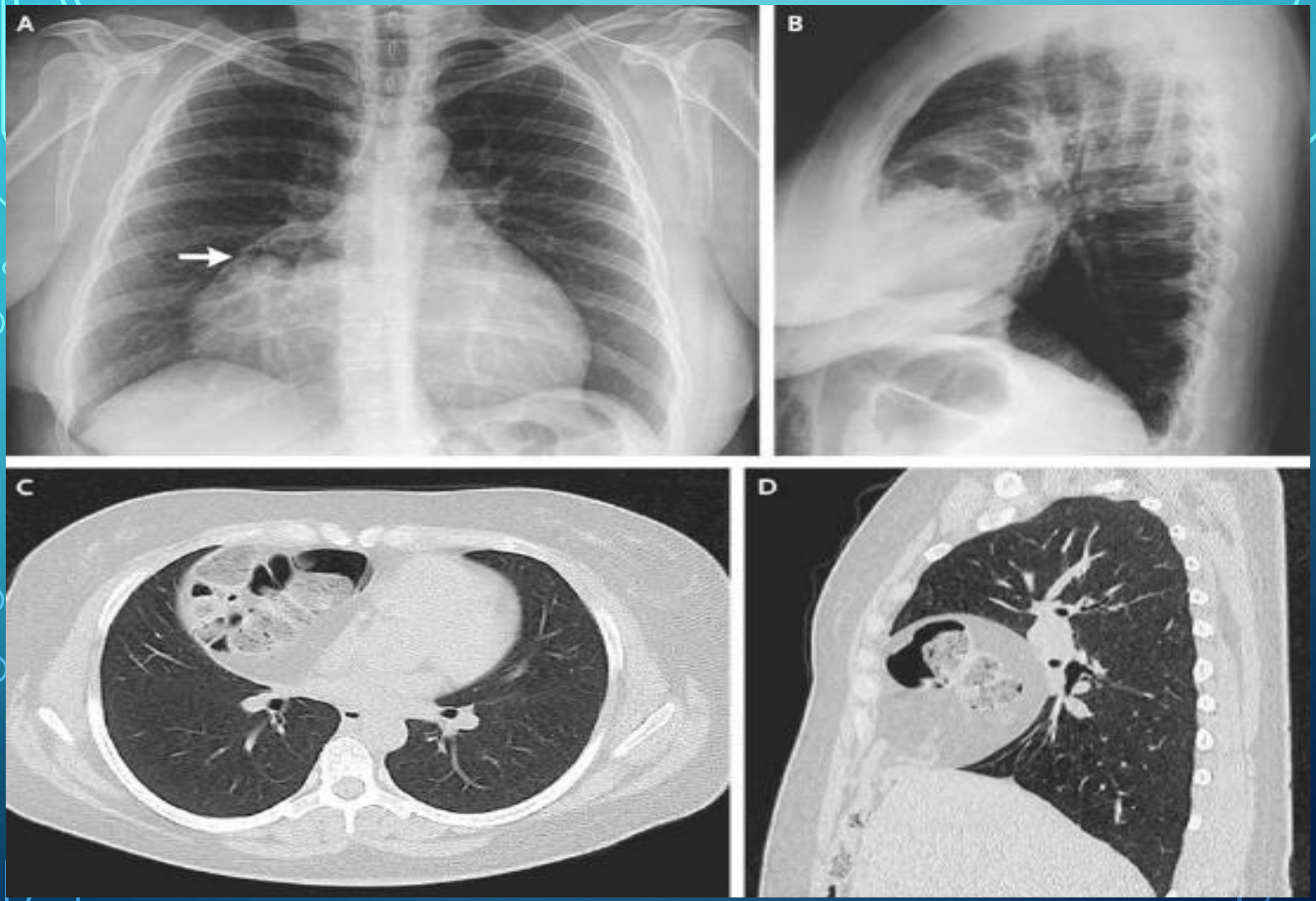
- **Bochdalek hernia**

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

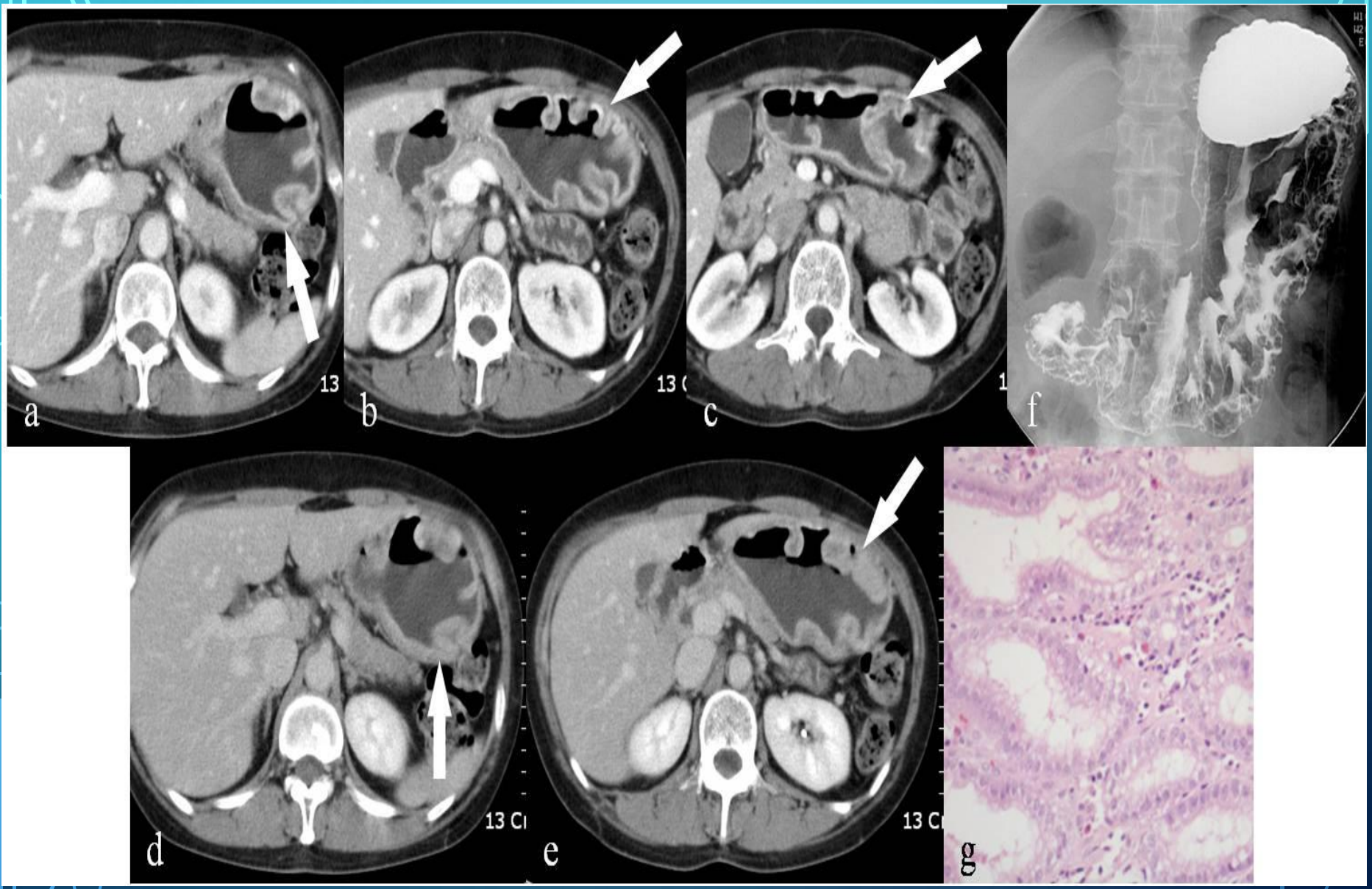
- **Morgagni hernia**

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

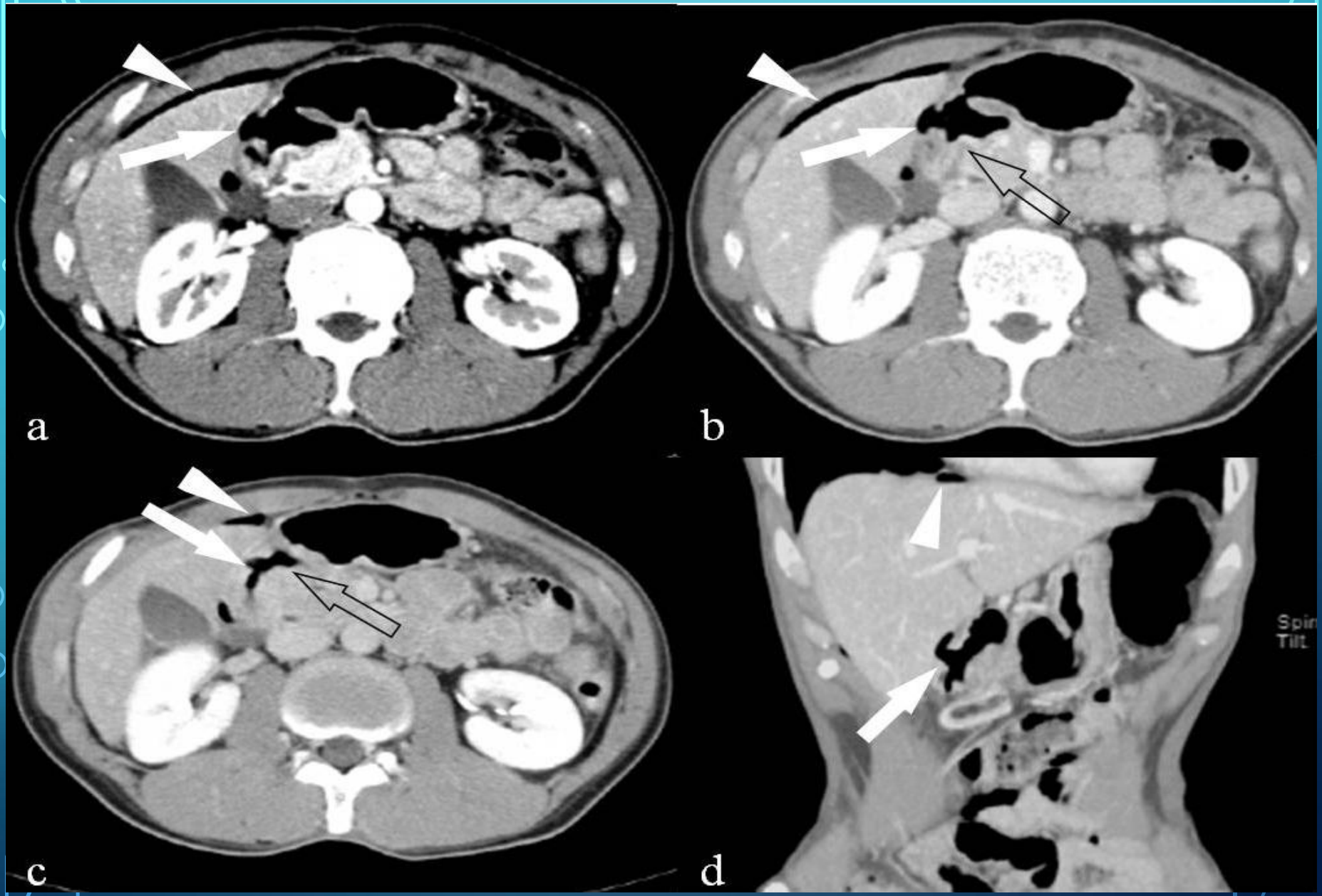
Two cases Bochdalek hernia.



Morgagni hernia.

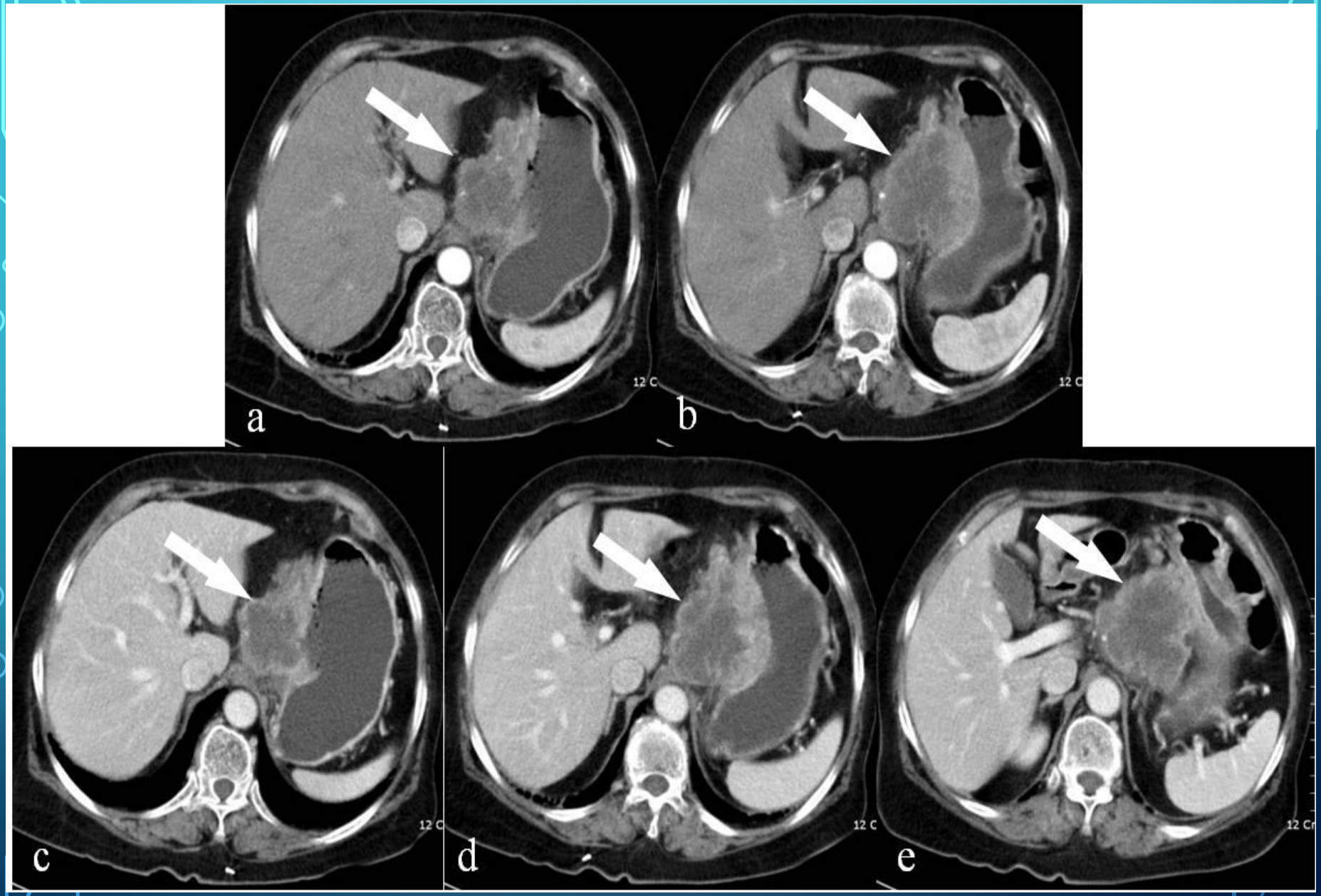


Hypertrophic gastritis.

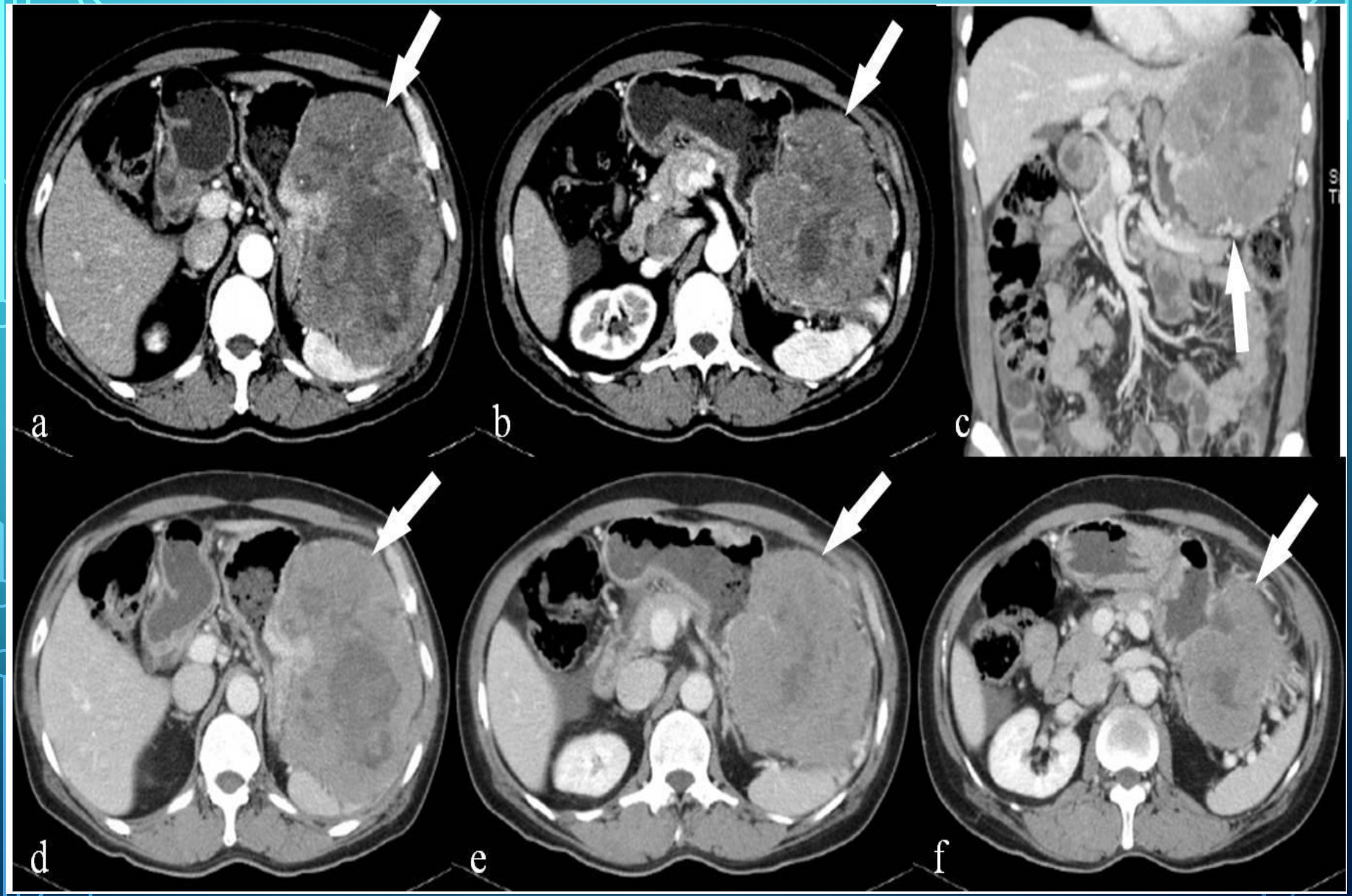


Perforated gastric ulcer.

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

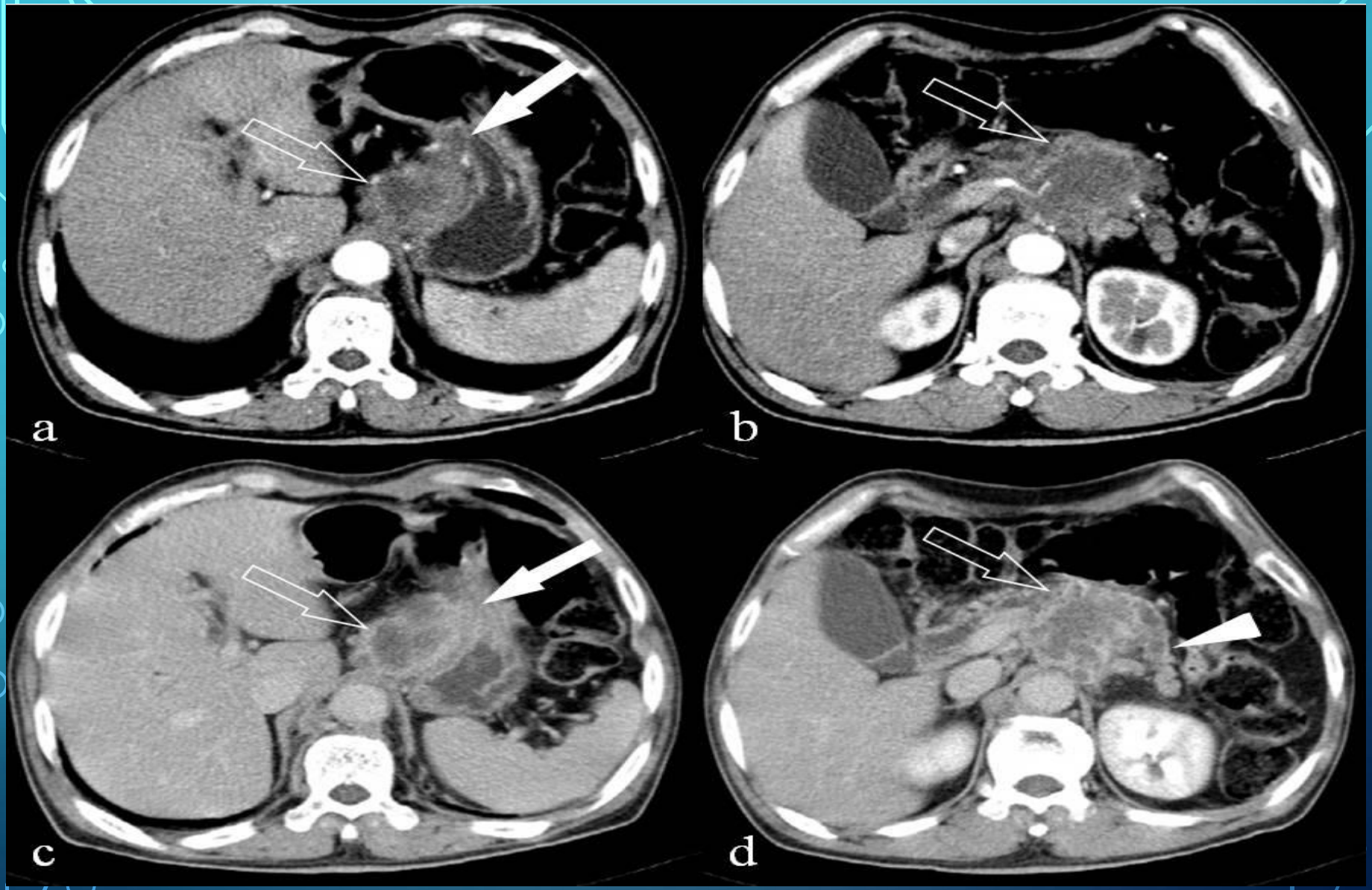


Exophytic adenocarcinoma.

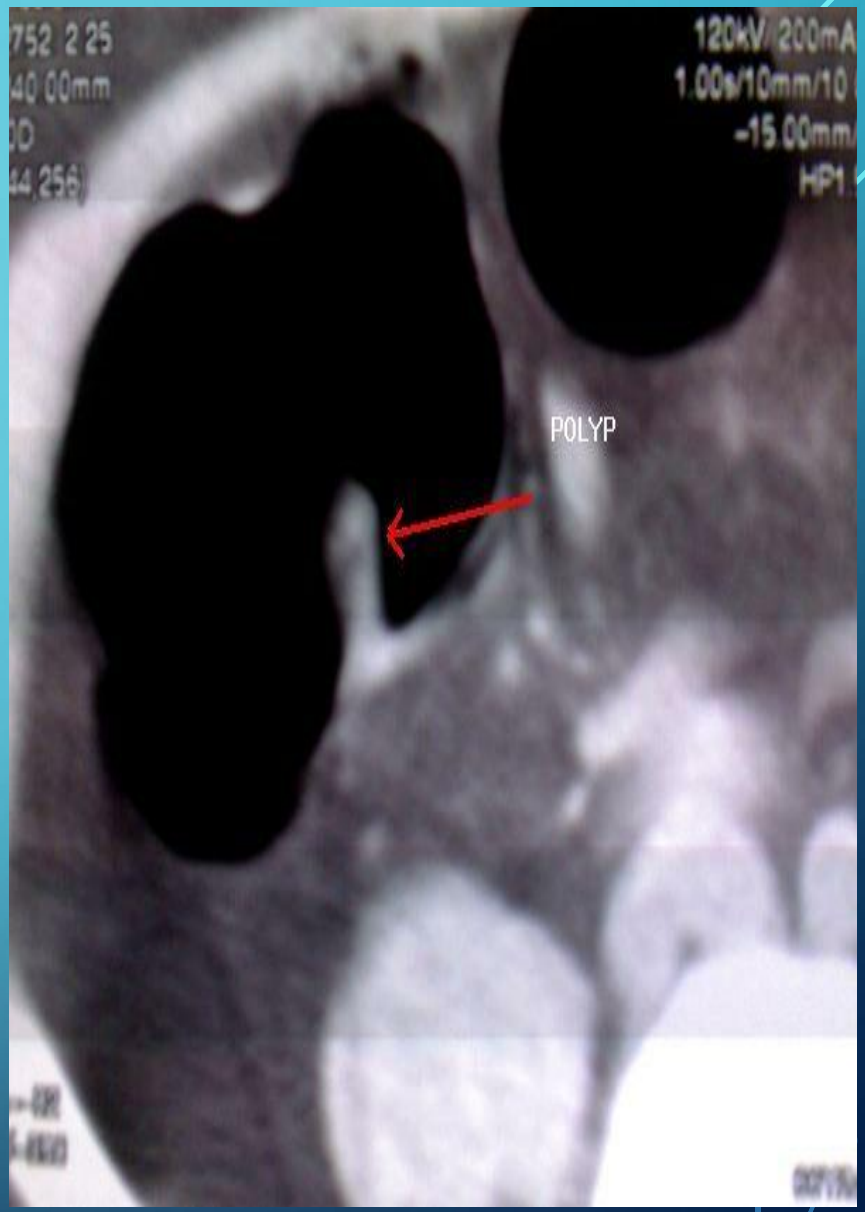


High grade gastrointestinal stromal tumor.

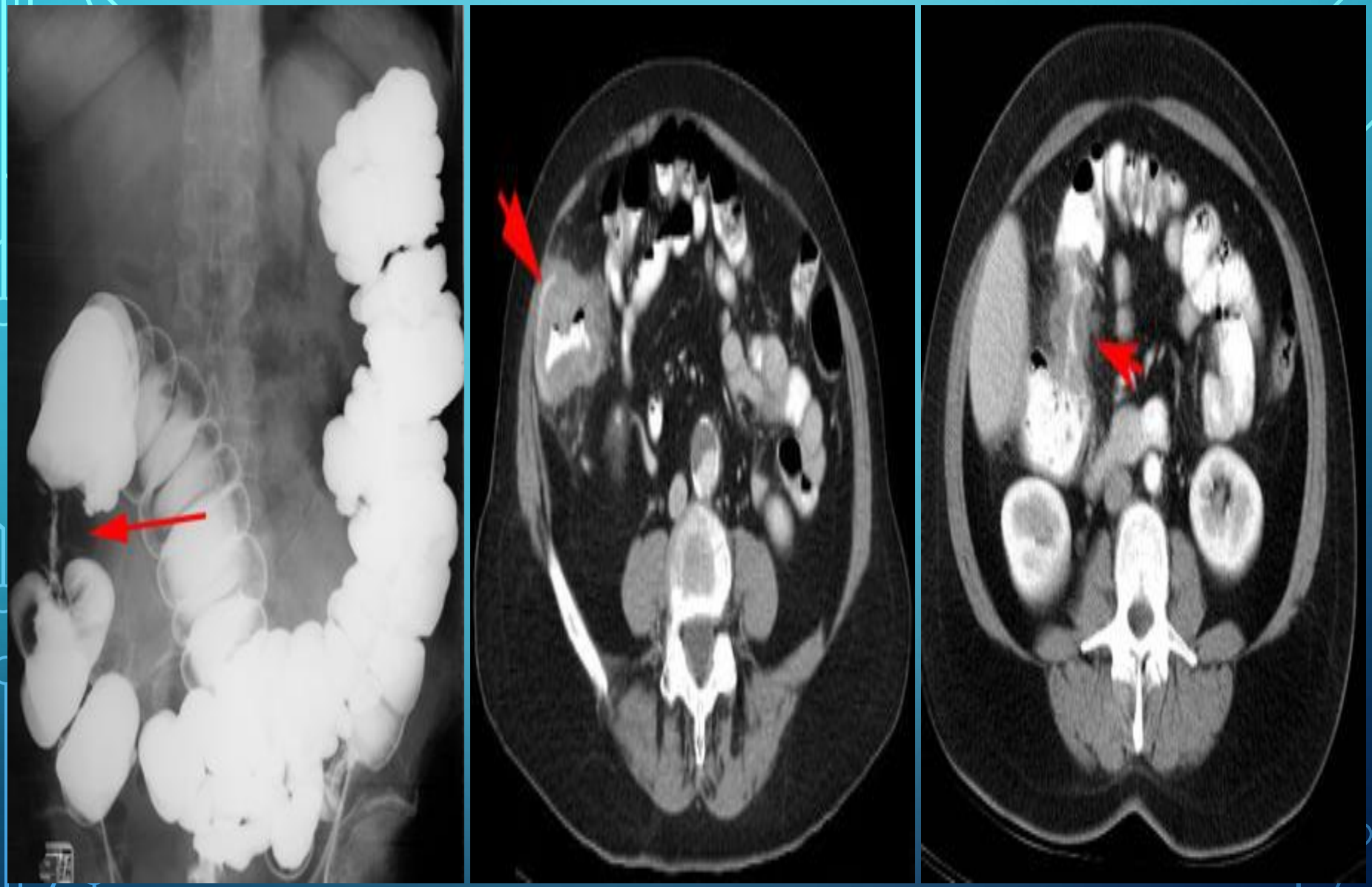
Carcinoid tumor.



Direct gastric metastasis of primary pancreatic cancer.



Colonic polyp

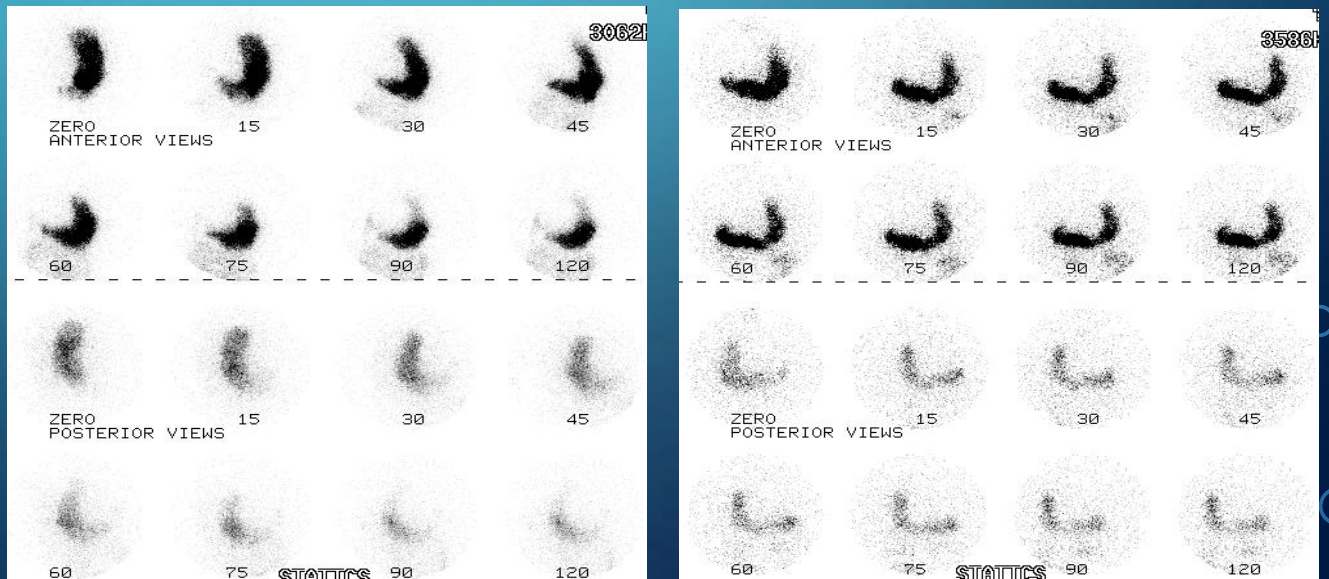


Colon Adenocarcinoma.

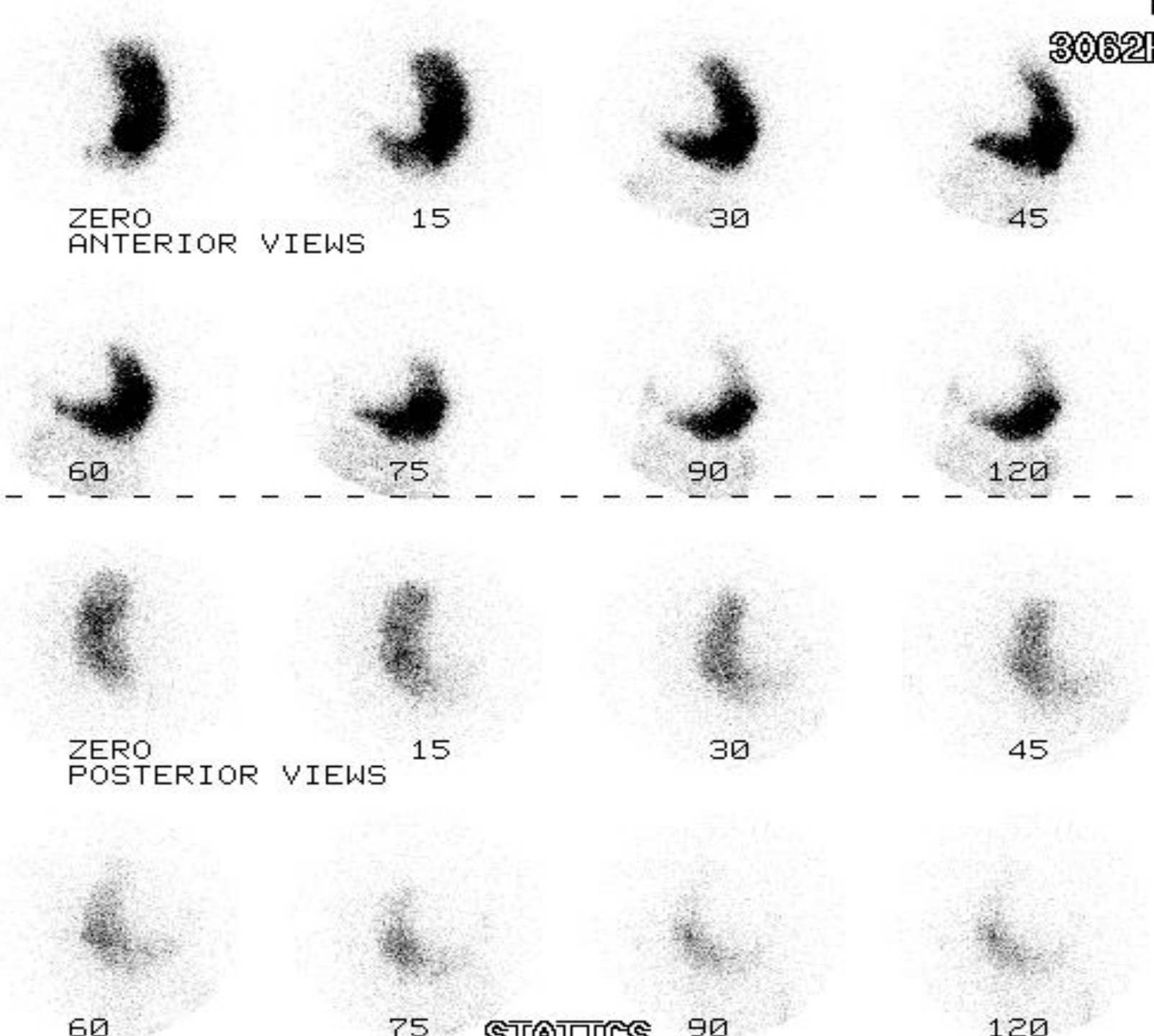
RADIONUCLIDE IMAGING

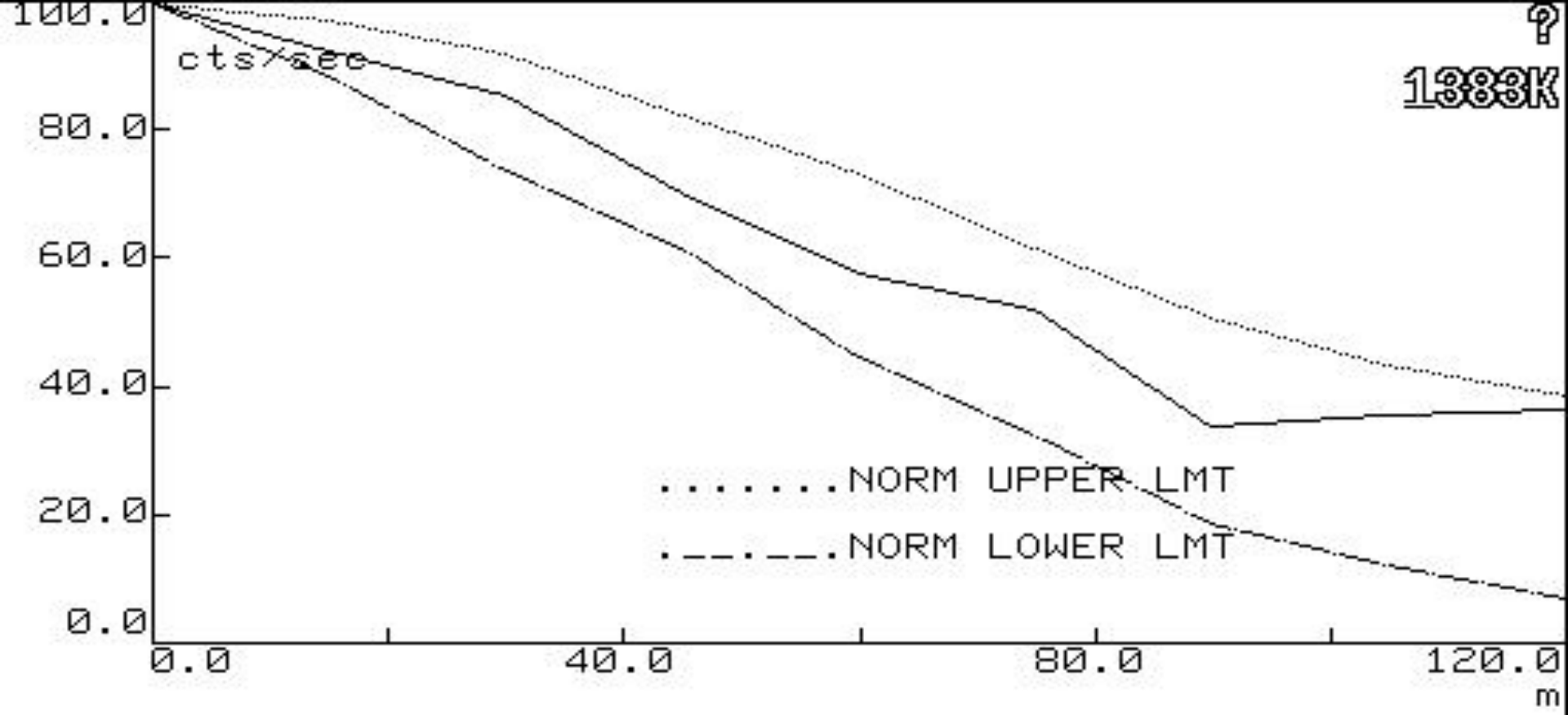
GASTRIC EMPTYING STUDY

- **Scintigraphy with a radiolabeled test meal** represents the gold standard for evaluating gastric emptying in patients with dyspepsia, and evaluation of gastric function in various systemic diseases affecting gastric emptying.



Normal Gastric Emptying



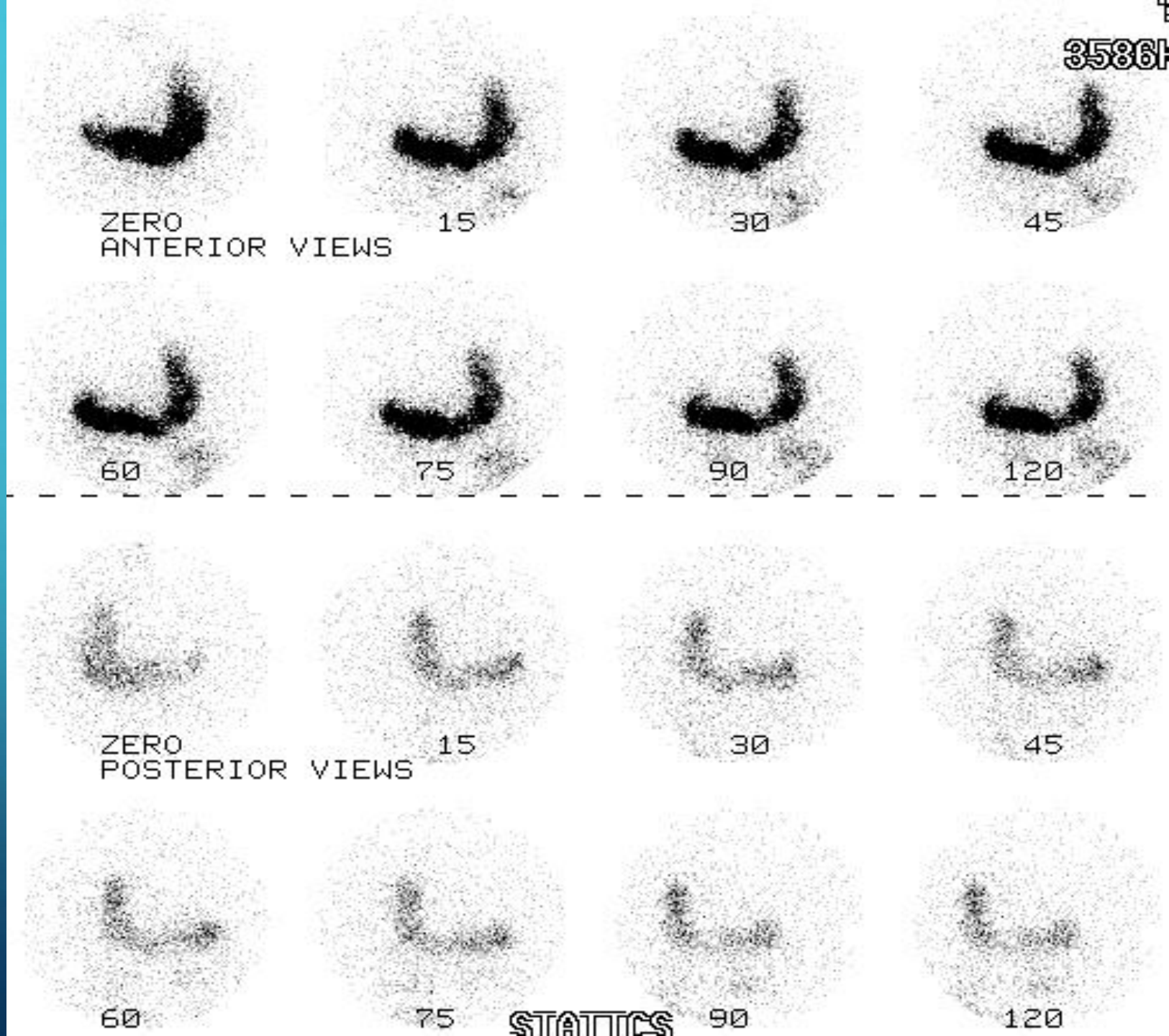


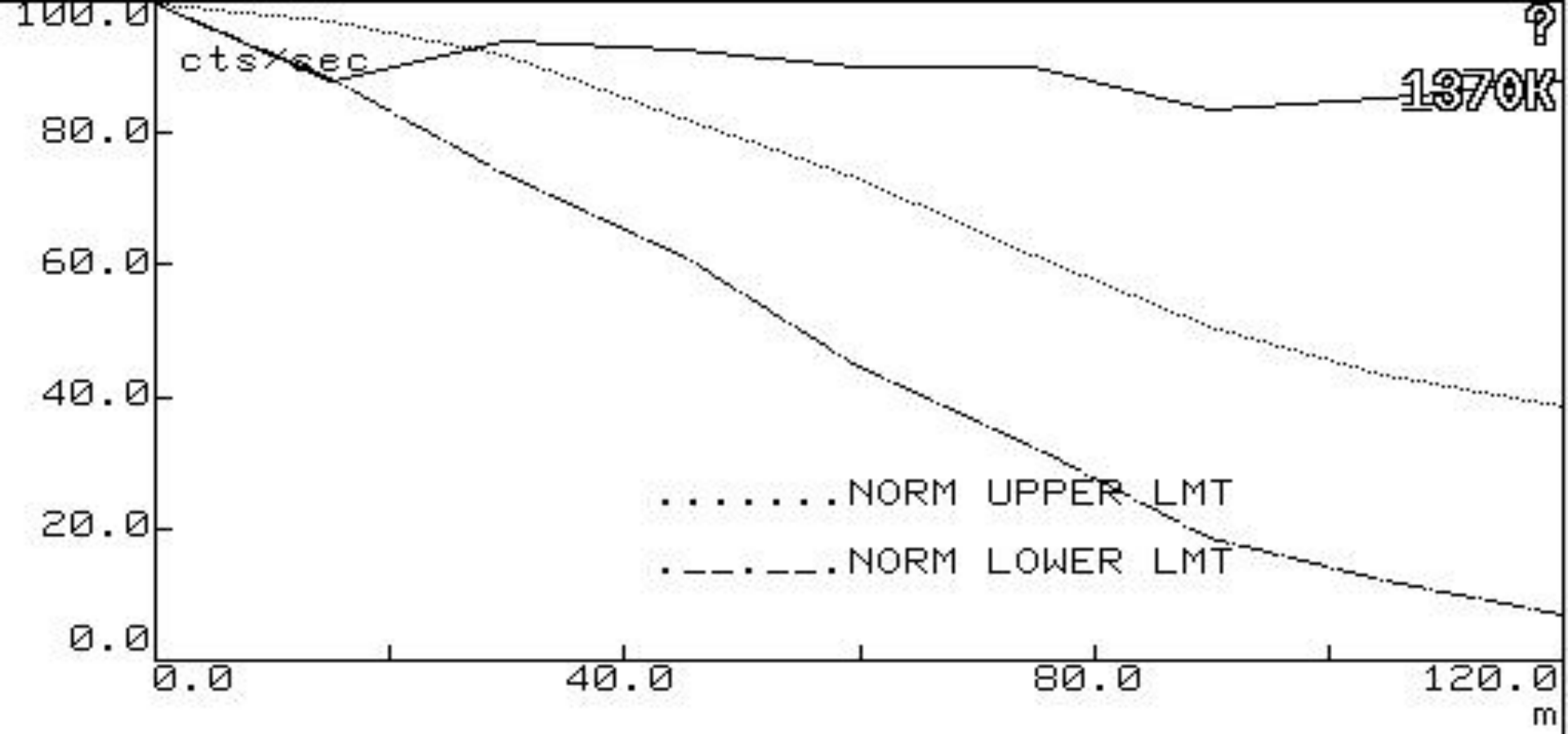
% EMPTYING

15	MIN:	7.4097
30	MIN:	14.508
45	MIN:	29.651
60	MIN:	42.068
75	MIN:	47.692
90	MIN:	66.172
105	MN:	64.466
120	MN:	63.468

Normal gastric emptying

Delayed Gastric Emptying





% EMPTYING

15	MIN:	11.947
30	MIN:	6.0272
45	MIN:	7.1314
60	MIN:	9.7620
75	MIN:	9.6091
90	MIN:	16.379
105	MN:	14.630
120	MN:	12.000

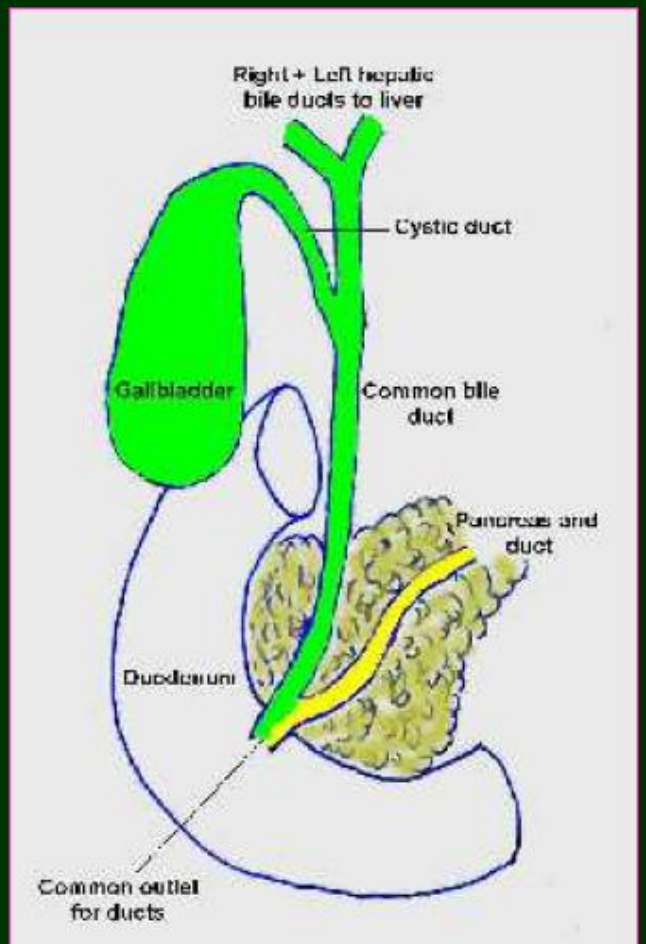
Delayed gastric emptying

HEPATOBILIARY SCAN

- Tracers : Tc-99m IDA derivatives (Tc-99m DISIDA, Mebrofenin)
- Route : IV injection
- Mechnism : Carrier-mediated, non sodium dependent organic anion transport process
- Tecnique : -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)

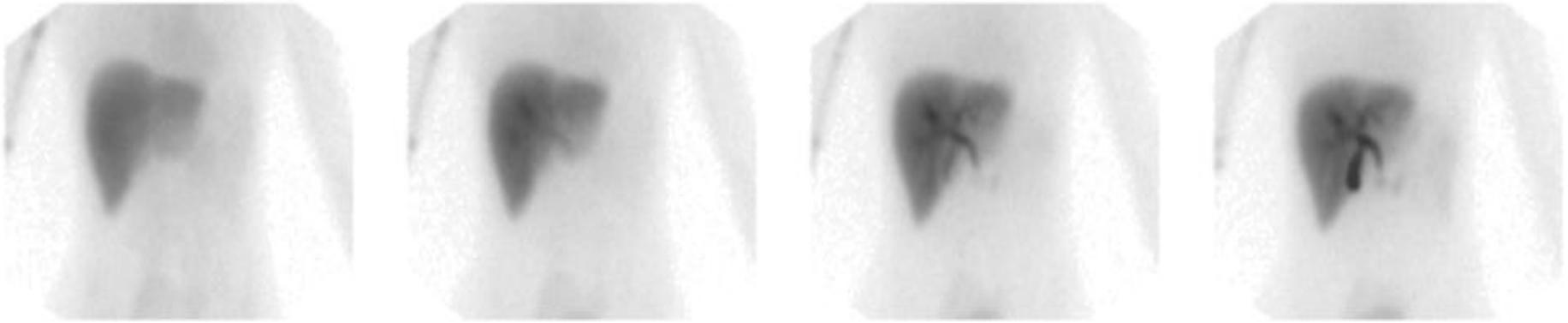
HEPATOBILIARY SCAN:
Indications

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

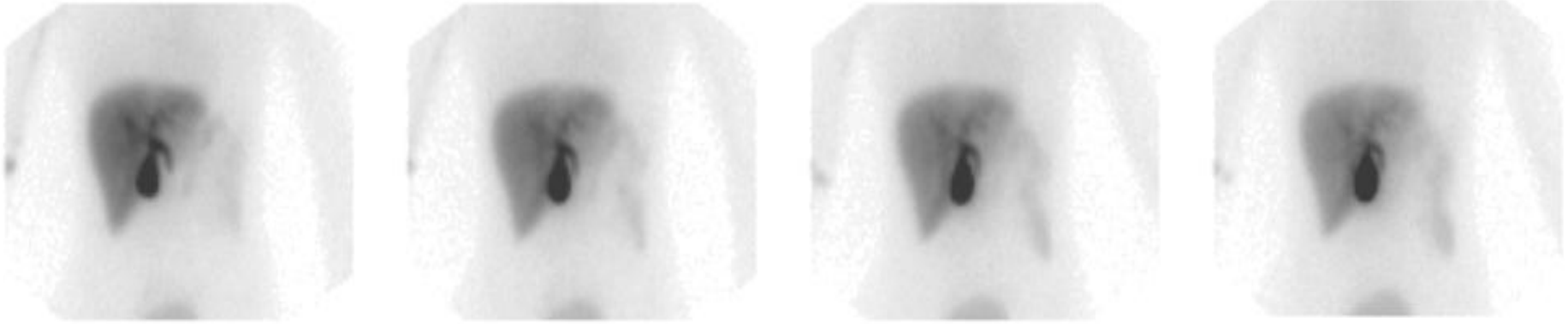


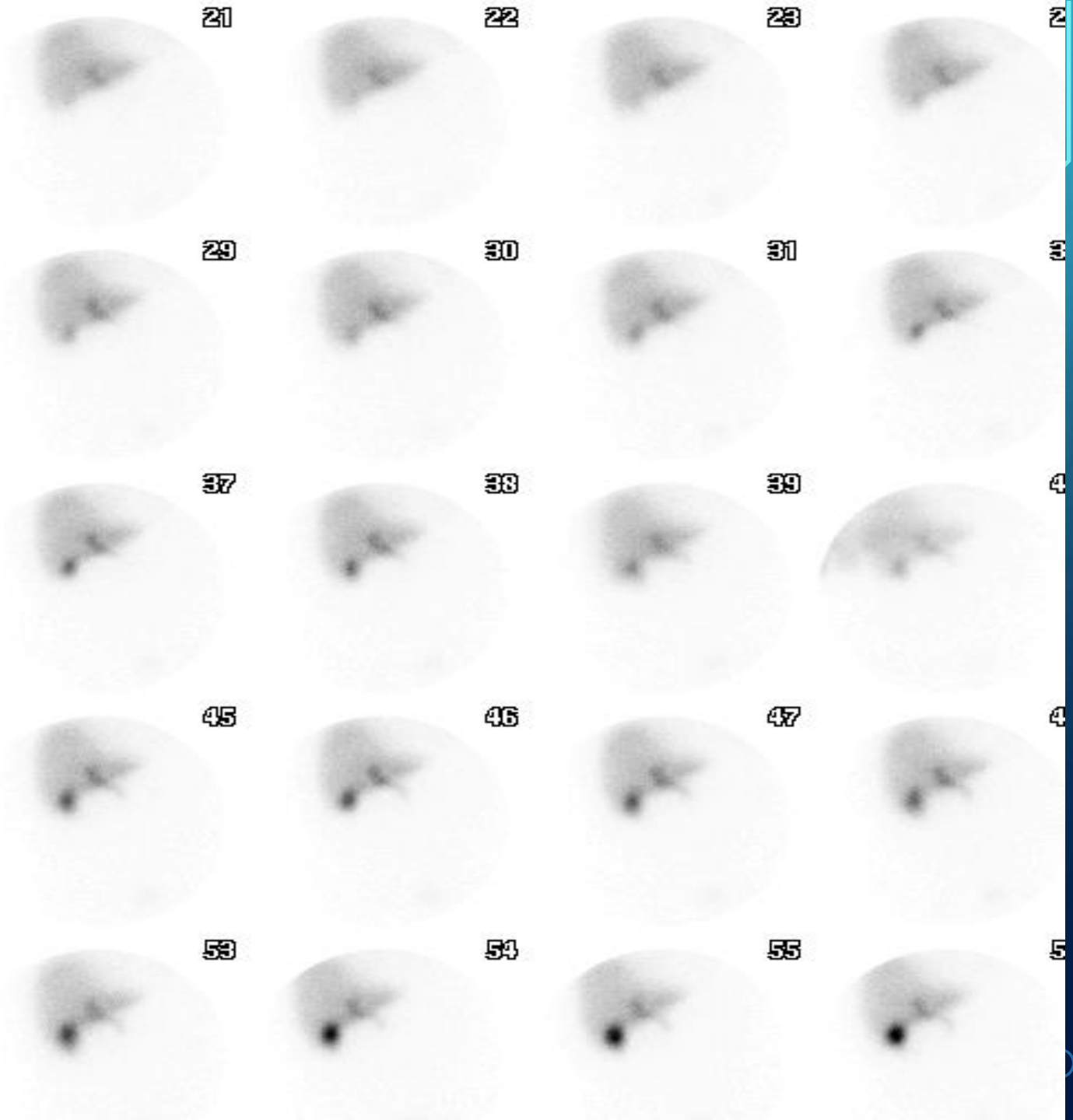
NORMAL CHOLESCINTIGRAPHY

(HIDA scan)



5 minutes per frame

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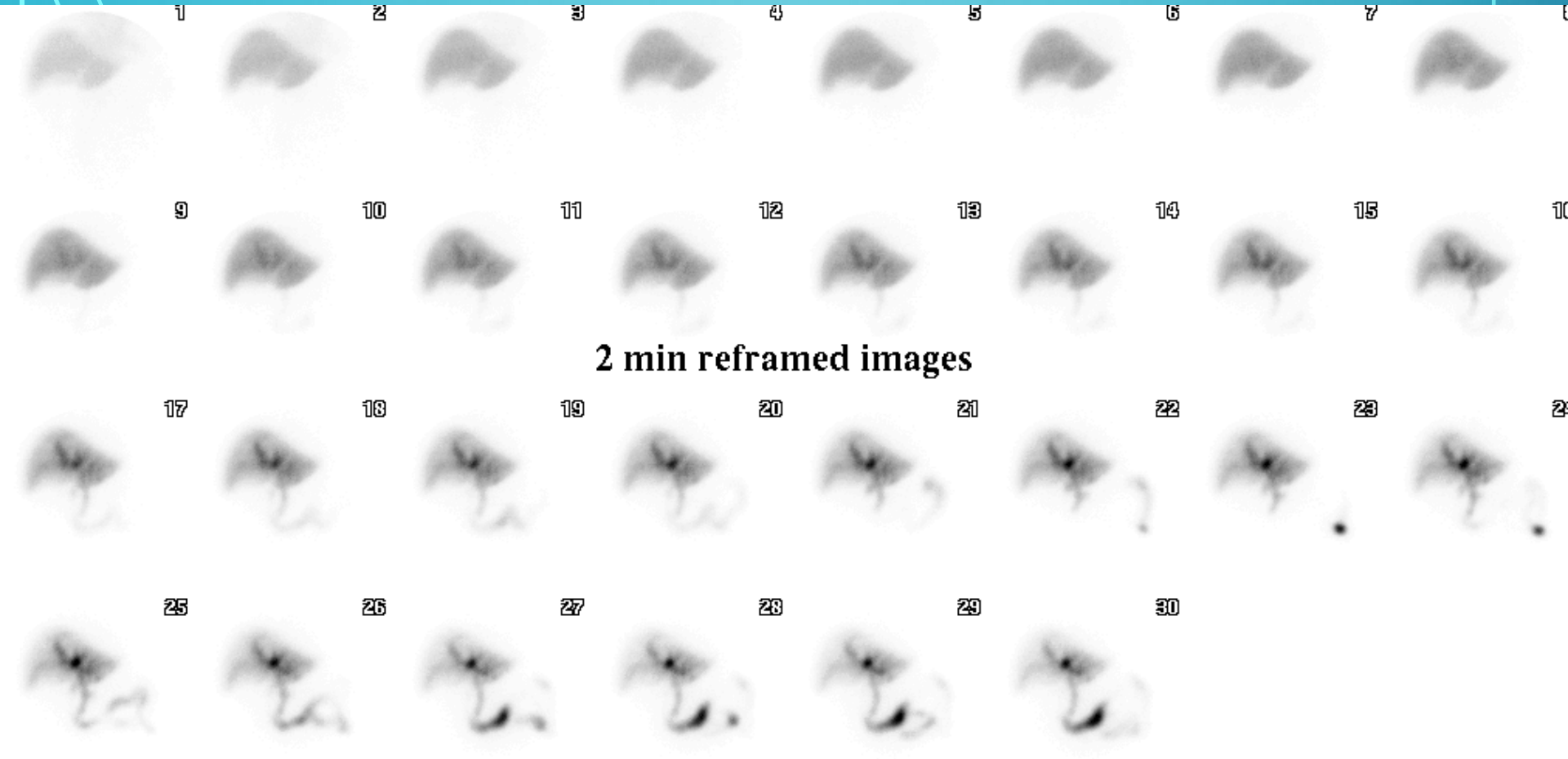
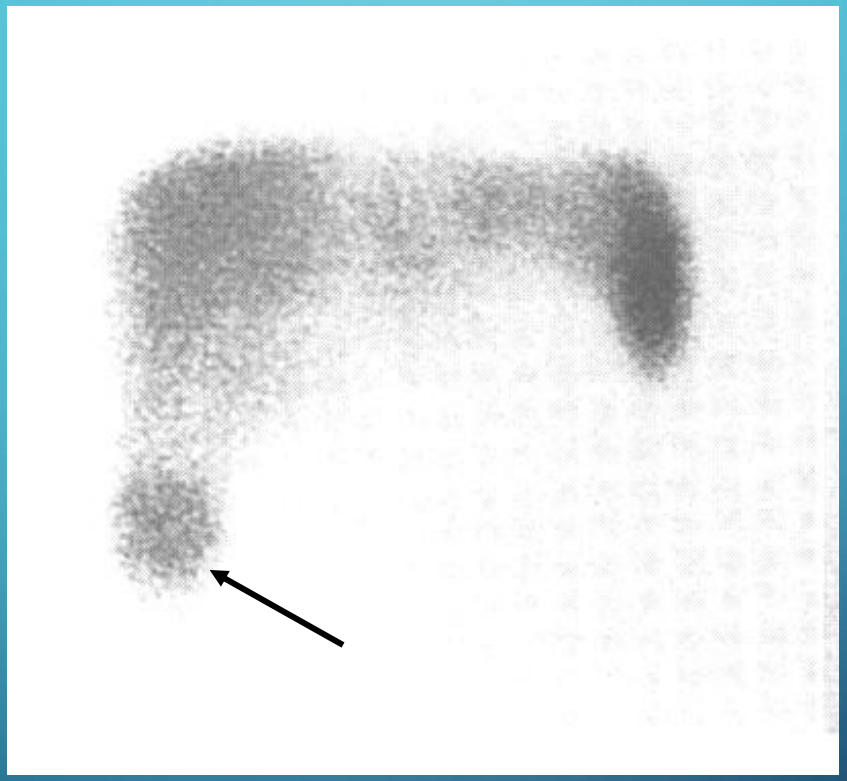
CHOLESCINTIGRAPHY



Acute cholecystitis

LIVER / SPLEEN SCAN

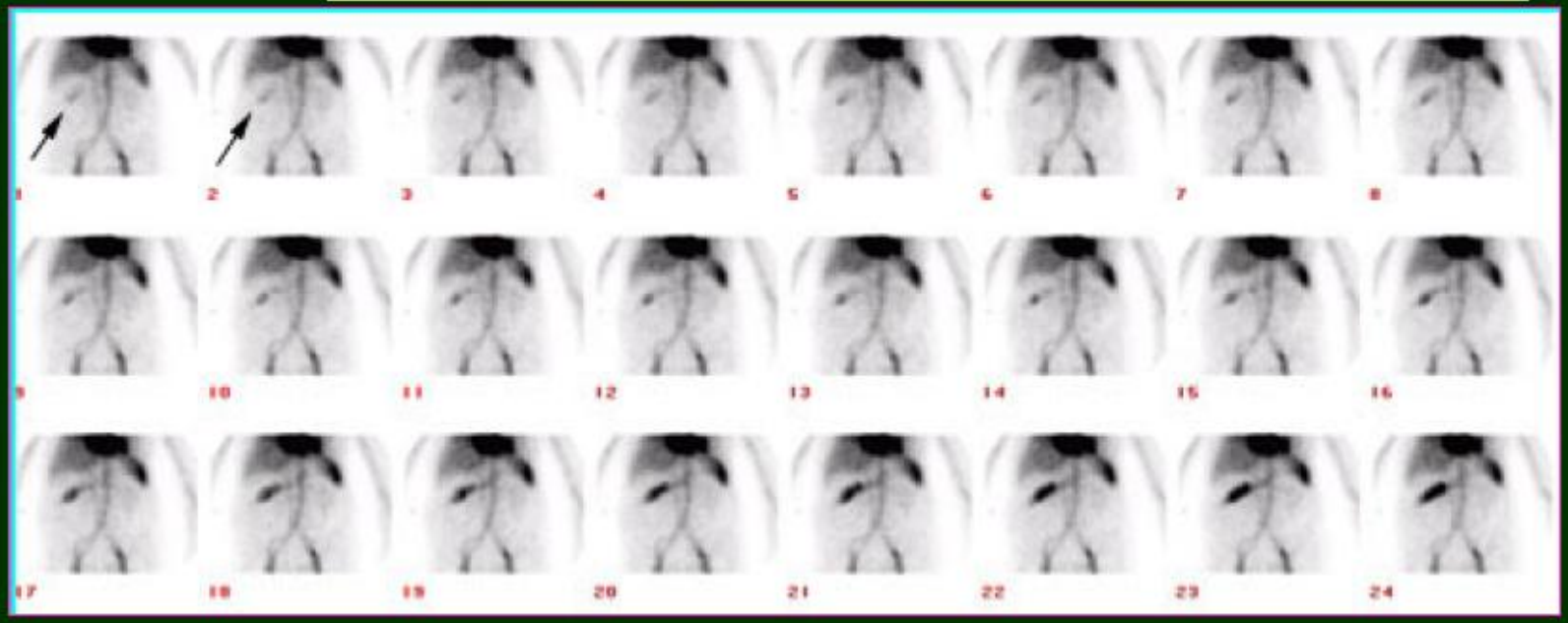


Focal Nodular Hyperplasia

GI BLEEDING STUDY

- Lower GI tract
- Active bleeding
- Tc-99m SC or Tc-99m RBC* (intermittent)
- More sensitive than angiography but less anatomical details
- Less specific in nature

POSITIVE FINDINGS



- Tc-99m RBC
- Hepatic flexure

- Extravasation of the tracer into bowel lumen
- → Focal area of increased activity, move // bowel movement
- Pattern depends on site of bleeding & bowel peristalsis

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 that ultrasound for visualizing large stones, and also is useful for counting the number of stones present.
- Contraindications: Pts with bilirubin > 3mg/dL, or in pregnancy.

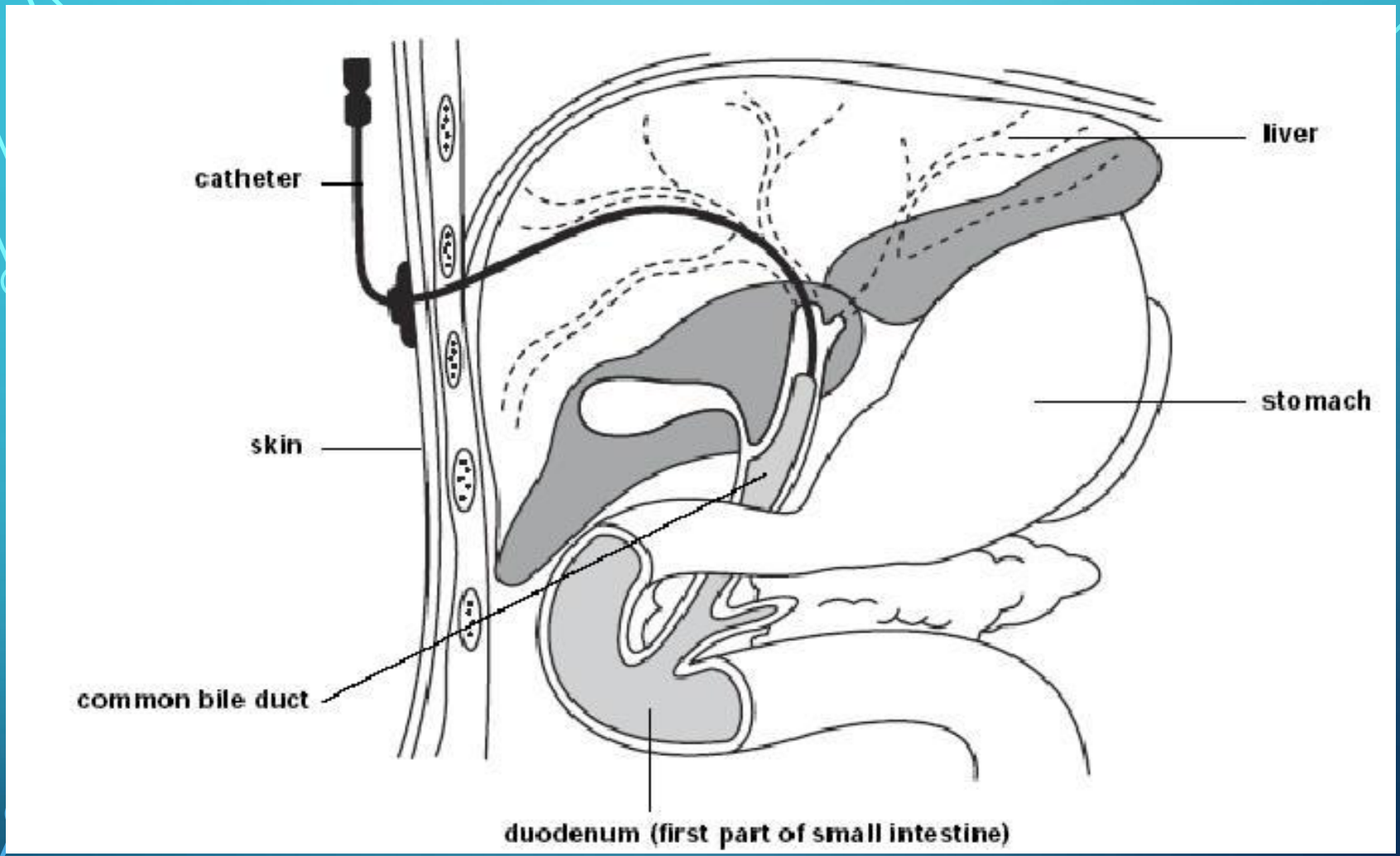
OCG

OCG

PERCUTANEOUS TRANSHEPATIC CHOLANGIOGRAM (PTC)

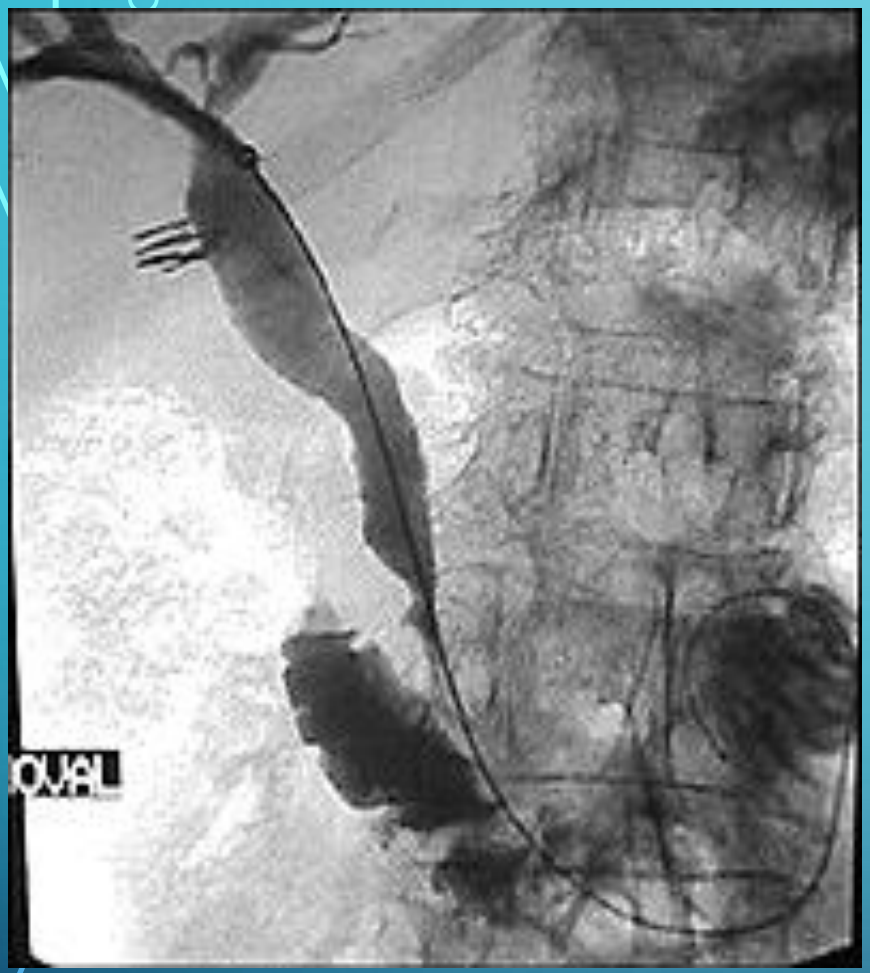
- PTC is indicated when percutaneous intervention is needed and ERCP either is inappropriate or has failed.
- Can be used to drain biliary obstructions.

PTC


catheter
liver
stomach
skin
common bile duct
duodenum (first part of small intestine)

- PTC demonstrating dilated ducts.

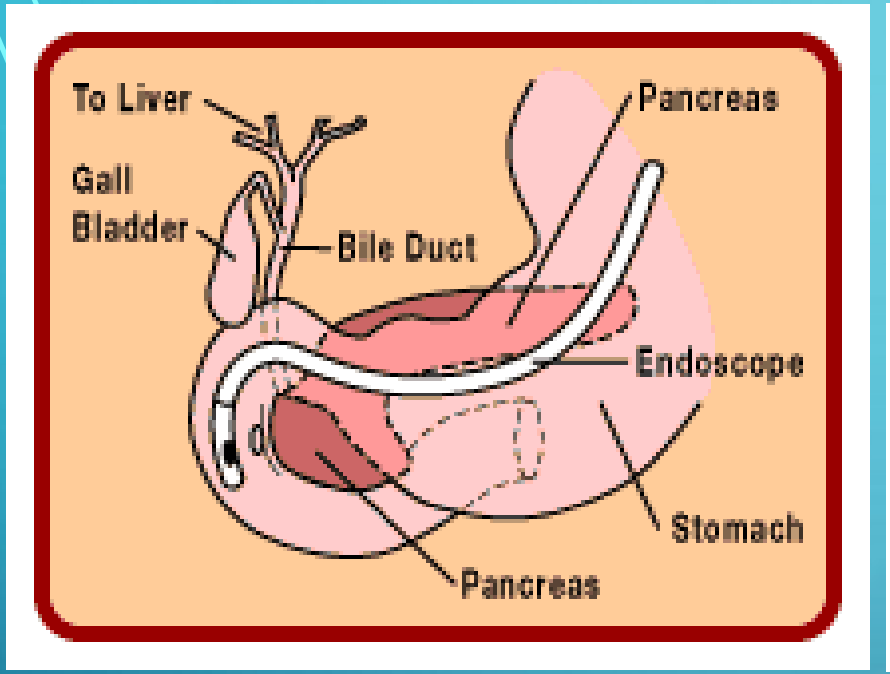
- PTC after injection of dye, showing a large gallstone trapped in the duct.

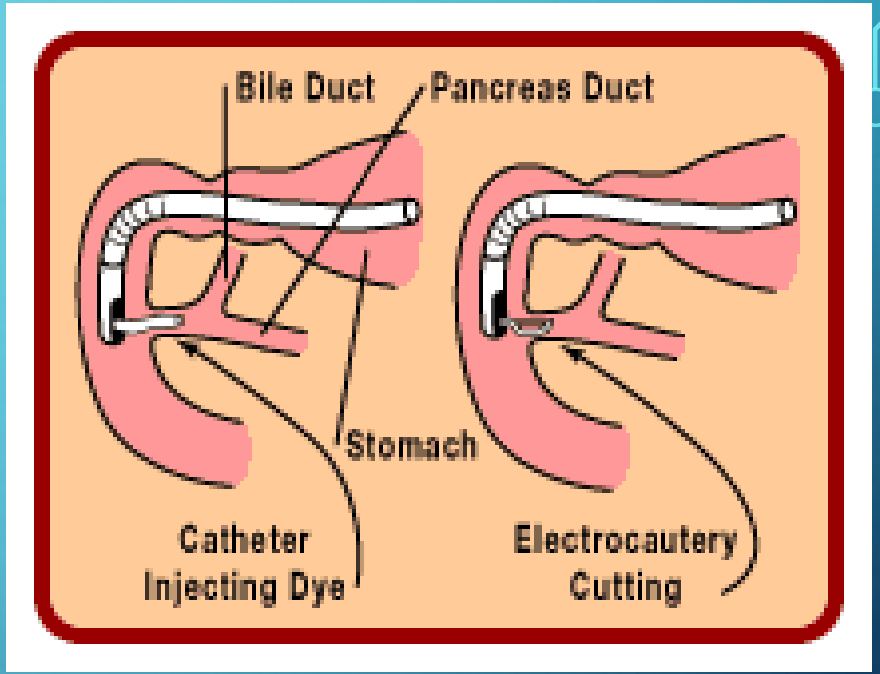


- PTC: The same duct as before, after removal of the stone through the drainage catheter.

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, OF PERFORM OTHER TREATMENTS.

ERCP

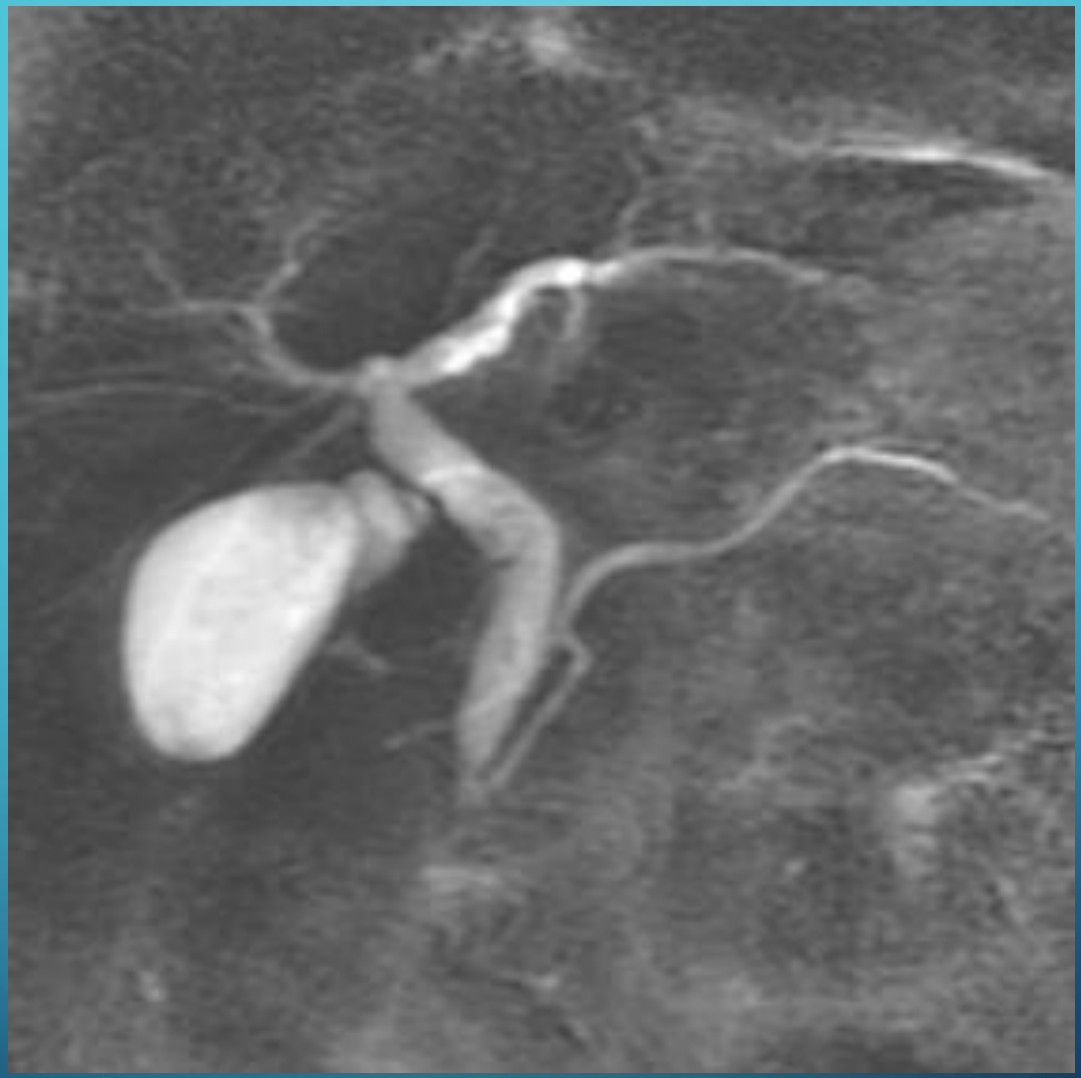
- The most important indication for ERCP is obstructive jaundice, as it can demonstrate the cause and extent of the obstruction.
- ERCP is the preferred method of examination of patient with possible choledocholithiasis, because the stones can be extracted with balloons or gaskets after sphincterotomy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

ERCP SHOWING STONES

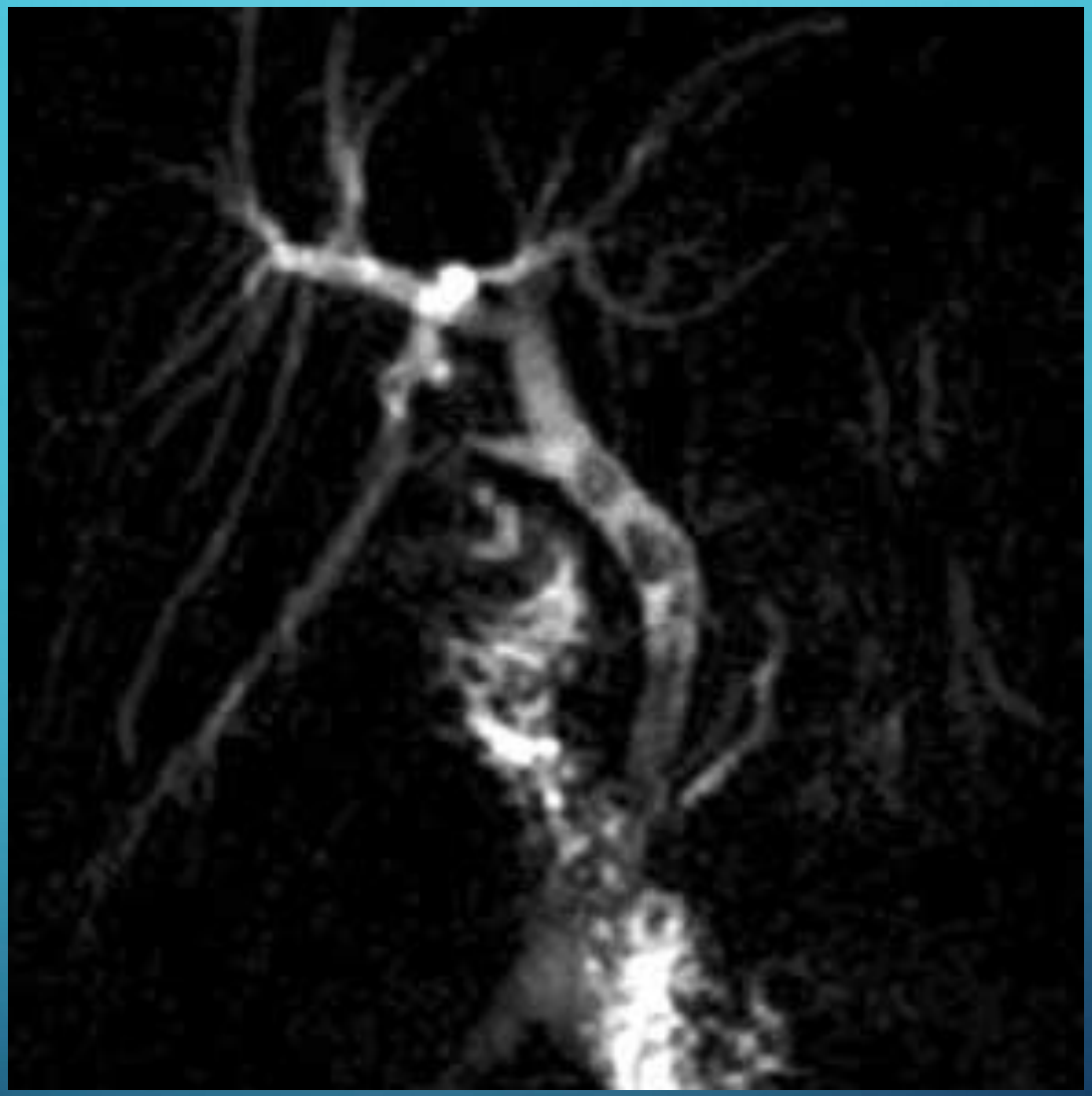
ERCP: SHOWING SLIGHTLY DILATED COMMON BILE DUCT WITH CALCULUS AND NORMAL PANCREATIC DUCT

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