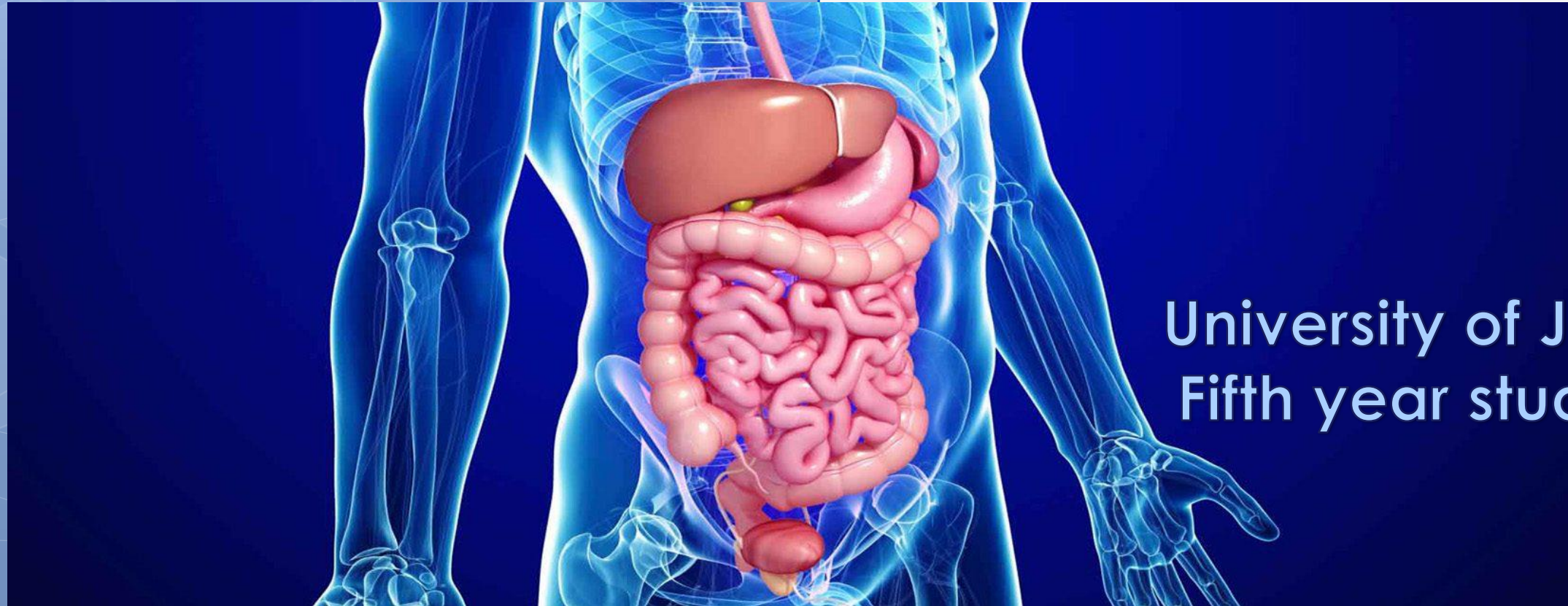


GIS radiology

Done by: Touleen Qatawneh



University of Jordan
Fifth year students

GI SYSTEM

ANATOMY

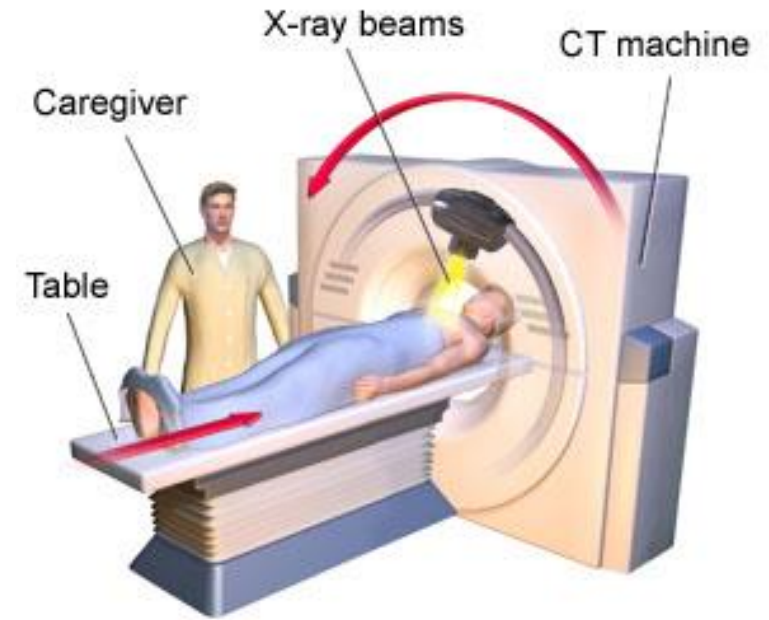
PATHOLOGY

GIS ANATOMY

In CT images ... ●

CT ...

It obtains a series of different angular x-ray projections that are processed by a computer to give a section of specified thickness.



Computerized Axial Tomography Scan

- **Mention the section , body area**
- **Contrasted vs non contrasted**
- **The side for any paired organ**

Hounsfield scale for densities

Absolute positive: BONE +1000 →

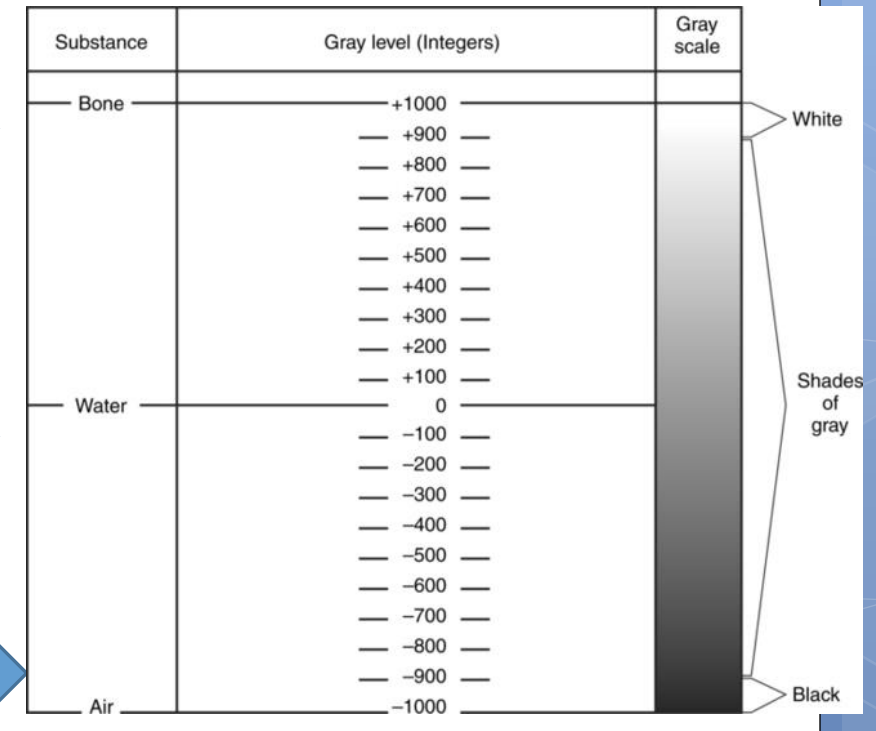
Contrast: 150

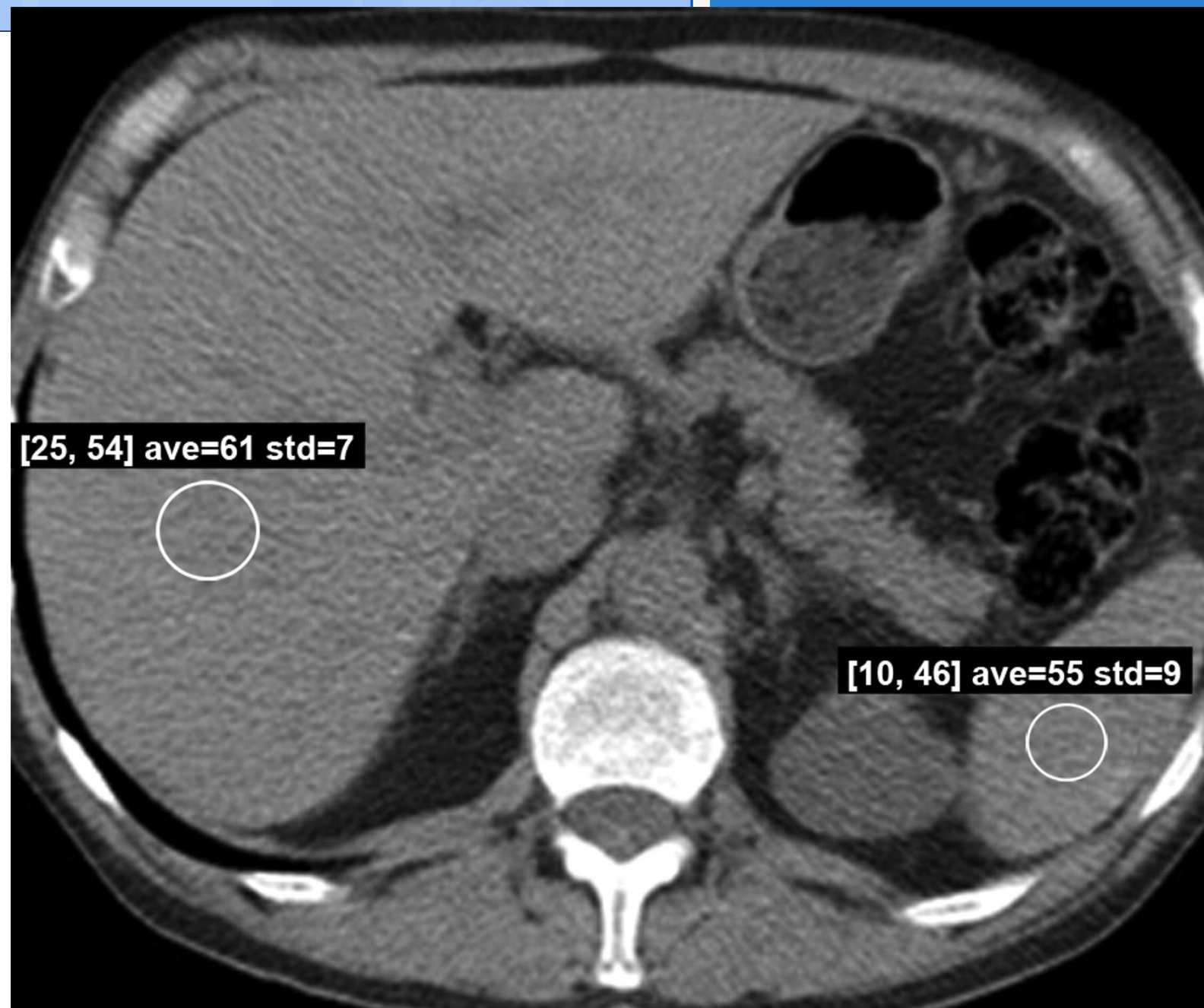
Soft tissue: 40-60

Neutral: FLUID 0 →

Fat: -20-30

Absolute negative: GAS - 1000 →





◆ How to differentiate between a contrasted and a non-contrasted CT:

A non-contrasted CT is a CT of low resolution. The borders separating the organs (or structures) are not clear. A non-contrasted CT is ordered in the following cases:

- Renal failure
- Suspicion of renal or gallbladder stones (remember CT scans are the most sensitive study to detect renal stones; however, an ultrasound is the ideal modality for detecting a gall bladder stone)
- Post-traumatic CT's: Here, we are looking for a hemorrhage. On a contrasted CT scan, hemorrhages can be masked by the presence of the contrast (they have similar densities)
- Renal failure or previous allergy to contrast material.

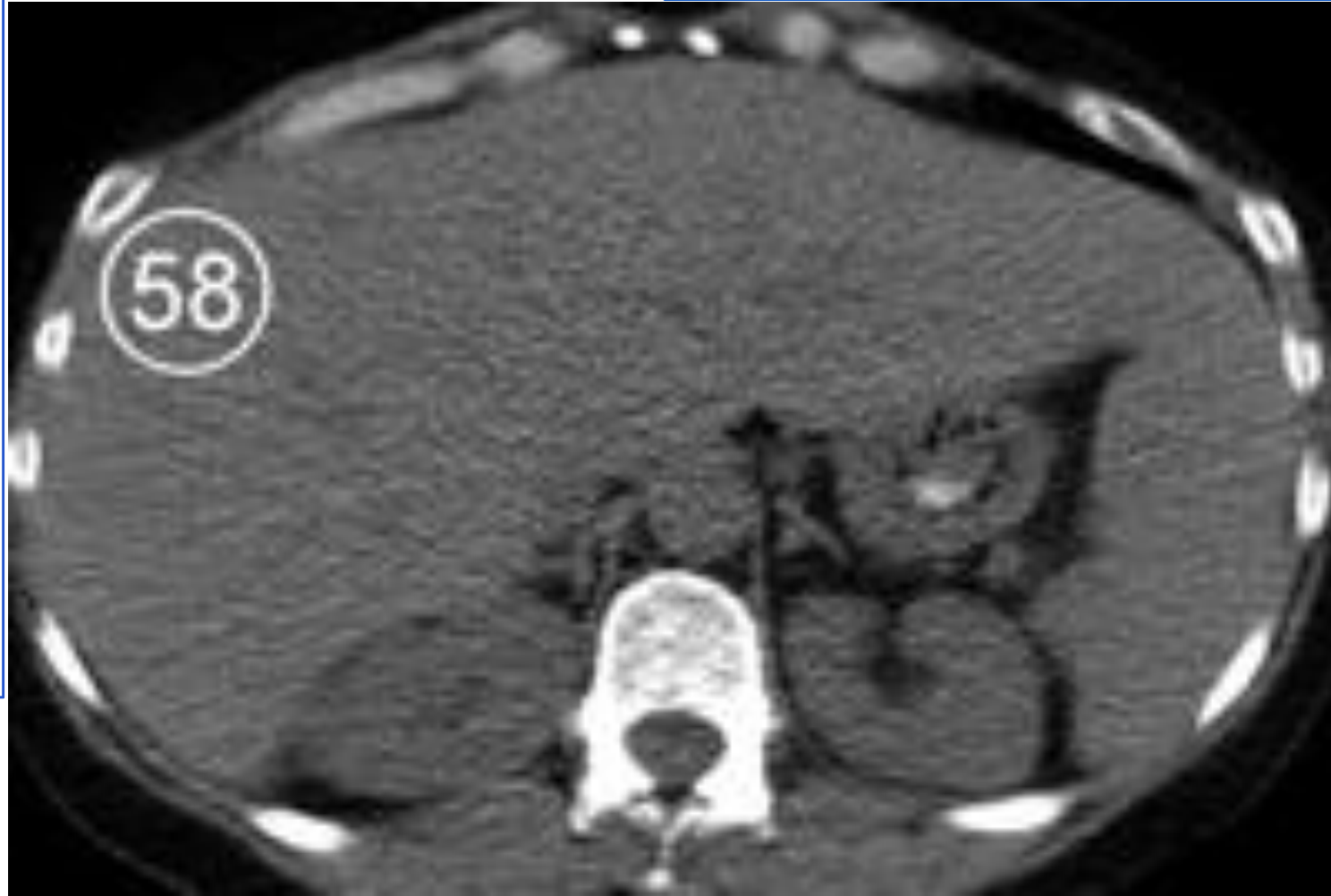
◆ How to tell if contrast material is present:

IV contrast (the presence of at least 1 of the following criteria):

- Liver vessels appear hyperdense in comparison to liver parenchyma.
- The vessels appear hyperdense compared to paraspinal muscles (especially the aorta and IVC)
- Cortico-medullary differentiation of the kidney: the presence of two different densities on the kidney..

Oral contrast: the presence of contrast density (hyperdensity) in a hollow organ like the stomach or bowel.

Axial abdominal CT scan
without contrast
- Notice that the
borders
between organs are not
clear and notice the
lack of corticomedullary
differentiation in the
kidneys.



- noncontrasted CT
- when to use noncontrasted image?

How to know its contrasted ?

Oral vs IV contrast



Axial abdominal CT scan With IV contrast.

Notice the hyperdensity of liver vessels. And hyperdensity of the aorta.

Abdominal aorta

Kidney

AGAIN...

Hounsfield scale for densities

Absolute positive: BONE +1000

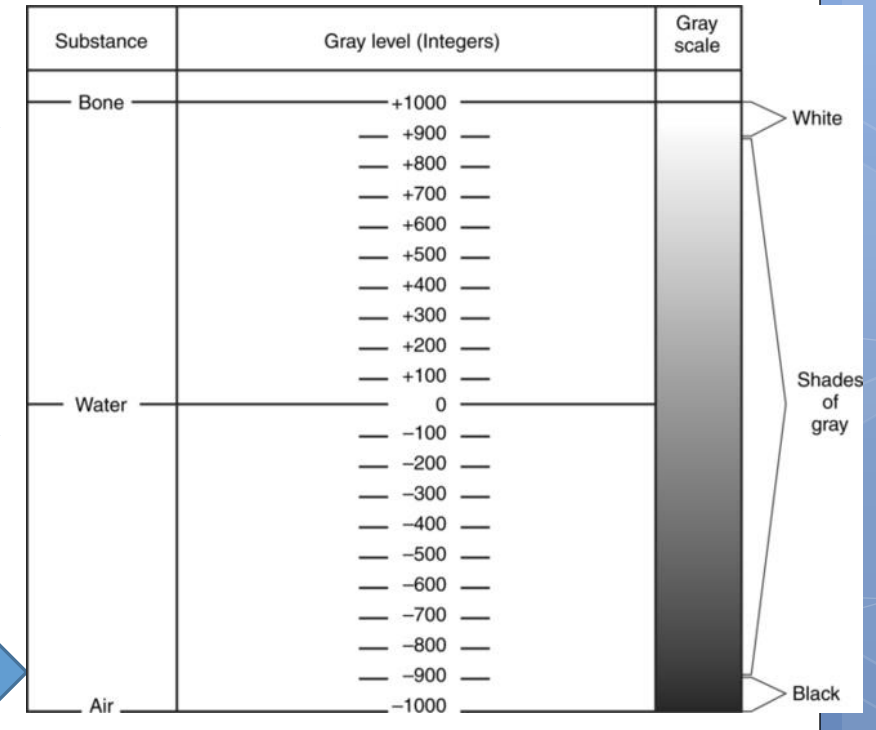
Contrast: 150

Soft tissue: 40-60

Neutral: FLUID 0

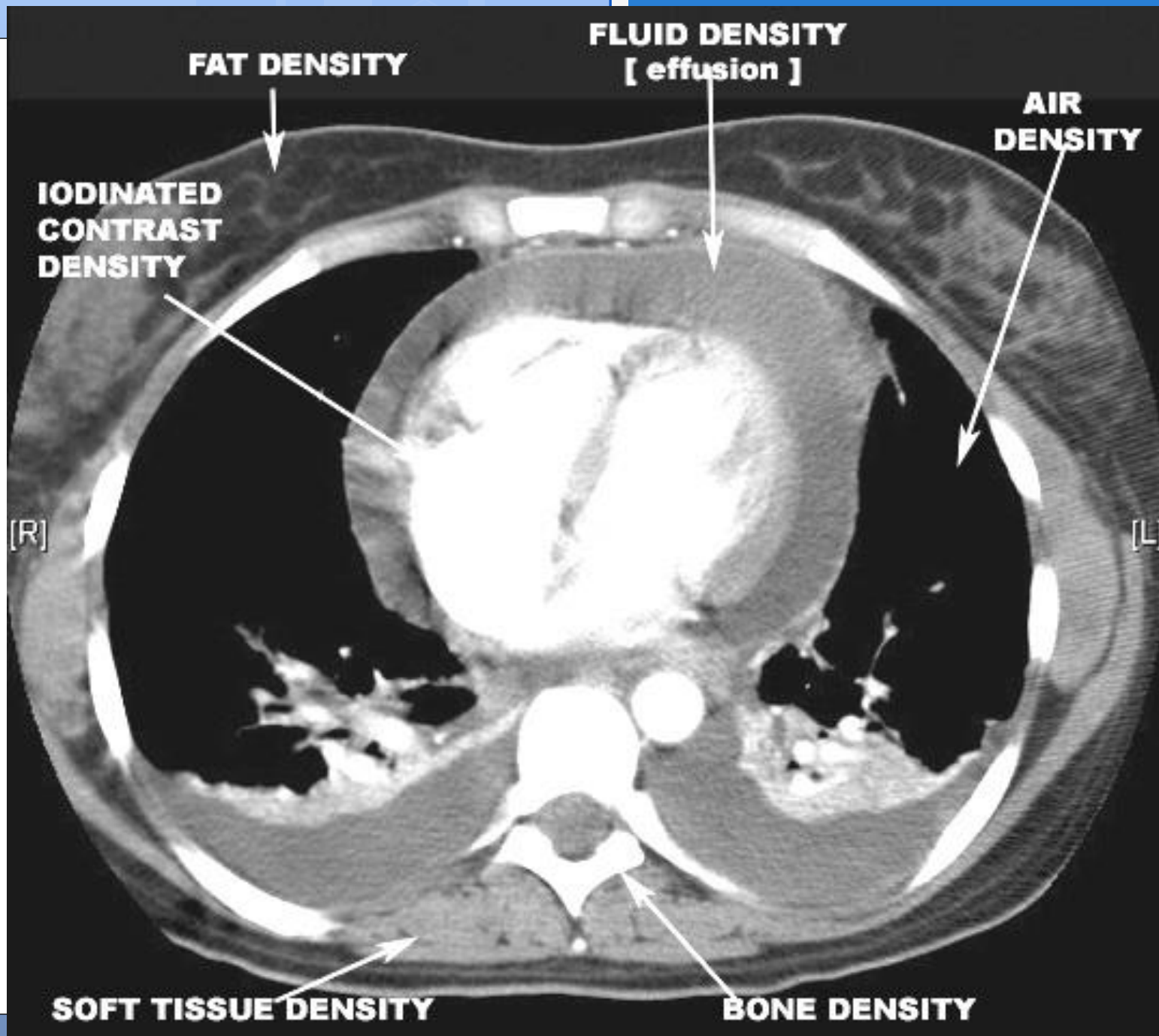
Fat: -20-30

Absolute negative: GAS - 1000



Axial chest
CT scan with
contrast

Organs
of
different
densities



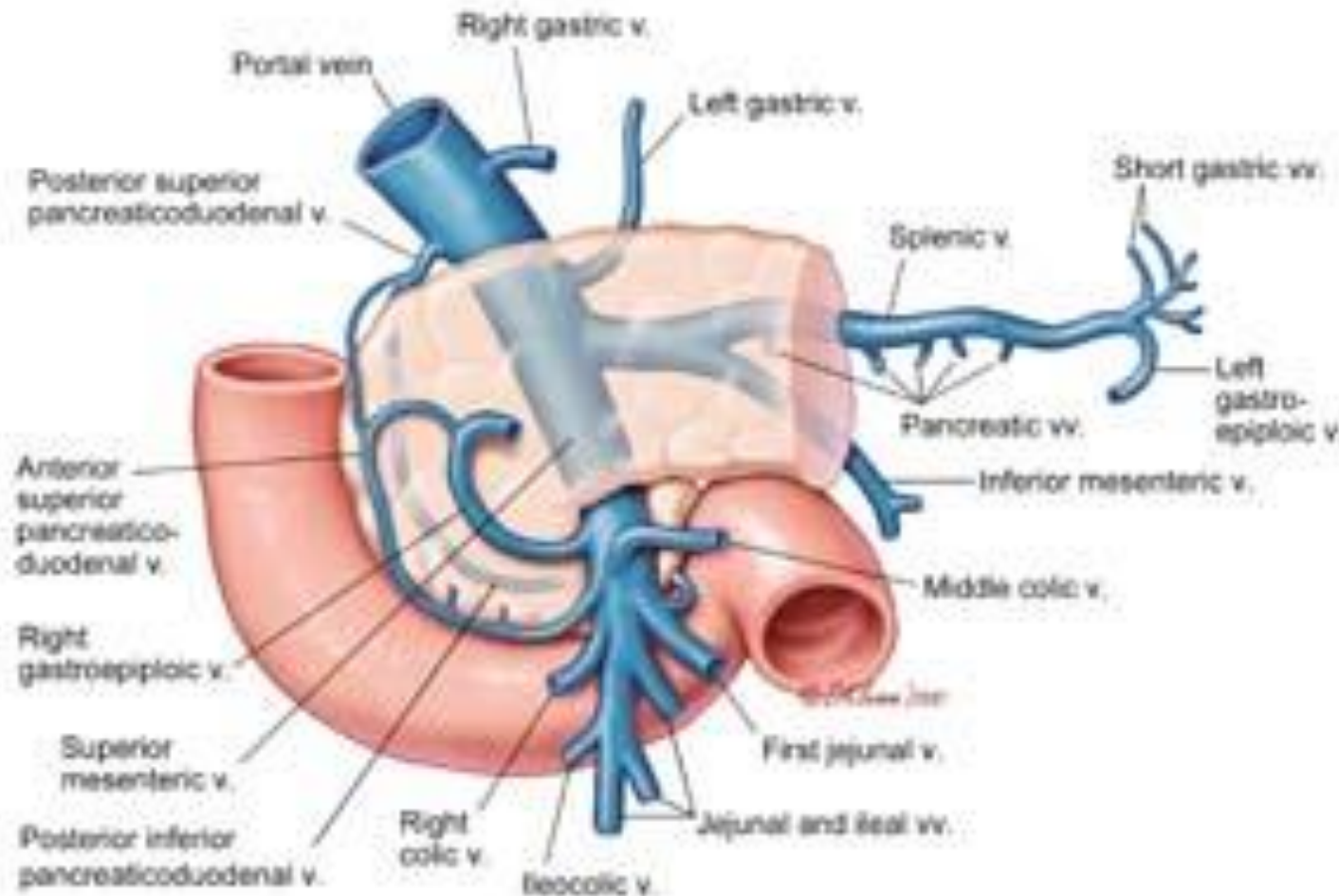
Notice the
hyperdensity inside
the stomach.
Notice the
hyperdensity of
the aorta.

.Absolute ✱
positive: BONE
+1000
.CONTRAST 150
.SOFT TISSUE 40-
60
.Neutral: FLUID 0
.FAT -20-30
.Absolute
negative: GAS -
1000

Important organs...

Portal vein

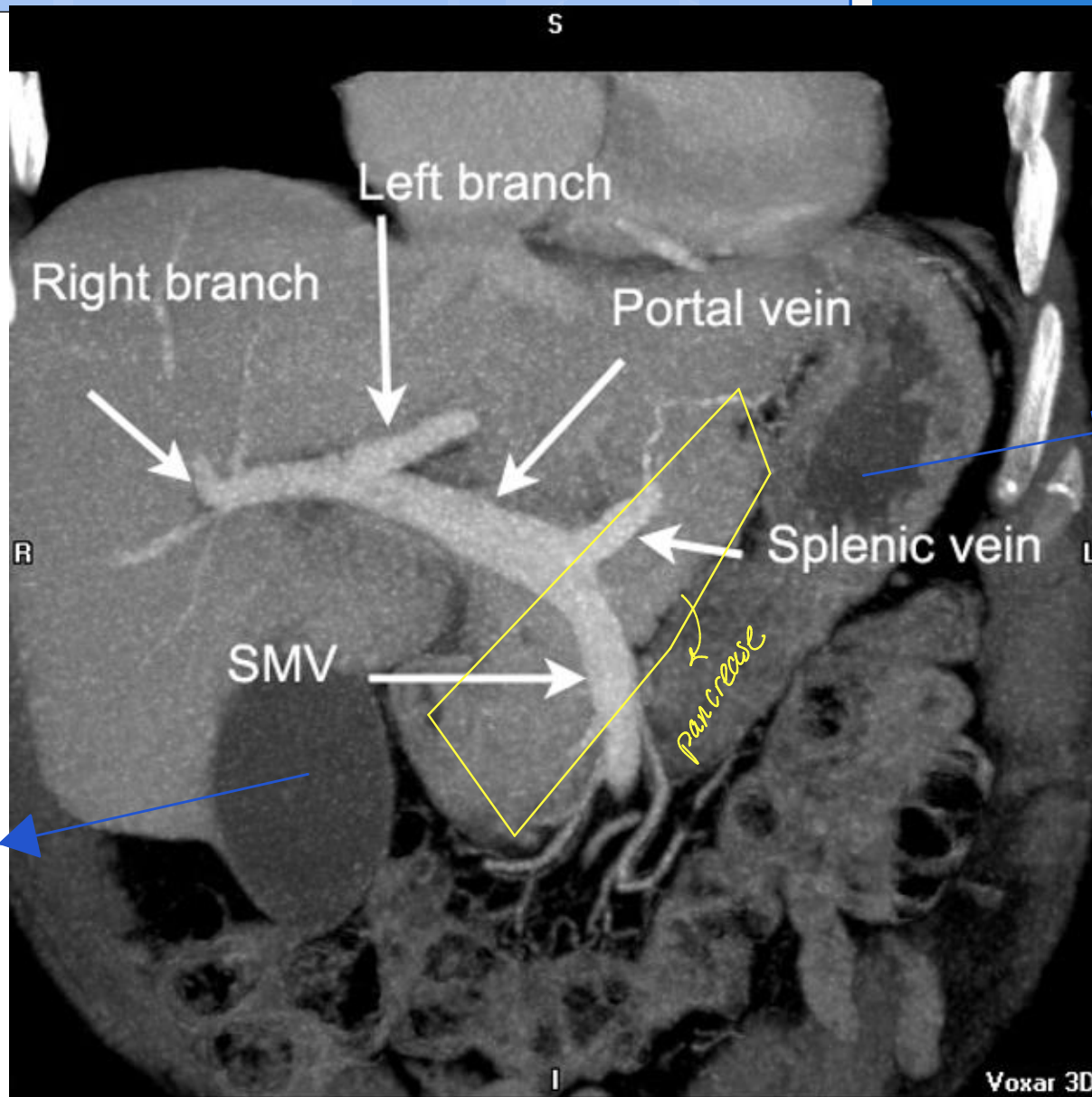
It is formed by the union of the superior mesenteric vein (SMV) and the splenic vein (often behind the neck of the pancreas).



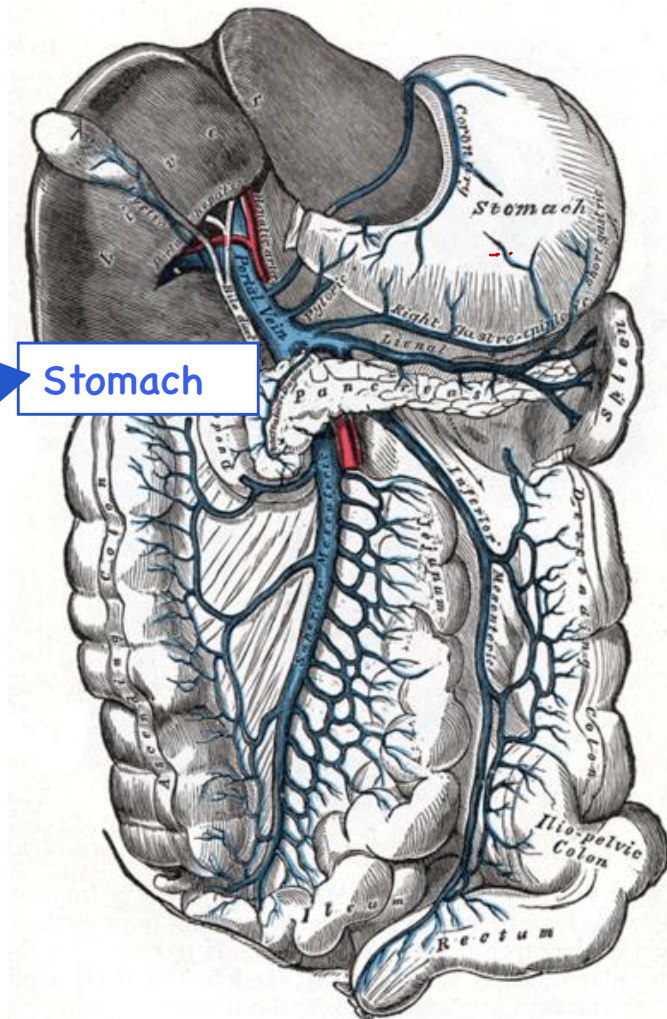
BEHIND THE NECK OF PANCREAS.

Lateral to the portal vein: head of pancreas.

Lateral to head of pancreas: second part of duodenum



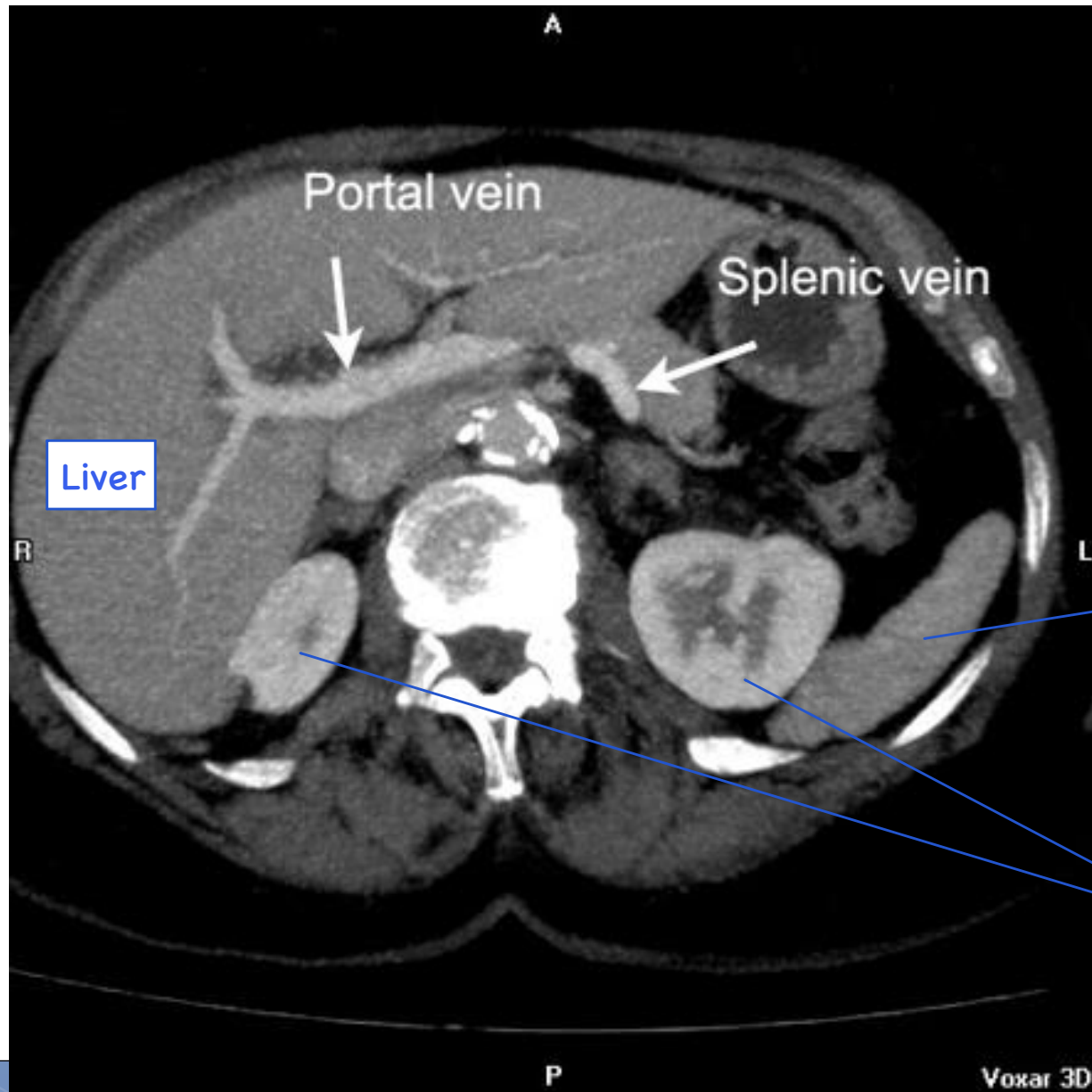
Gallbladder
(Bile)



Stomach

Coronal CT scan with IV contrast

Pancreas



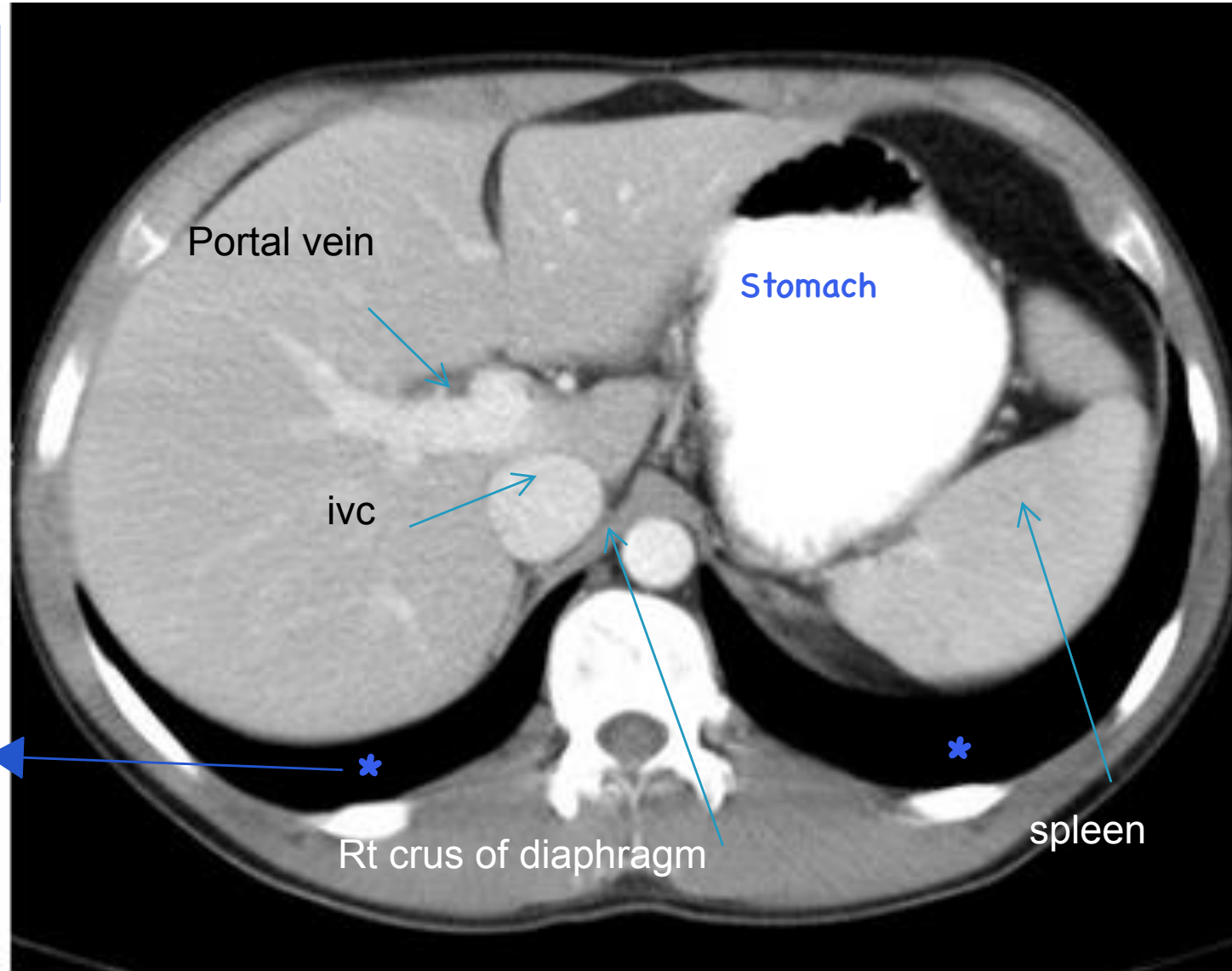
**THE SPLENIC VEIN
IS POSTERIOR TO
THE BODY OF THE
PANCREAS.**

Liver ... caudate lobe

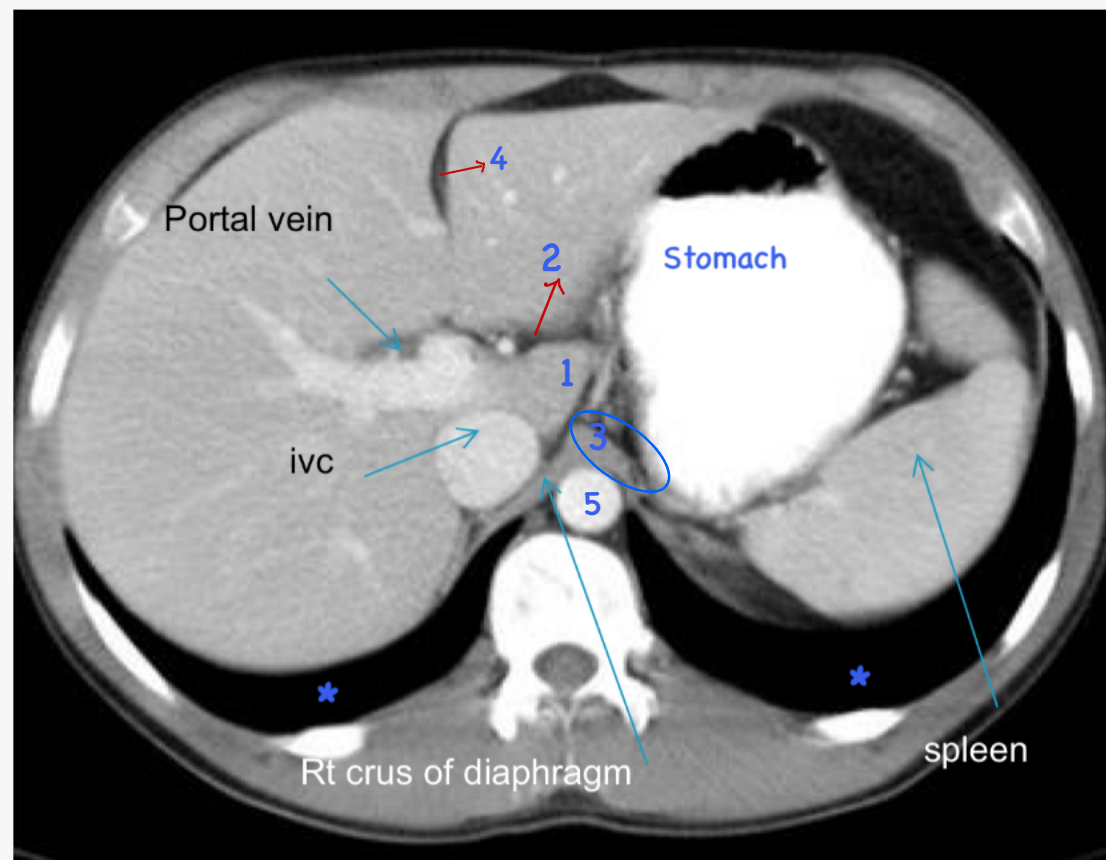
Axial abdominal CT scan
with IV and oral contrast

-Portal vs hepatic

* Air in the base
of the ling



**THE CAUDATE LOBE
LIES ANT TO THE IVC
, AND POST TO THE
FISSURE OF
LIGAMENTUM
VENOSUM.**



1. caudate lobe: Lies between the inferior vena cava (IVC) and the ligamentum venosum.

Sits on the posterior aspect of the liver's left lobe, just above the porta hepatis.

2. ligamentum venosum.

3. Median Arcuate Ligament

A fibrous arch formed by the right and left crura of the diaphragm, bridging over the front of the aorta.

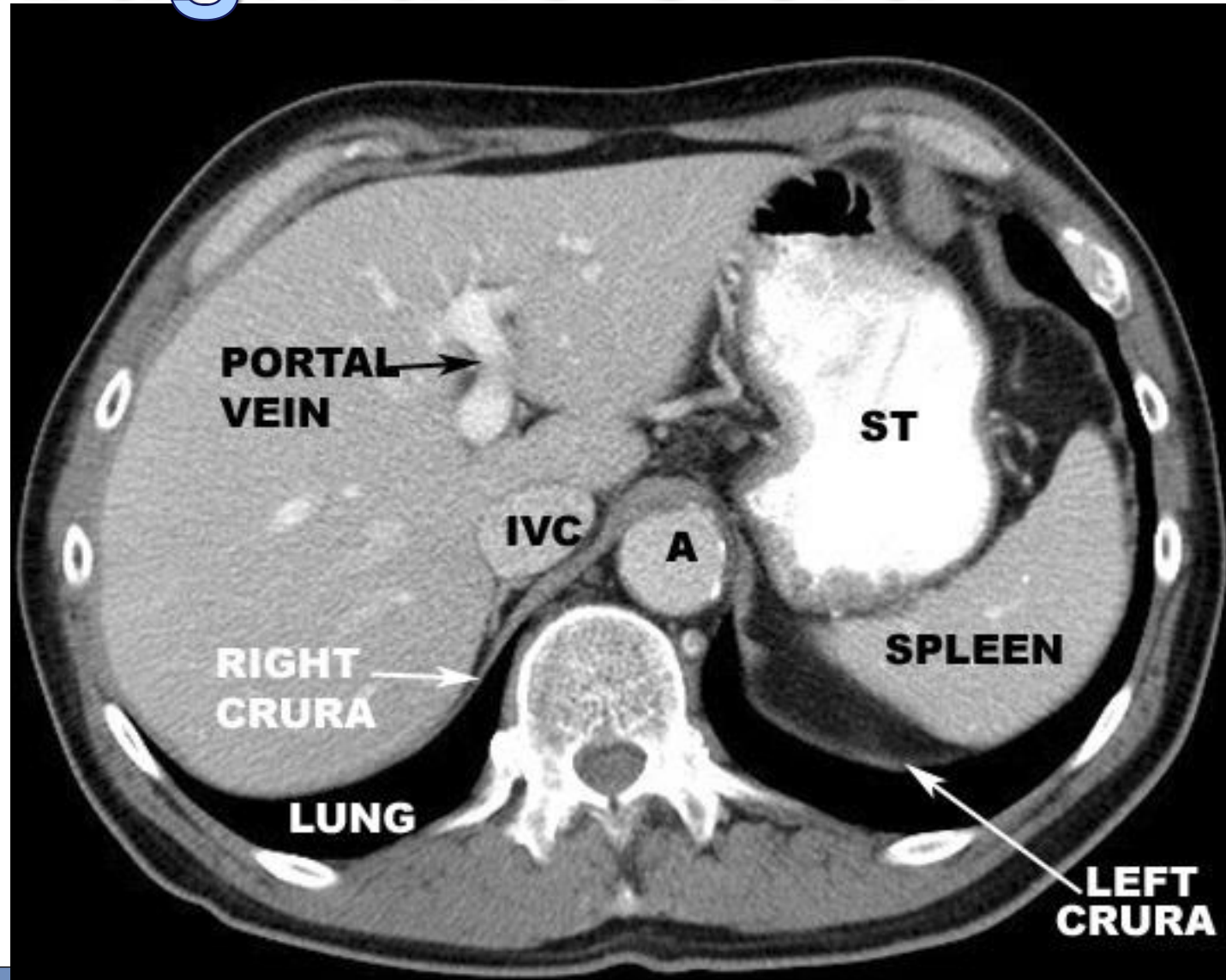
4. fissure of ligamentum teres

5. Aorta: anterior to the vertebra

→ Diaphragmatic crura (singular crus)

- There are two crura, one on the right and one of the left.
- These crura surround the aorta and attach to the diaphragm on its inferior surface.
- These structures have soft tissue density and surround the aorta in front of the vertebra. They can only be visualized on a high abdominal cut (a cut right below the diaphragm)

Diaphragmatic crura



AORTA JUST ANT
TO VERTEBRAE.

Adrenal glands

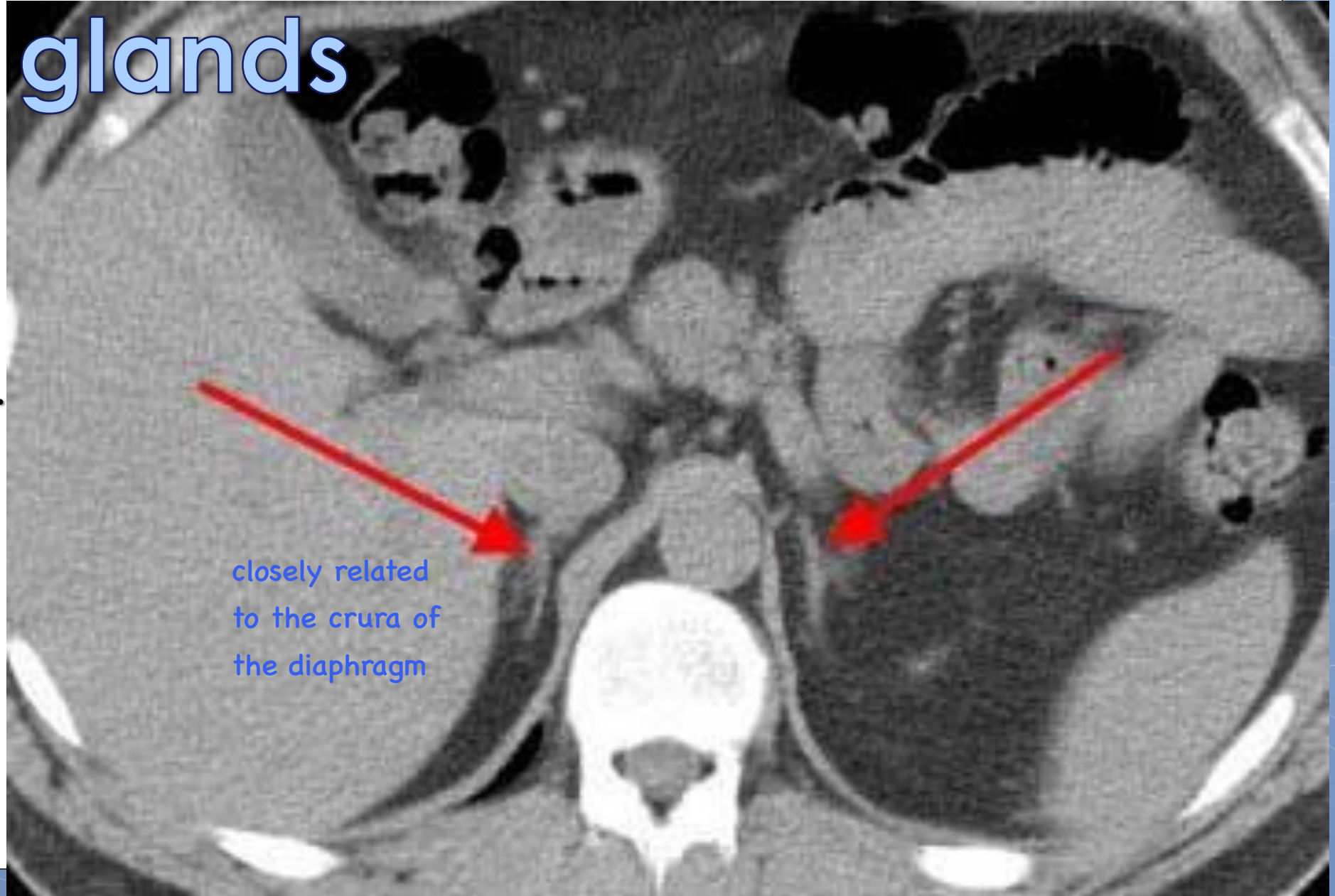
Axial abdominal CT scan
without IV or oral
contrast

-Hat shaped,
inverted Y shaped.

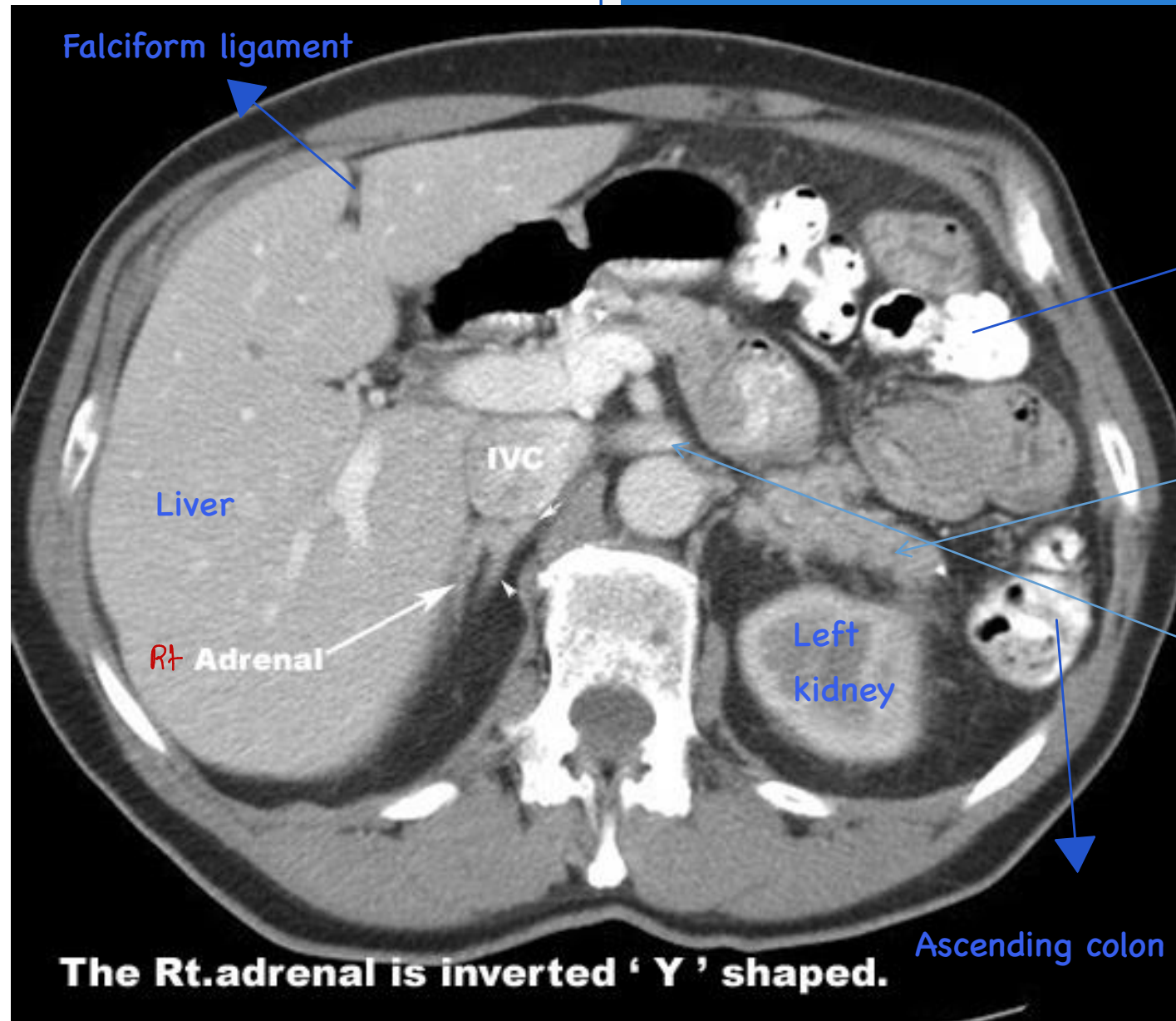
-Rt and Lt adrenals.

-Rt is superior to rt
kidney.

-It is anterior to the
upper pole of lt
kidney.



Axial abdominal CT
Scan with IV and
oral contrast



Falciform ligament

Liver

Rt Adrenal

IVC

Left
kidney

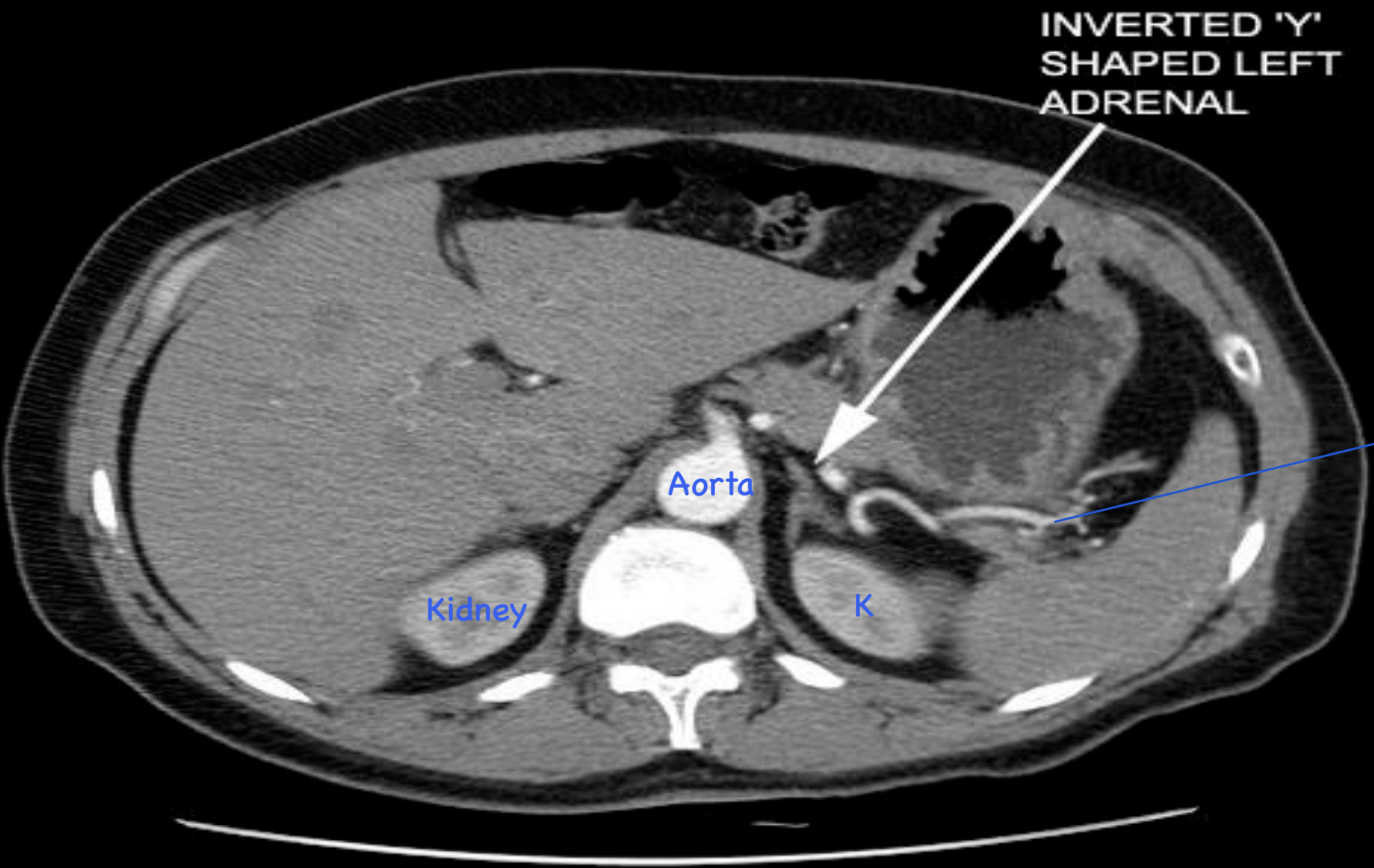
Ascending colon

Transeverse colon

Tail of pancreas

Left renal vein

with IV contrast, you
can see
corticomedullary
differentiation



▶ **Splenic artery= tortious + contrast density+ from aorta to spleen + above pancreas**

Important vessels

3 single branches of the abdominal aorta:

- Celiac trunk (T12,L1): LEFT GASTRIC, COMMON HEPATIC, SPLENIC
- SMA (L1)
- IMA (L3)

Celiac

Axial CT scan with IV contrast

T12, L1

Celiac trunk

Common hepatic duct



Seagull sign

Celiac



SMA

Celiac trunk

Gallbladder

pancreas

Stomach

Axial abdominal CT scan with IV and oral contrast

Spleen

Splenic artery

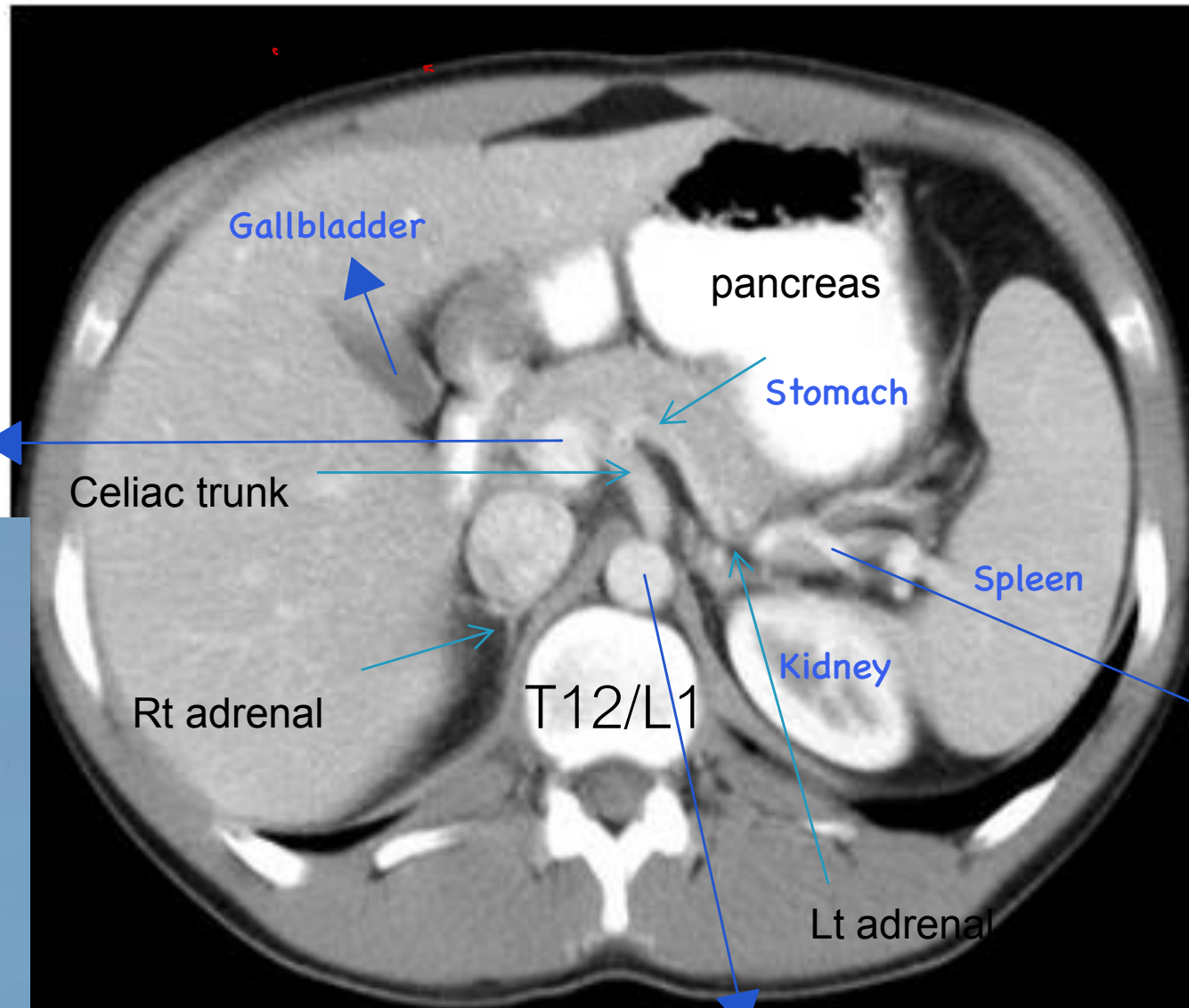
Kidney

Rt adrenal

T12/L1

Lt adrenal

Descending Aorta

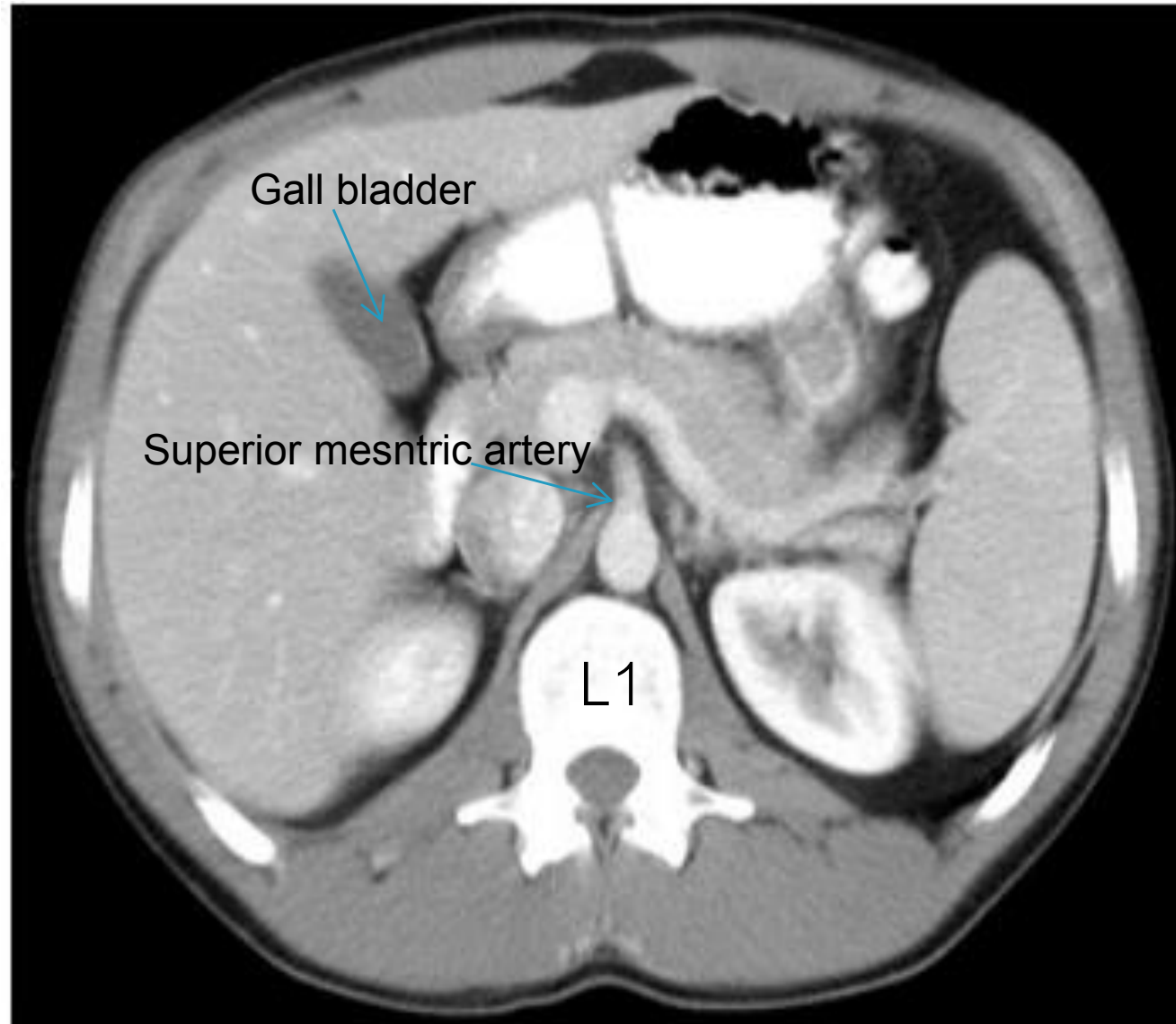


Seagull sign

SMA

Axial abdominal
CT scan with IV
and oral contrast

At level: L1



- LOOK AT THE LEVEL
- SEAGULL SIGN
- THE CONFLUENCE/THE SMV / SPLEENIC VEIN THIS IS SMA LEVEL.

How to differentiate between
SMA and Celiac trunk on CT
scan

Celiac trunk: It appears as a
clear continuous vessel

SMA it sometimes appears
with some dark area or gap

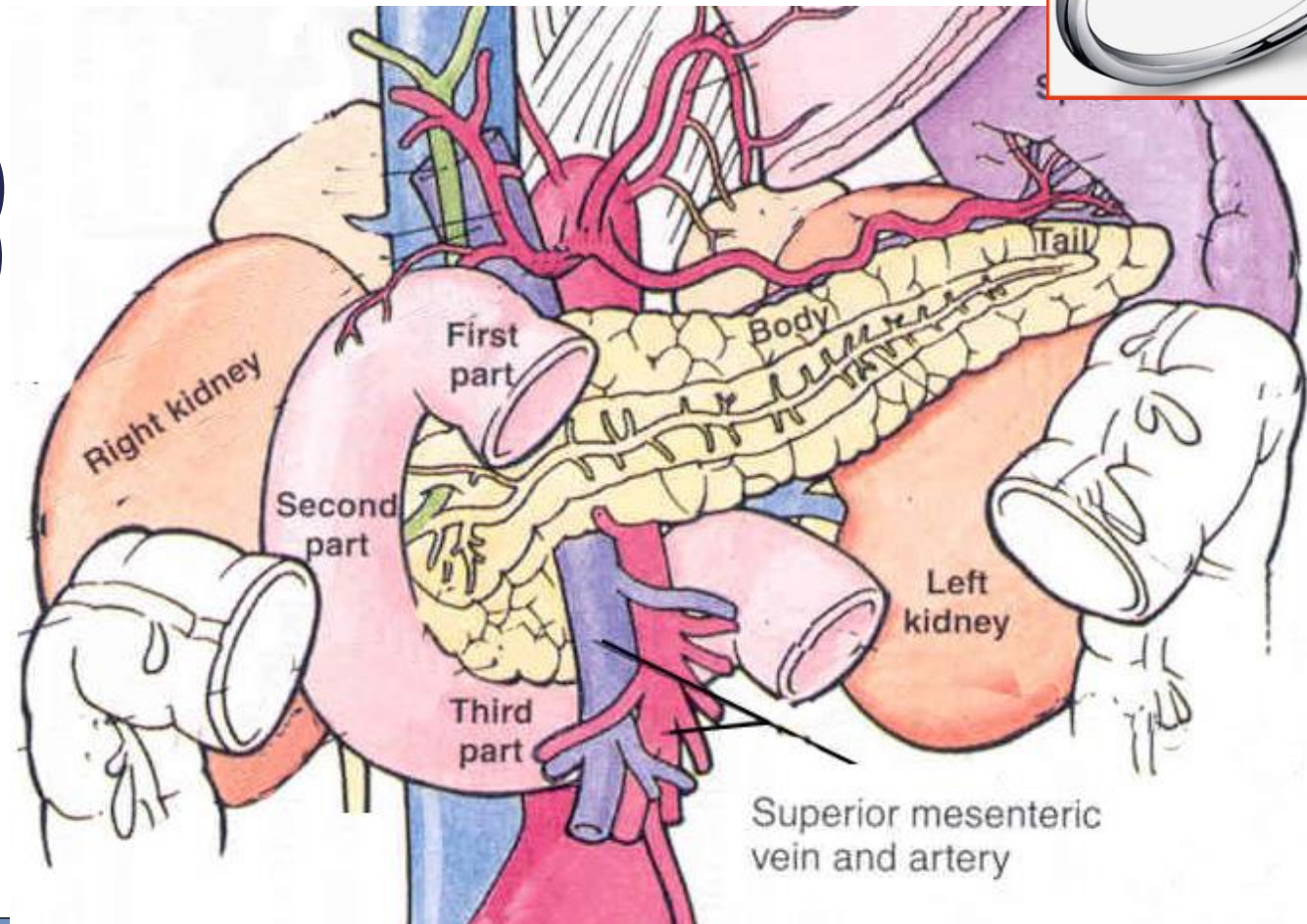
Signet ring sign



SM vessels :

head of pancreas(ant)
uncinate process(post)
2nd part of
deudenum(lat)

Vein to the right



PANCREAS

Region of the
Lesser sac

2nd part
Duodenum

St

PB

H

CBD

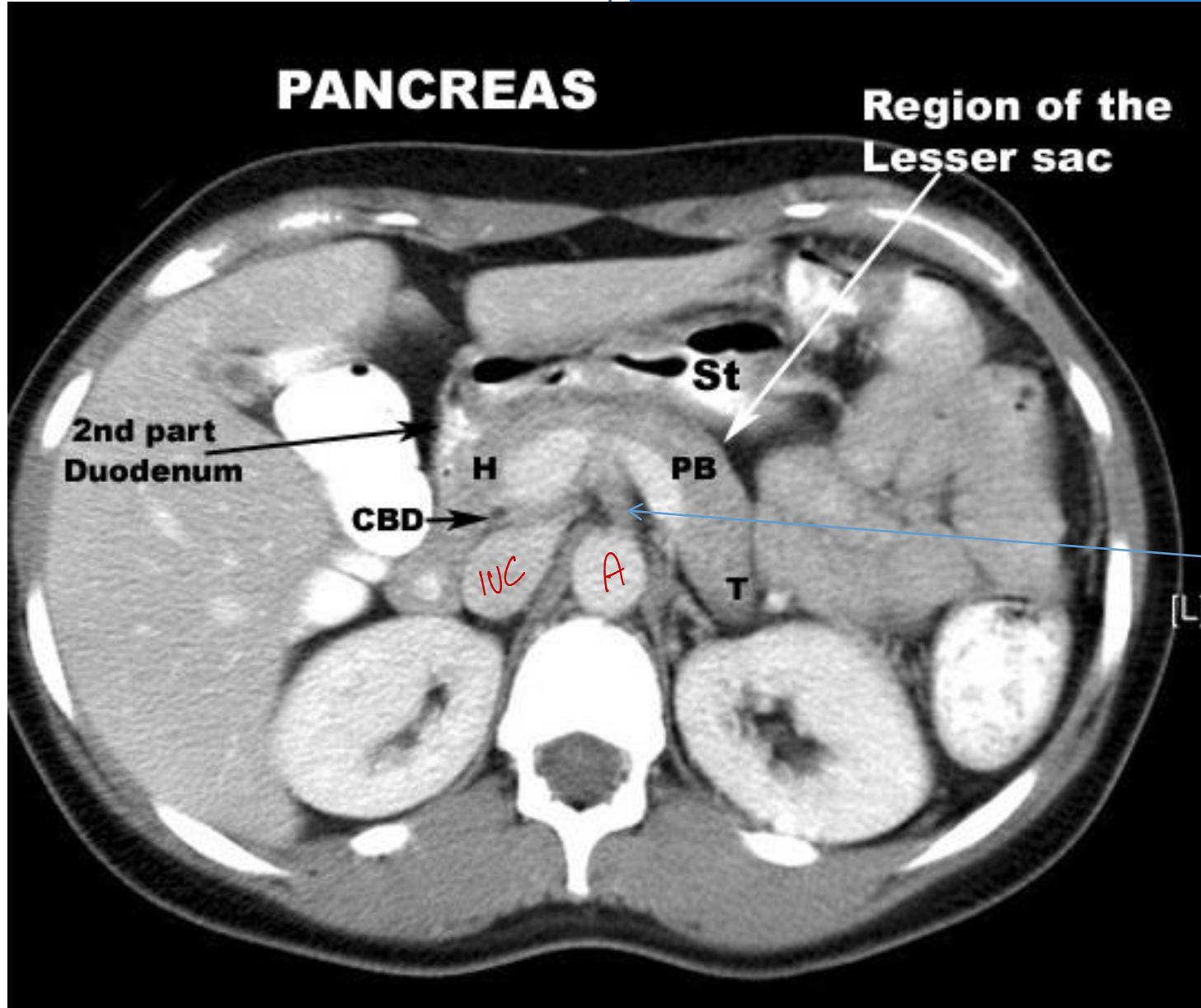
IVC

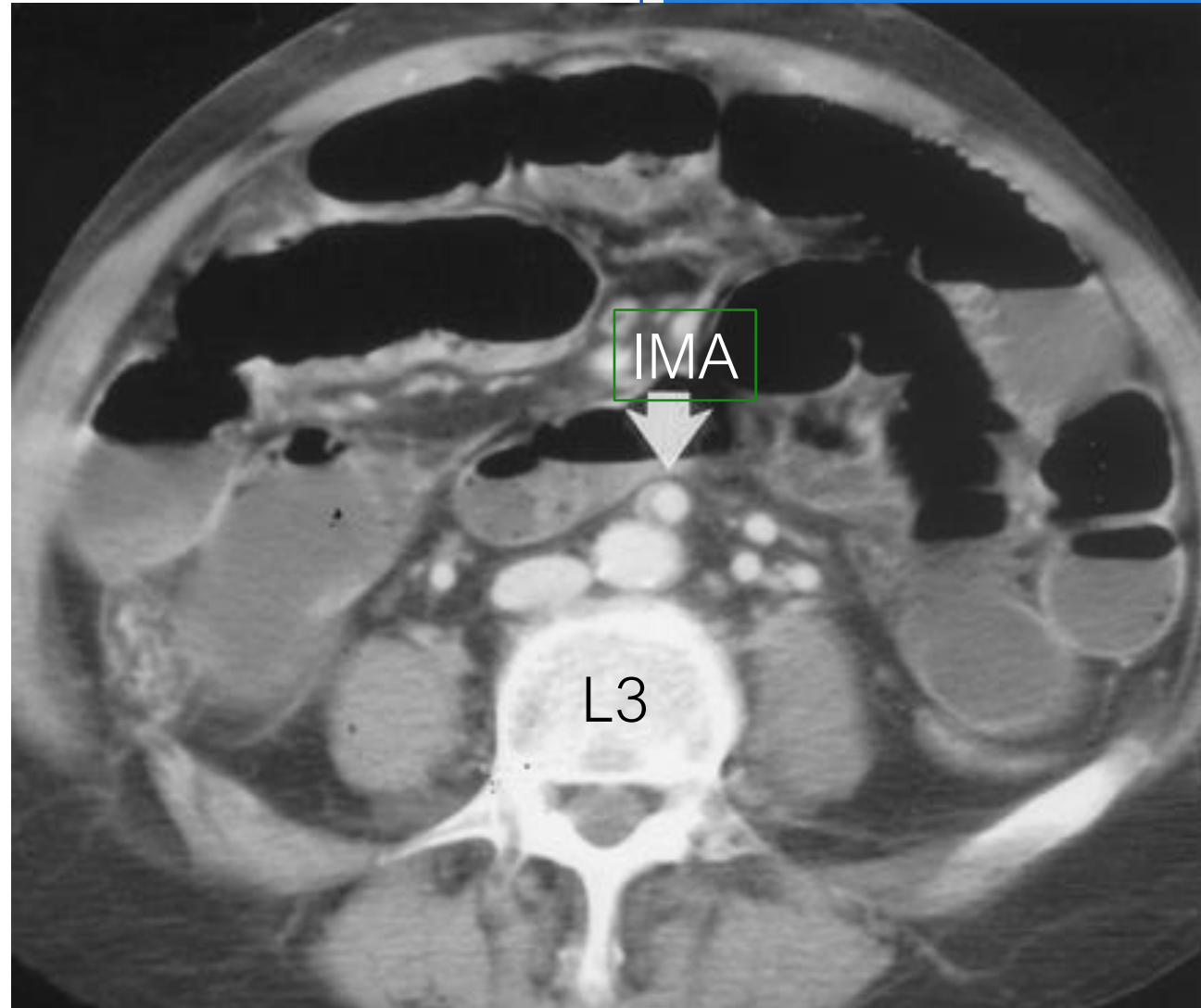
A

T

SMA

[L]

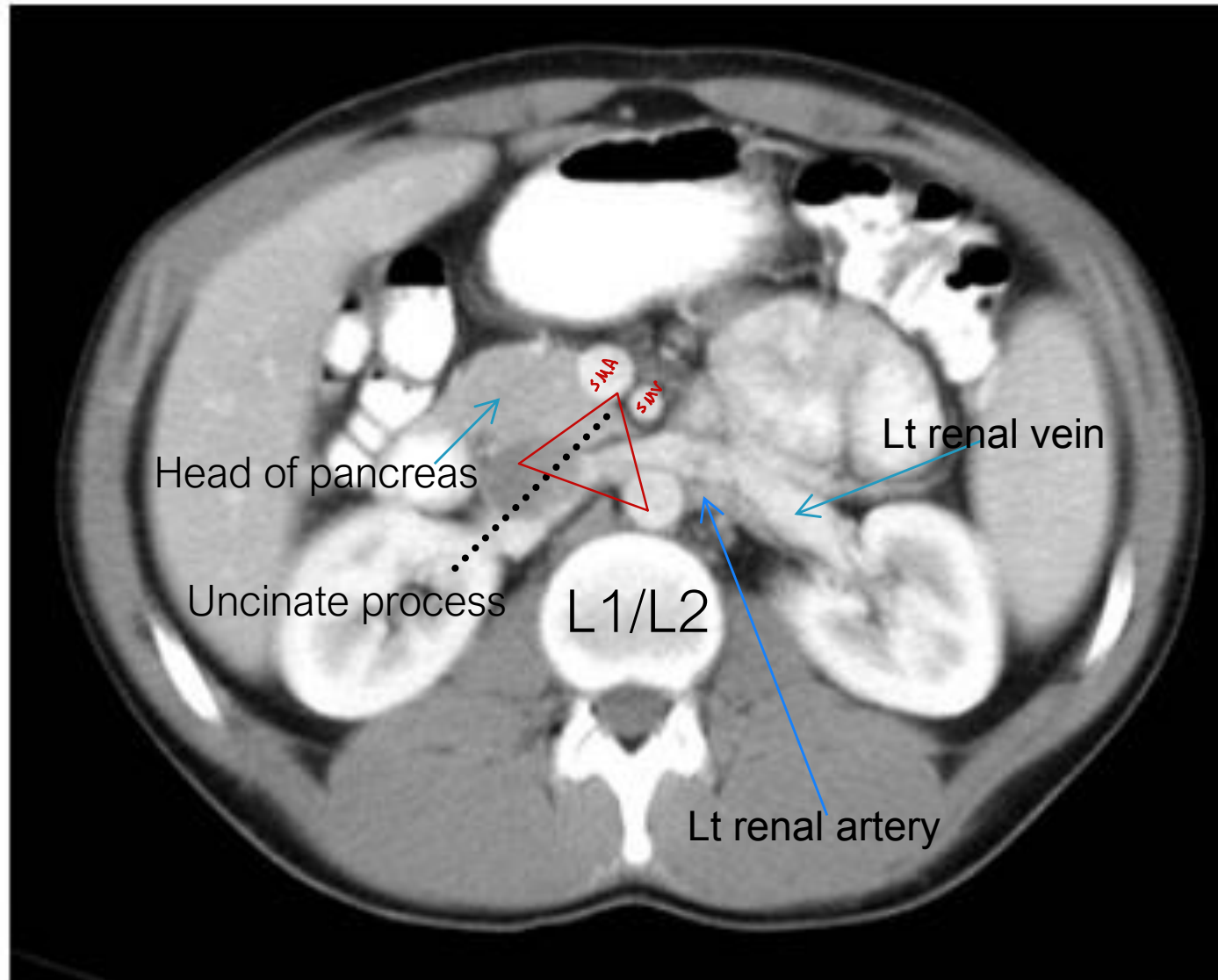




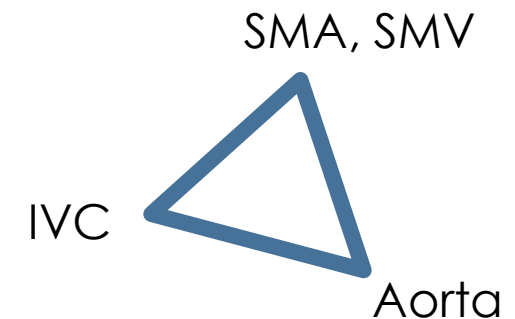
IMA:
Going to left with
all its branches.

Diffuse small-bowel ischemia in 60-year-old man with occlusive mesenteric ischemia. Axial CT scan obtained at level of inferior mesenteric artery (arrow) shows large caliber of this vessel. Long segment of small-bowel dilatation has minimal wall thickness of 1-2 mm.

Vascular triangle



- ~~8/~~ ~~8/~~
- BEHIND SM VESSELS:**
1. Uncinate process
 2. 3rd part of deudenum
 3. LEFT Renal vein



1. Superior Mesenteric Artery (SMA) Syndrome

Rapid weight loss → Loss of mesenteric fat → angle between SMA and abdominal aorta becomes too narrow → **SMA compresses the third part of the duodenum.**

Symptoms:

- Nausea, vomiting (especially after meals)
- Early satiety (feeling full quickly)
- Abdominal pain that improves when lying knee-chest or prone

CT finding:

- Obstruction at 3rd part of duodenum

2. Nutcracker Syndrome

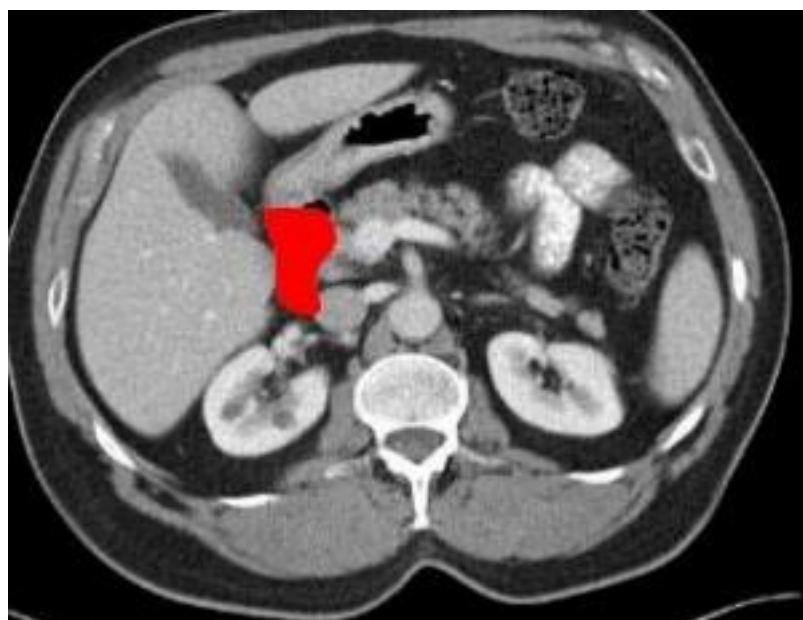
Loss of fat → narrowed aortomesenteric angle → **SMA compresses the left renal vein between SMA and abdominal aorta (like a nut in a nutcracker).**

Symptoms:

- Flank pain
- Hematuria (microscopic or visible)
- Pelvic congestion in females (pelvic pain, varicose veins)

CT findings:

- Narrowed LRV between SMA and aorta

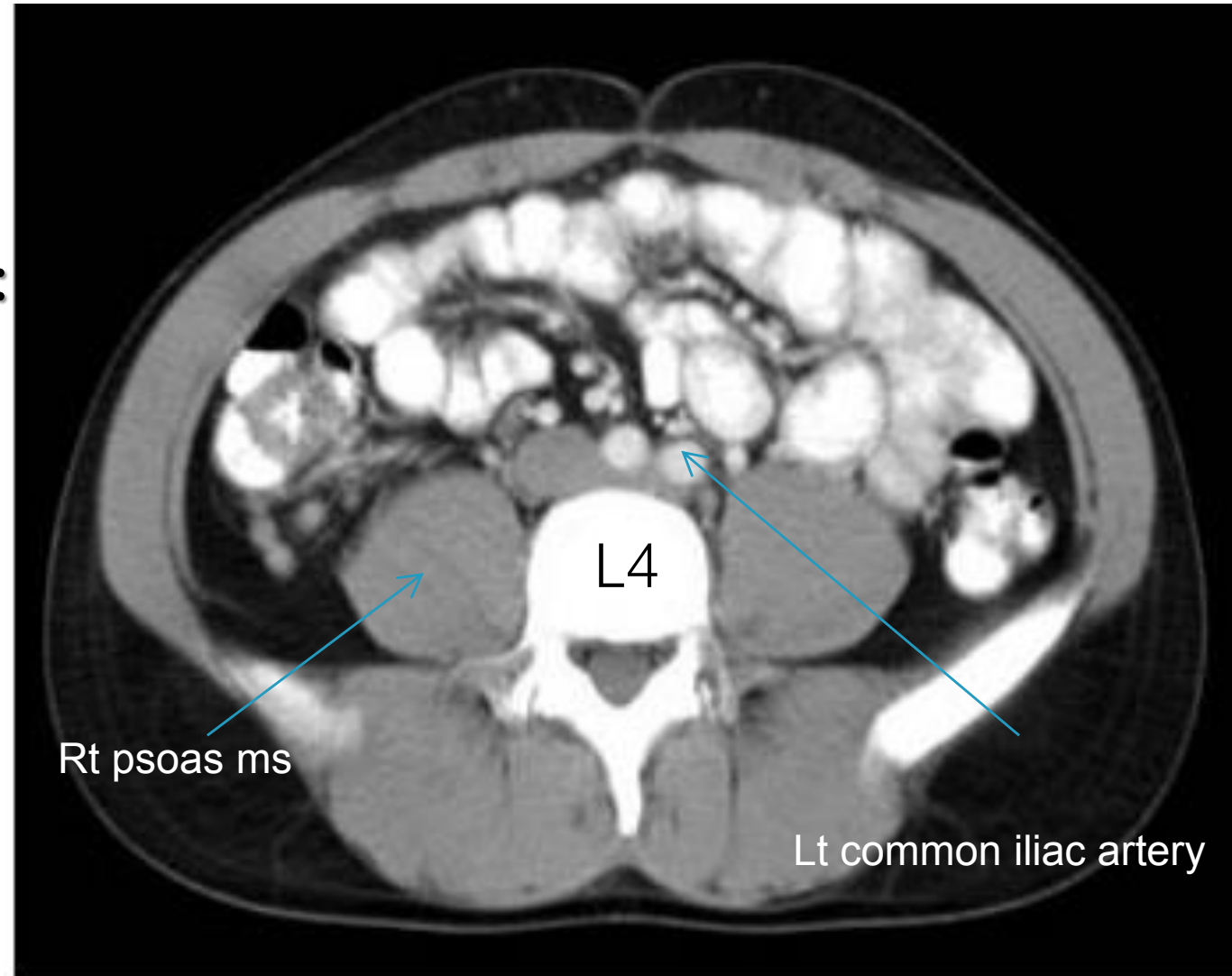


Duodenum

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**3 vessels at
the level of L4:
IVC
Right and left
common iliac
artery**

This is the only
abdominal CT section
where we can find
three vessels



3 vessels

sometimes on axial CT images, the psoas muscle can look like the kidney, especially if you're not paying attention to its location and shape.

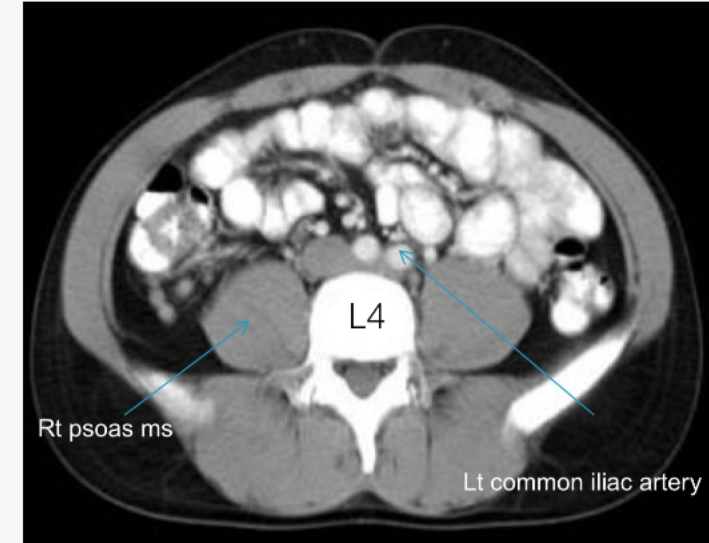
1. Psoas muscle

Origin: Comes from the transverse processes, bodies, and discs of the lumbar vertebrae (spinal column).

Appearance on CT:

- Oval or elongated soft-tissue density.
- Symmetrical on both sides.
- Seen extending down into the pelvis to join the iliacus muscle (forming iliopsoas).

Key point: It can extend into the pelvis, unlike the kidney.



2. Kidney

Location: Retroperitoneal, lateral to the psoas muscle, generally between T12–L3 vertebral levels.

Appearance on CT:

- Bean-shaped.
- Surrounded by a rim of fat (perinephric fat).
- Does not extend into the pelvis.

Simple rule to remember:

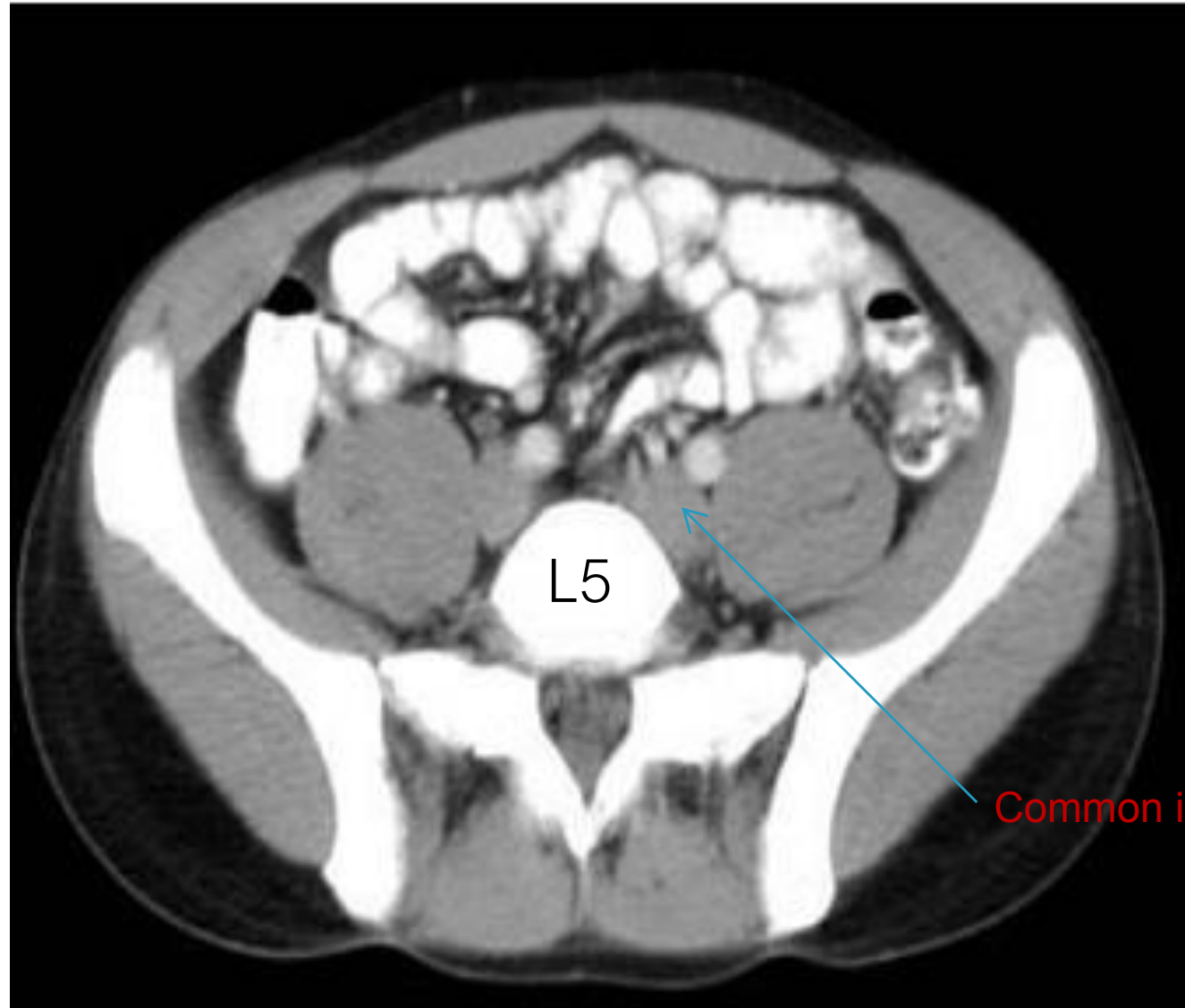
- Kidneys stay in the upper abdomen and have surrounding fat.
- Psoas muscles run from the spine into the pelvis and have no surrounding perinephric fat.



- **4 vessels at the level of L5 :
2 arteries and 2 veins**
- **Pelvic veins are post. To the arteries.**

At this level, the inferior vena cava is still not formed.

This is the only level where we can see 4 vessels.



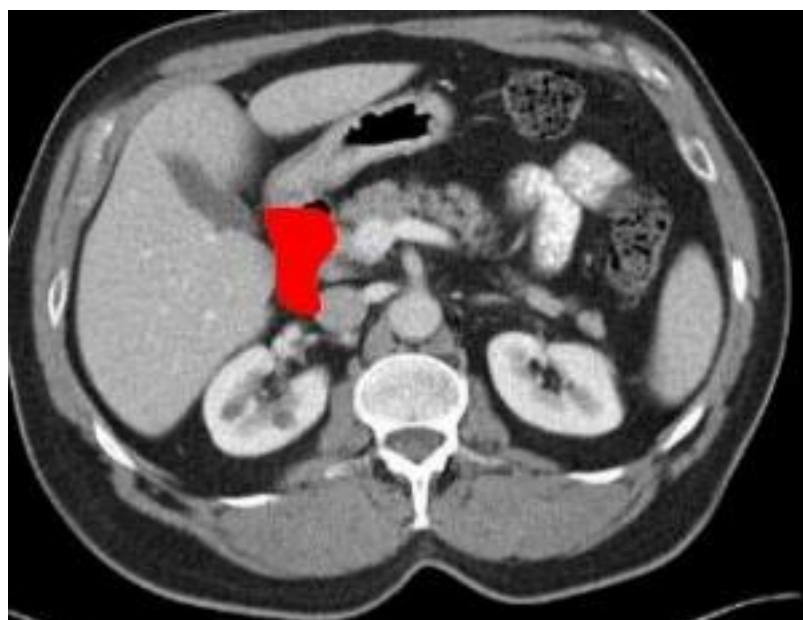
Artery is
Anterior

Common iliac vein It

Small and large bowel

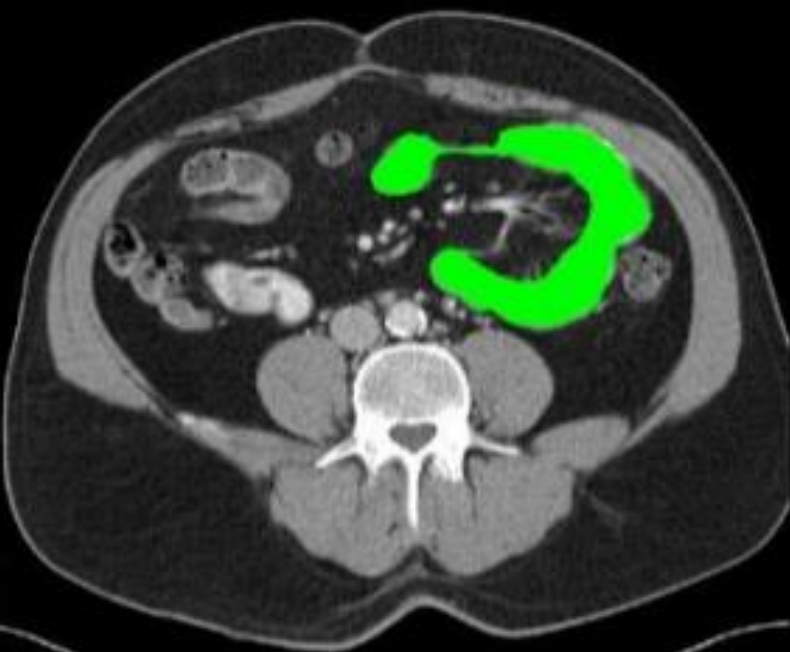
Small bowel : central , fluid content (succus entericus)

Large bowel : peripheral , feces and gas.



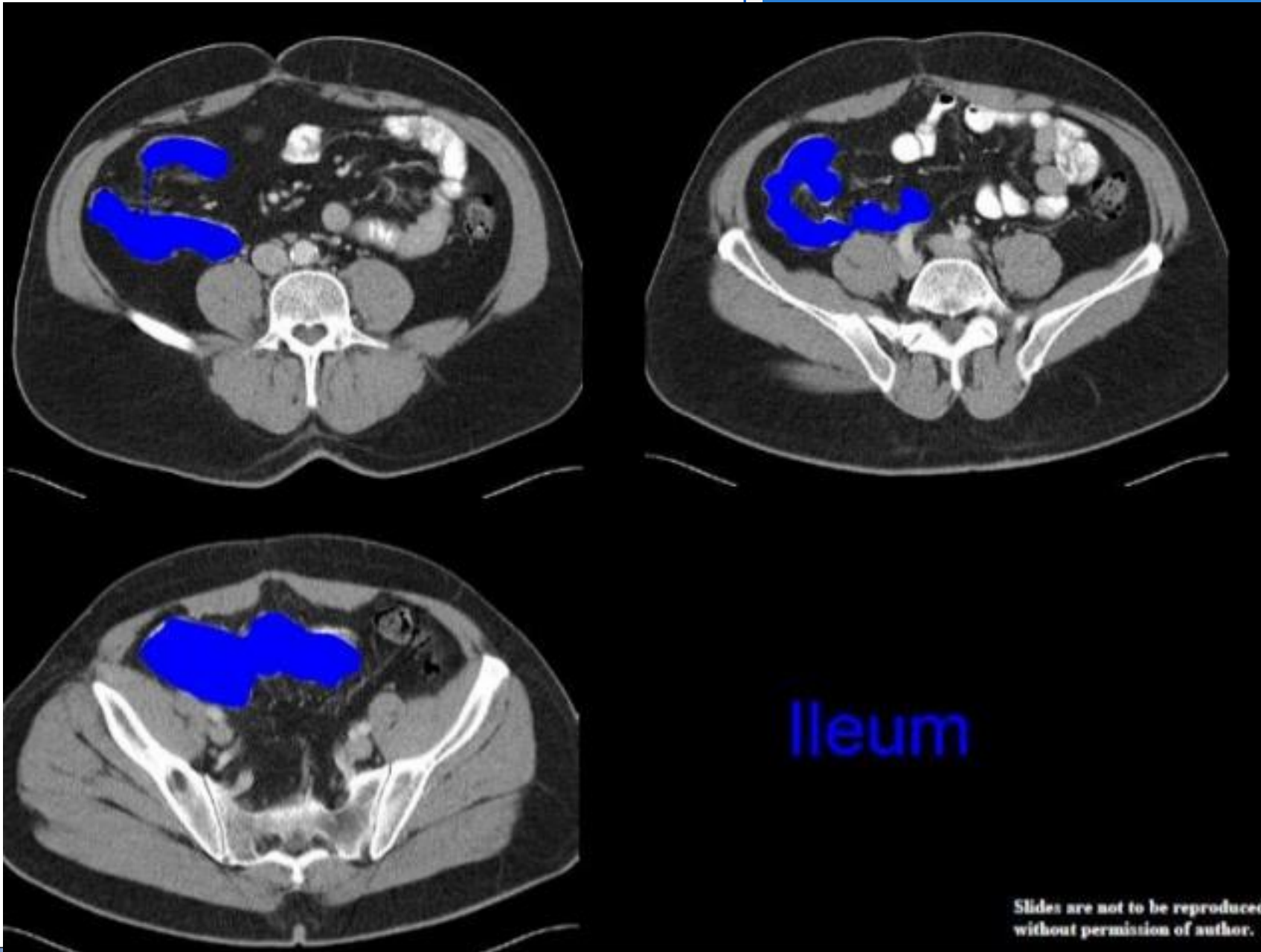
Duodenum

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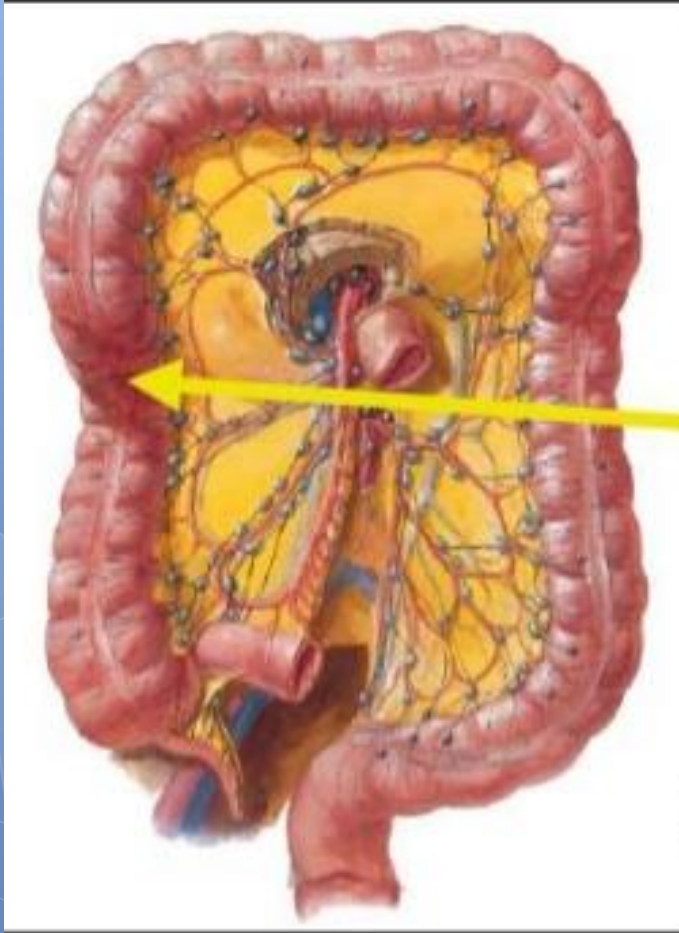
Jejunum

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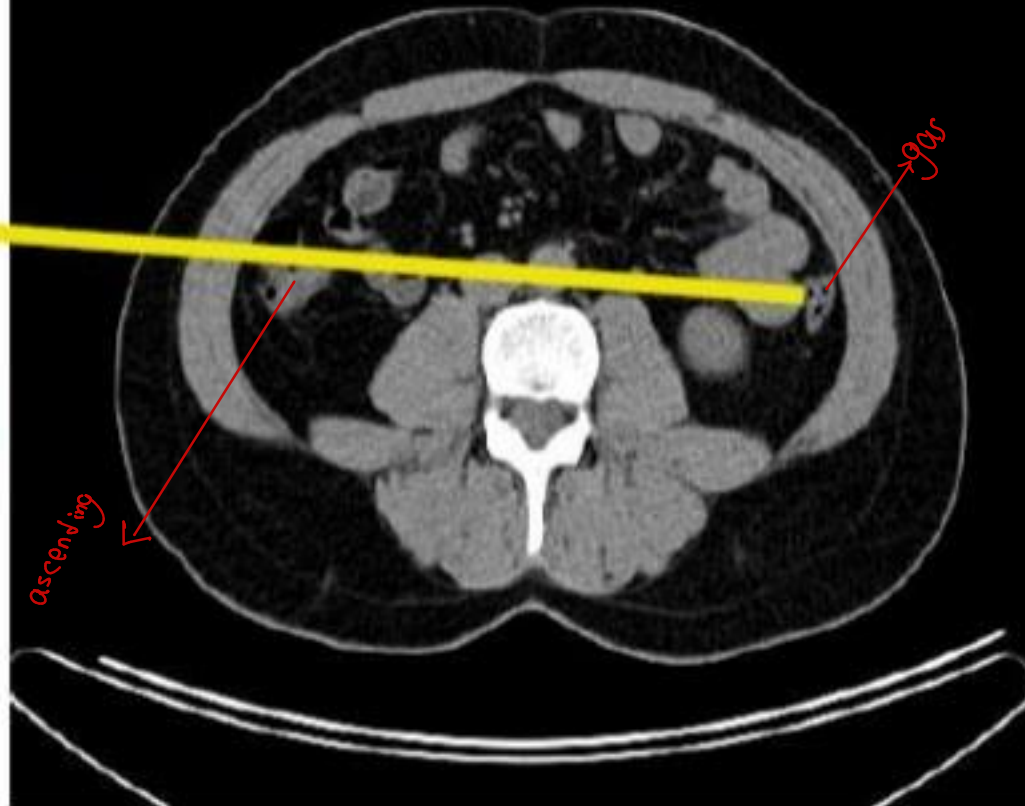
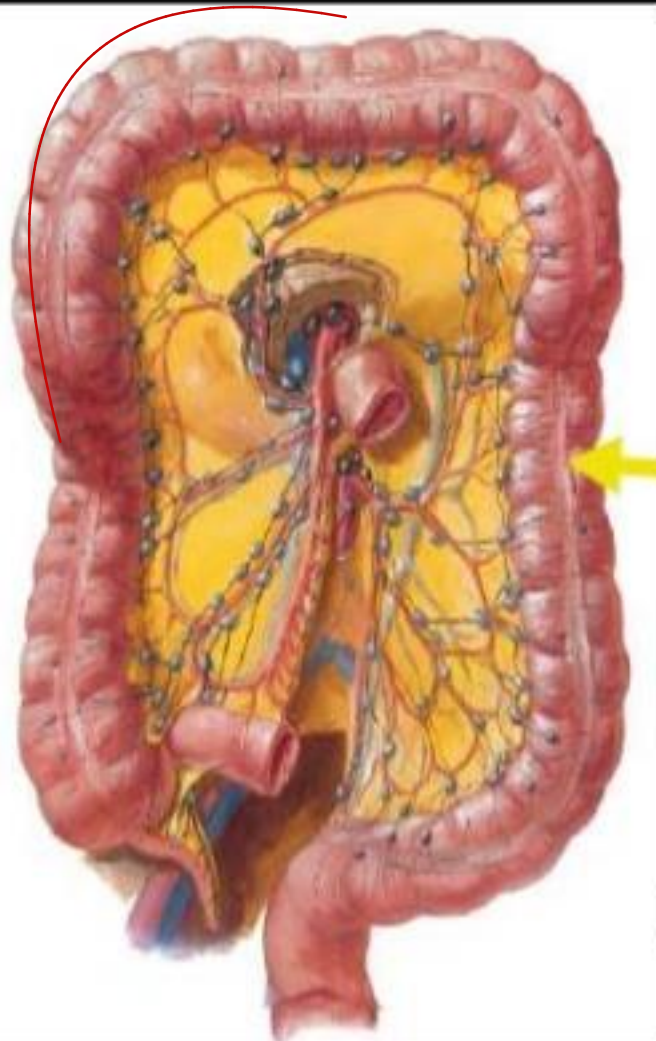


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Ascending Colon



Descending Colon

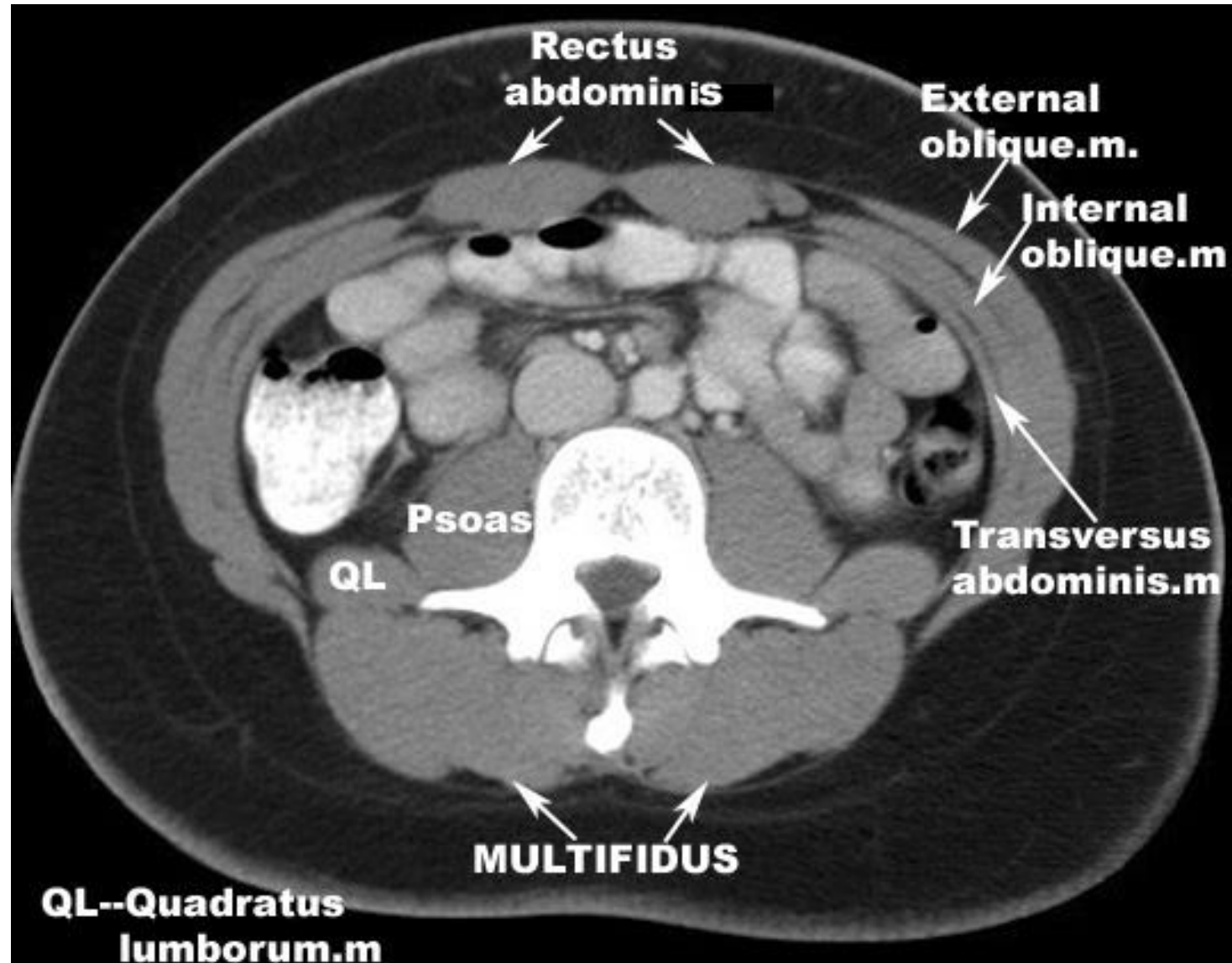


Abdominal muscles

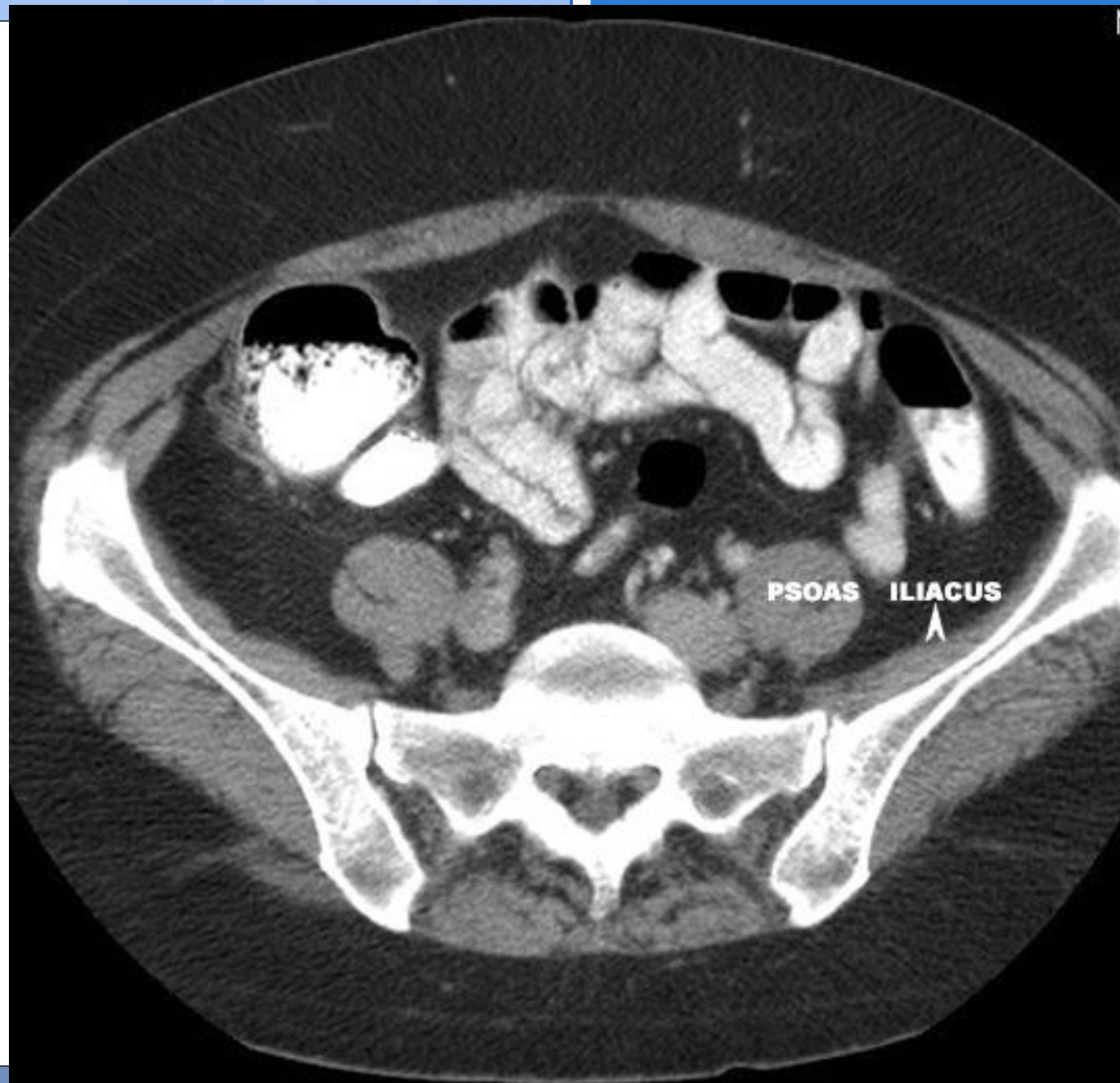
Important muscles in the abdominal area: (The obliques are separated by a thin line of fat; the line of fat looks hypodense)

- Rectus abdominus: anterior wall of the abdomen separated by linea alba
- Psoas muscle: on both sides of the spine
- External oblique muscle
- Internal oblique muscle
- Transversus abdominus Important muscles: psoas, rectus abdominus, external oblique, internal oblique, transversus abdominus.
- At the level of iliac bone: iliacus muscle on the internal aspect of the iliac bone

Abdominal muscles



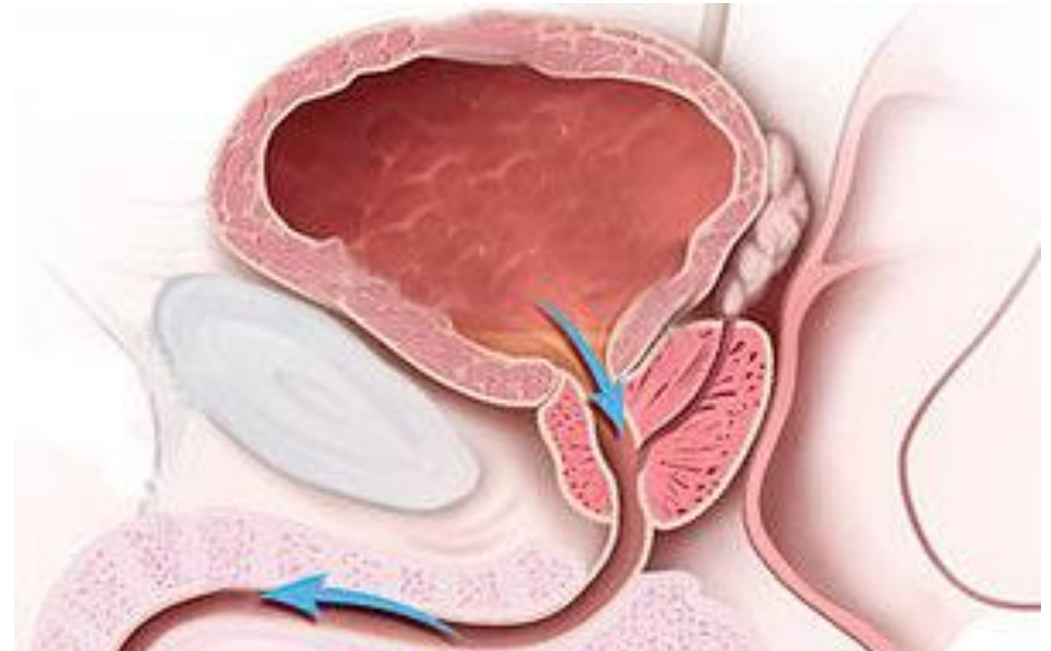
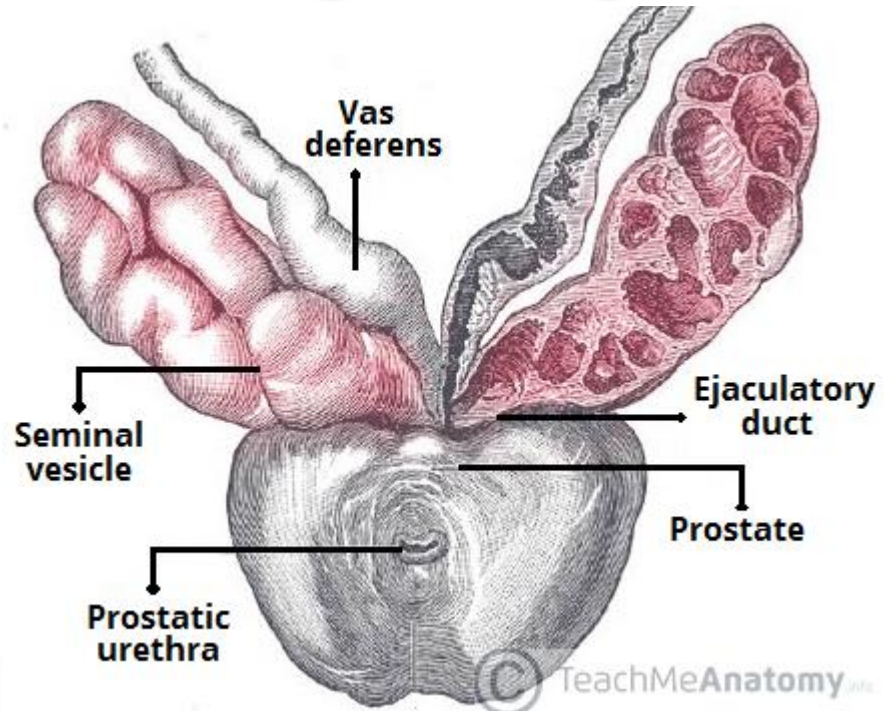
RIGHT
VS
LEFT



The Female Pelvis



The male Pelvis



Pelvis:

1. Female pelvis:

The most anterior structure is the urinary bladder; the structure has a fluid like density with a thin wall

The uterus:

- It is located superior to the bladder
- The cervix lies posterior to the bladder.
- The uterus appears as a hyperdense structure with a small triangular hypodensity marking the endometrial cavity)
- The ovaries are located on both sides of the uterus in a nulliparous woman. However, in a multiparous woman, the location of the ovaries might differ.
- If a section shows the urinary bladder, the uterus, and the cervix; the cut is a very low cut.

The most posterior structure is the rectum, which lies anterior to the coccyx.

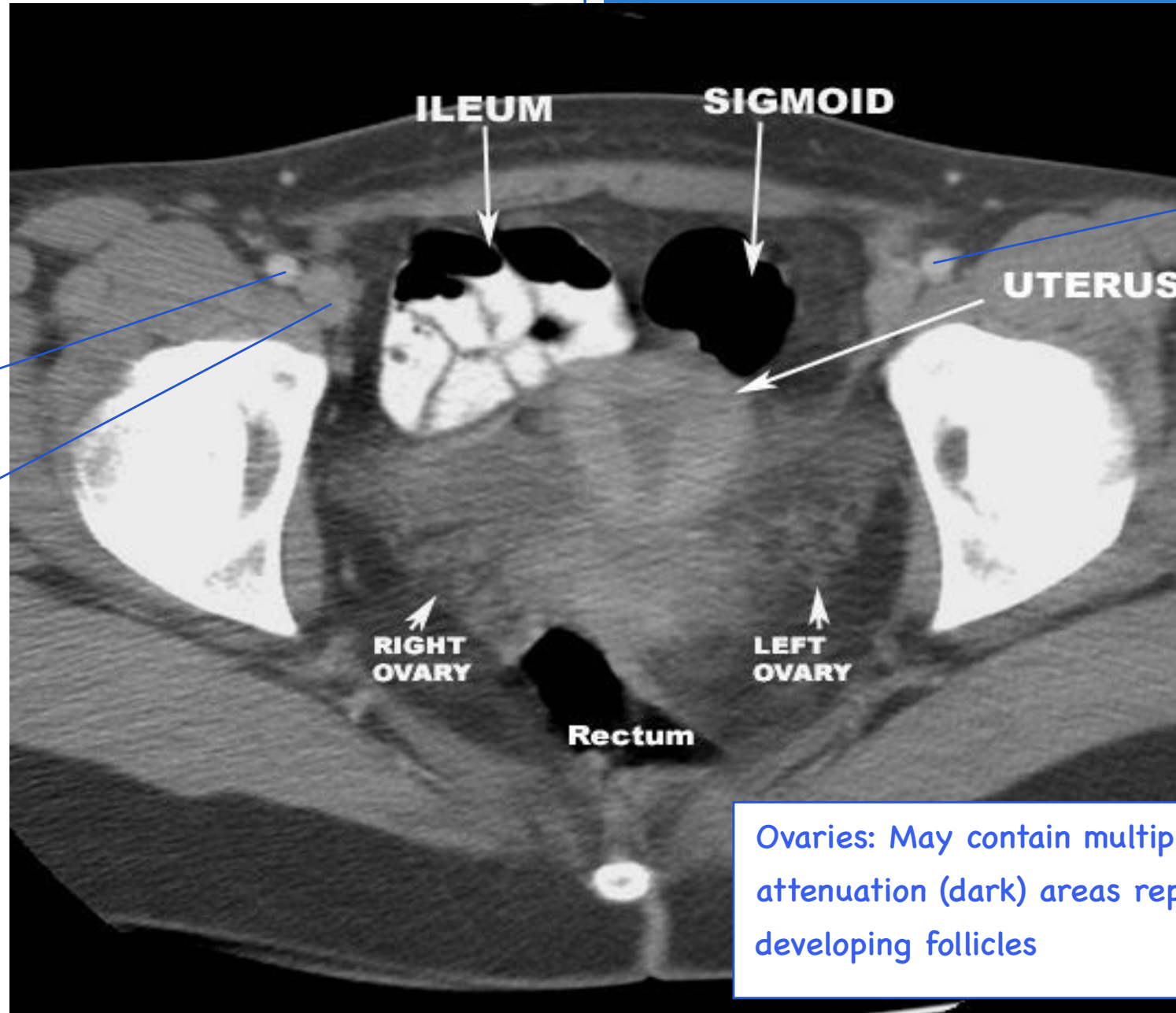
2. Male pelvis:

- Urinary bladder most anterior structure
- Rectum lies behind the urinary bladder
- The prostate lies inferior to the urinary bladder
- In a male, we can visualize the seminal vesicles; The seminal vesicles appear as cystic like structures (In the upper cuts, they have soft tissue density); they look like a moustache on CT scan.

Axial abdominal
and pelvic CT
scan with oral
and IV contrast

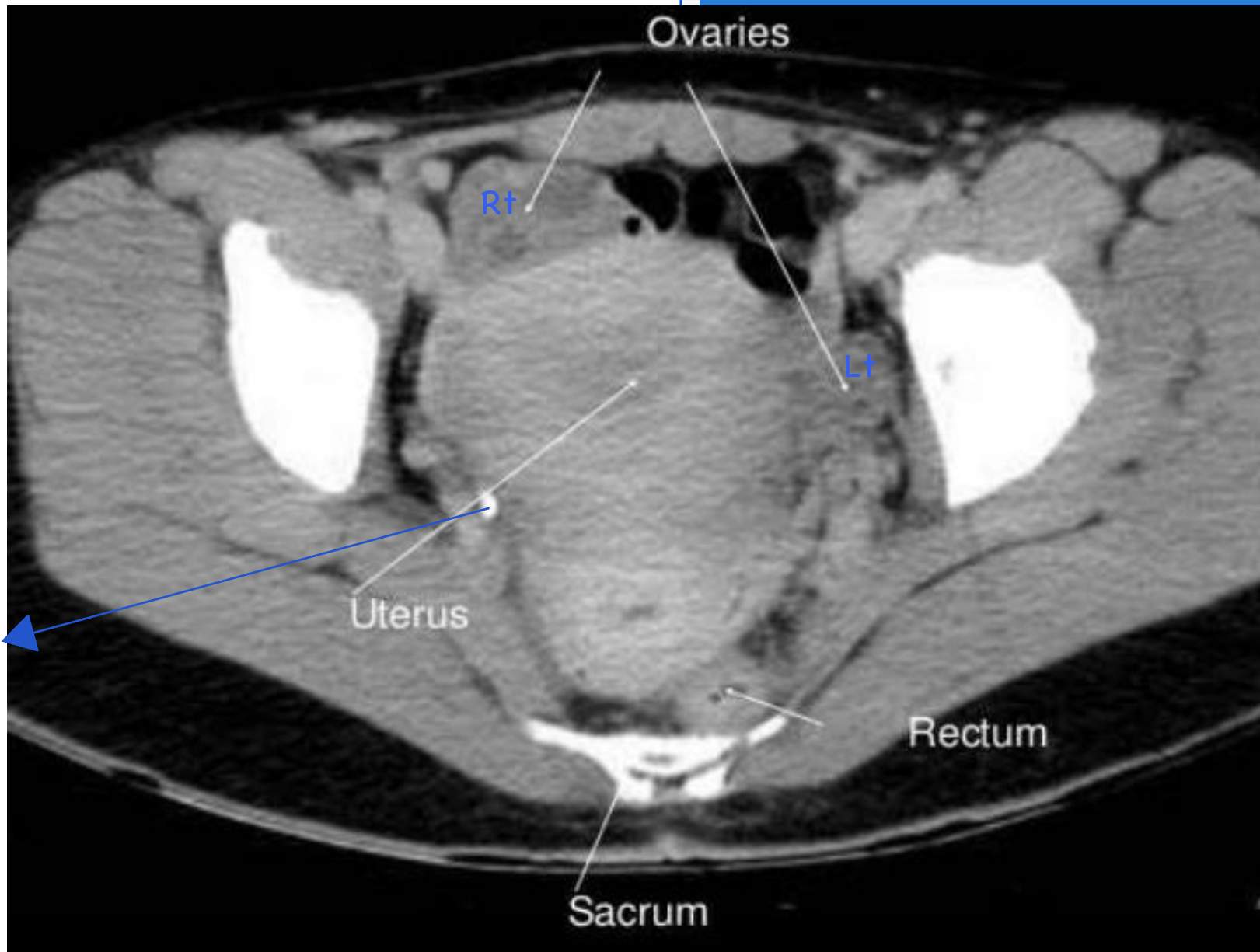
Right external
iliac artery

Right external
iliac vein



Left external
iliac artery

Ovaries: May contain multiple small, low-attenuation (dark) areas representing developing follicles

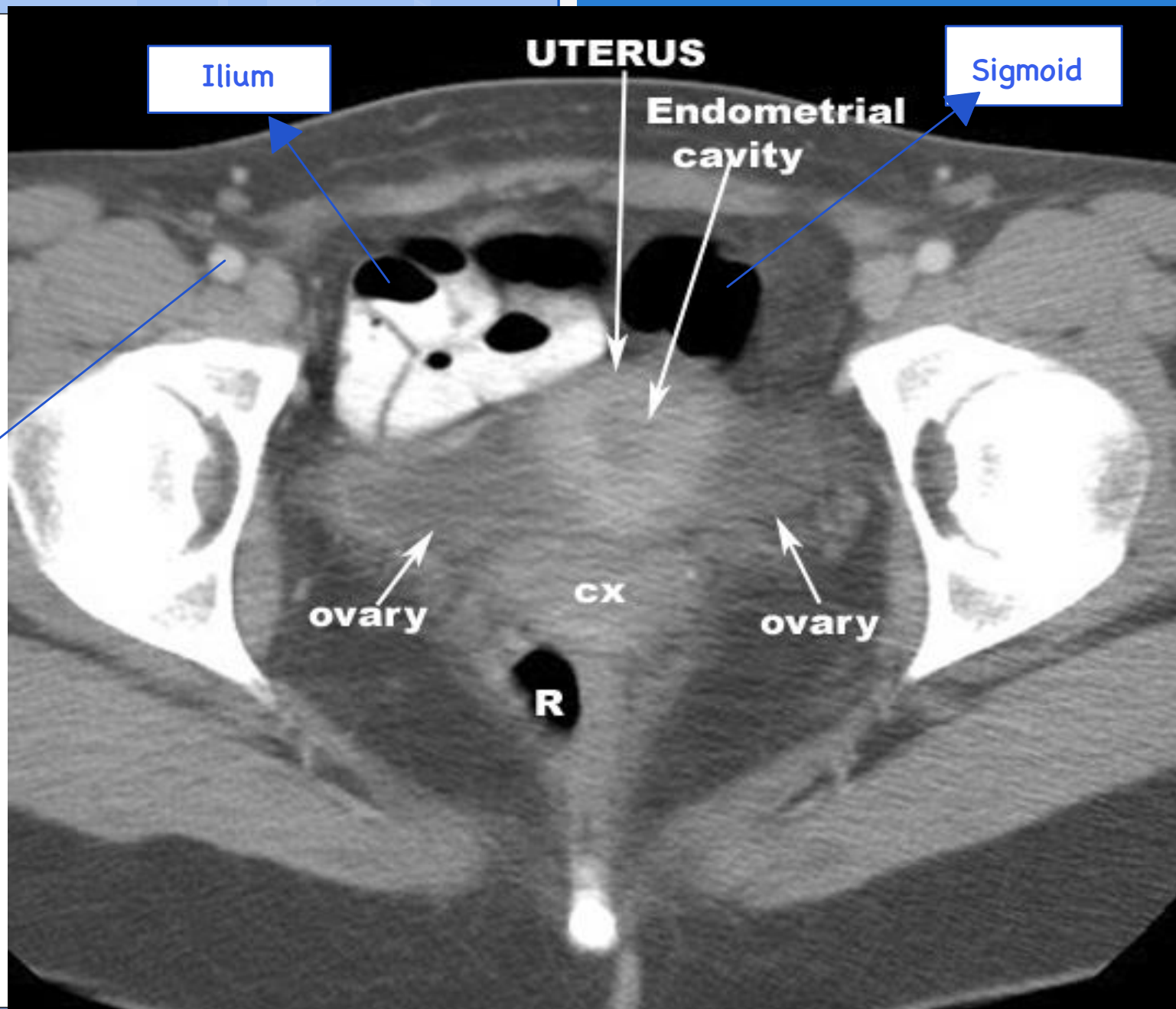


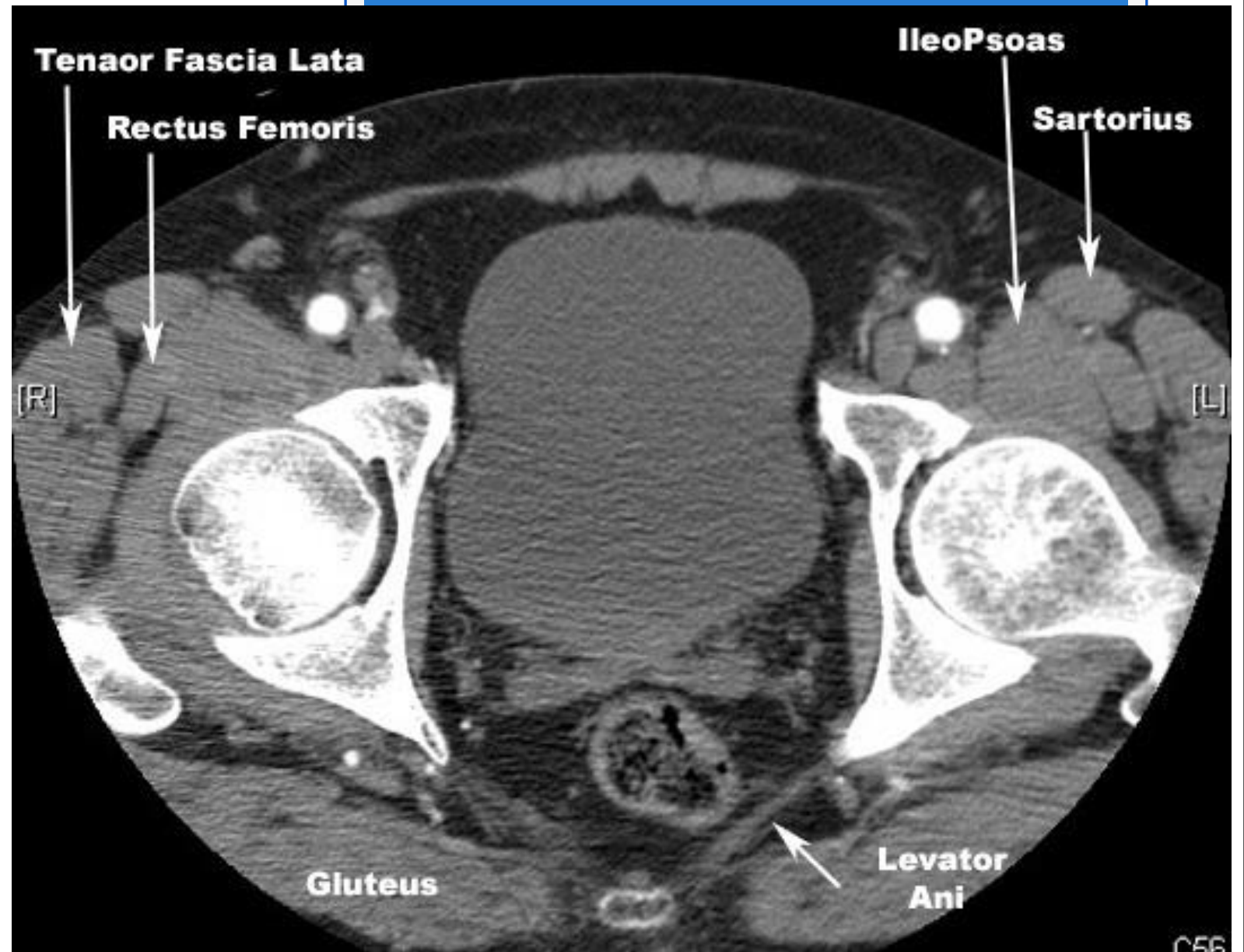
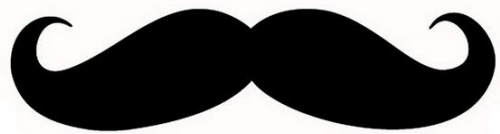
Axial CT scan of the abdomen and pelvis without IV and oral contrast

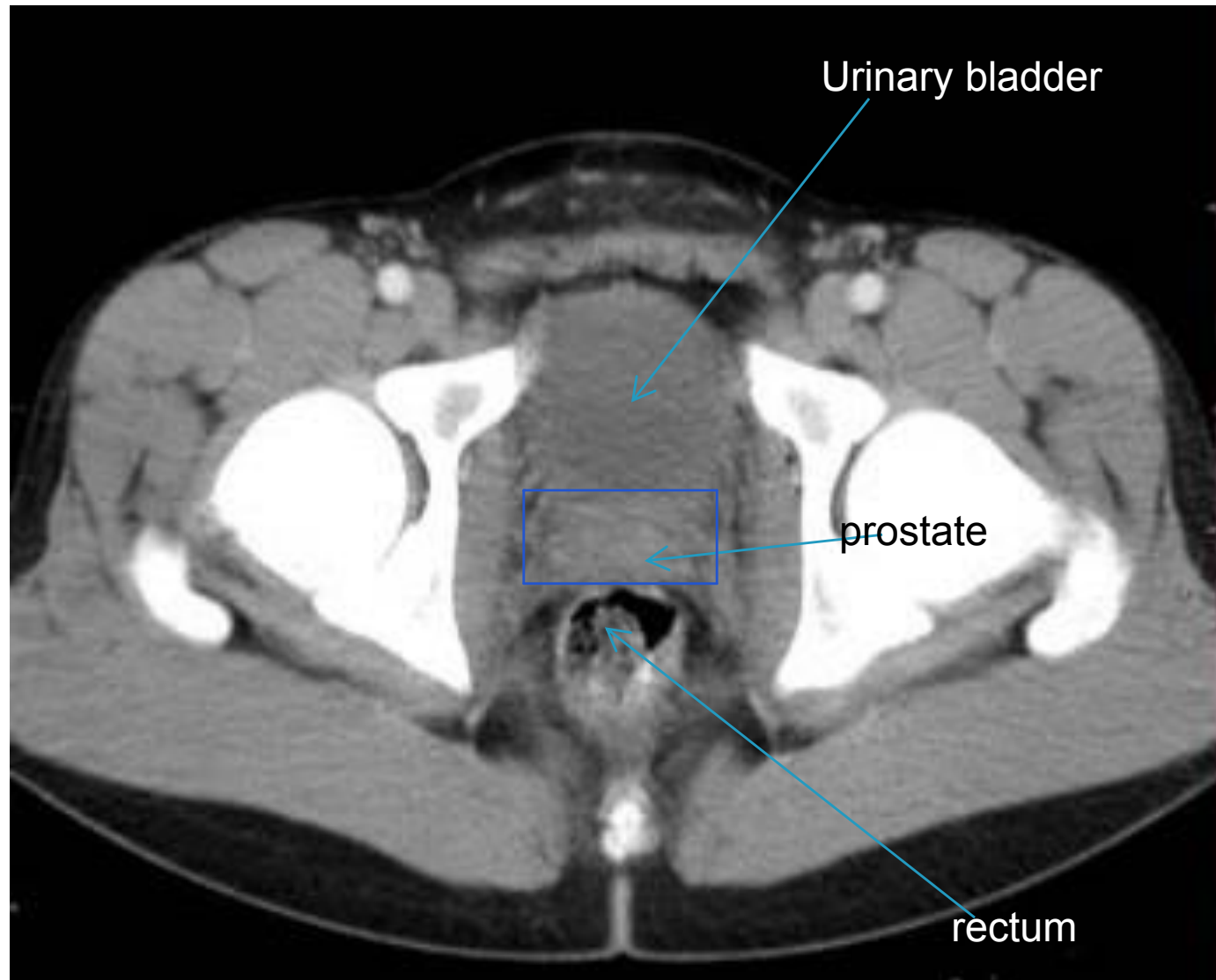
Calcifications

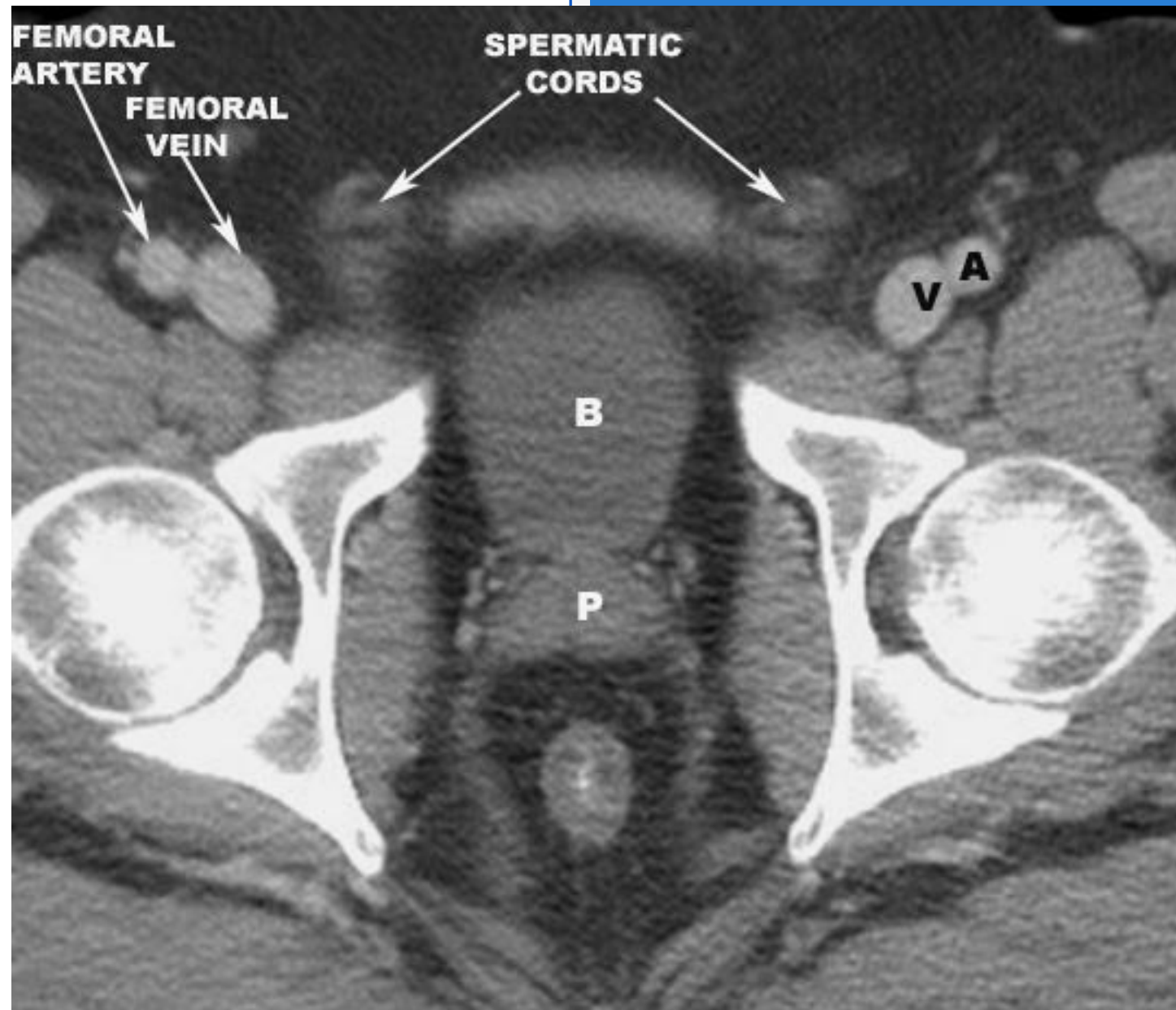
Axial abdominal and pelvic CT scan with IV contrast

Rt external iliac artery

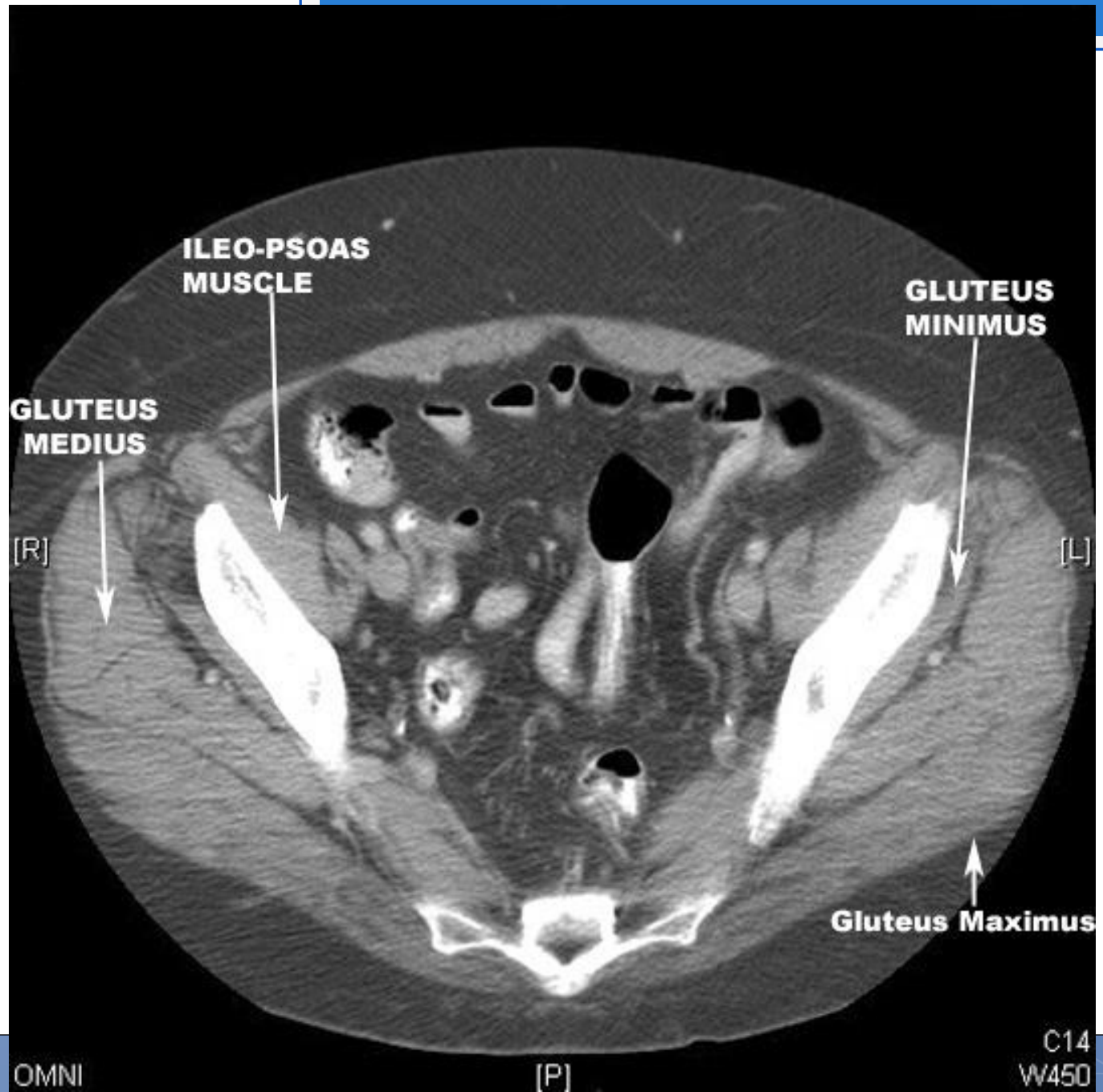


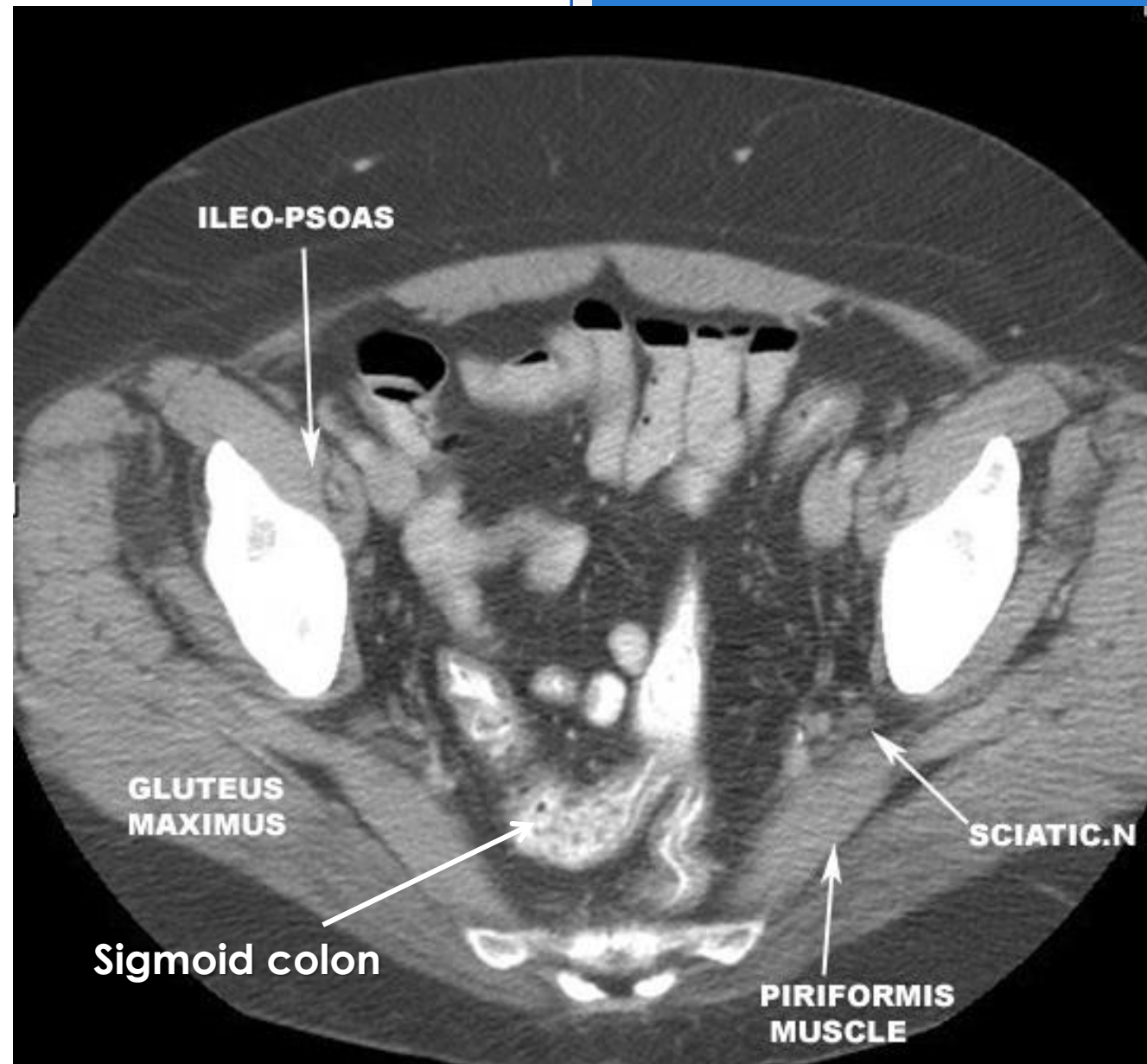


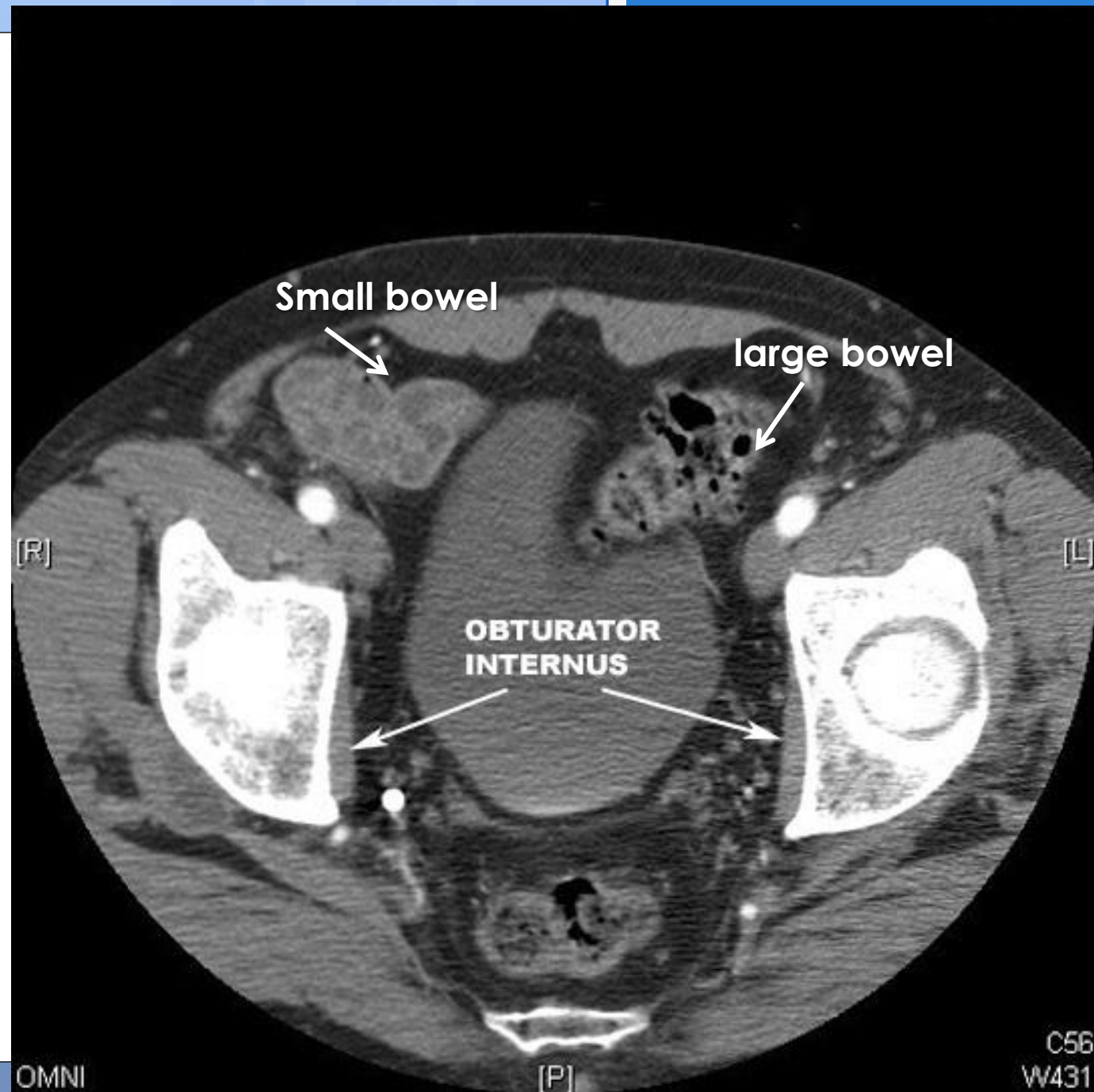




Pelvic muscles









GIS PATHOLOGY

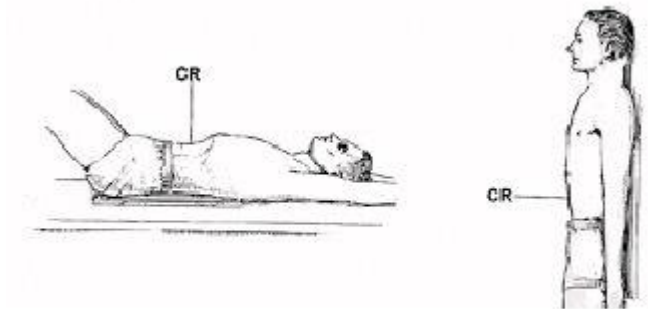
**PLAIN FILMS ...
FLUOROSCOPY**



How to look at an abdominal X-ray

The initial inspection of any X-ray begins with a technical assessment. Establishment of the “**name, date, age and sex** of the patient at the outset is crucial”

Virtually every abdominal X-ray is an AP film, but these are occasionally accompanied by erect or even **decubitus views** (also APs). Usually the radiographer will **mark** the film with a badge or write on it by hand ‘**Supine**’ or ‘Erect’ to guide you, so seek this out and use it.



Standard AP supine and upright abdominal patient position. Image courtesy of Dr. Naveed Ahmad.

AP SUPINE AND ERECT

From dossier:

1. General notes when reading a plain abdominal X-ray:

- When we look at a plain film, we need to comment on the age, gender, name, and date of the image.
- Unless otherwise indicated, abdominal X-rays are AP films. In some cases, we might require a supine, decubitus, or erect PA view.
- On an X-ray, there are 5 main densities; however, we only care about 2 of them. Bone looks white, and gas looks black. Other structures and tissues have varying opacities.

2. Systematic interpretation of an X-ray:

1. **Gas distribution** → The presence of a gas bubble below the diaphragm at the fundus on the stomach is normal. Gas can be present in the large bowel, especially along the transverse colon and rectum.
2. Then, look at the **position of the intestinal loops** (large and small intestines)
3. Then, look at the **diameter of the loops** to detect obstruction; the intestines will be dilated proximal to the obstruction and collapsed distal to the obstruction.

3. Differentiating between small and large bowel on an abdominal X-ray:

- The large bowels are located peripherally while the small bowels are located centrally
- The size of the bowel: we accept up to 3cm diameter of small intestines, 6cm for large intestines, and 9cm for the cecum
- Content: the large bowel contains fecal material and air; the small bowel contain fluid (succusentericus)
- Shape of wall: the large bowels have haustrations (the haustrations are separated by plicae semi-lunaris). Plicae semilunaris are circular smooth muscles that do not encircle the whole intestinal wall. The small intestines have a full ring of smooth muscles surrounding them. This ring is called valvulae connatae.

It is worth knowing that only **five basic densities** are normally present on X-rays, which appear thus:

Gas - black

Fat - dark grey

Soft tissue/fluid - light grey

Bone/calcification - white

Metal – intense white

N.B: Always check left and right on every film, consciously and routinely –especially just before surgical operations.



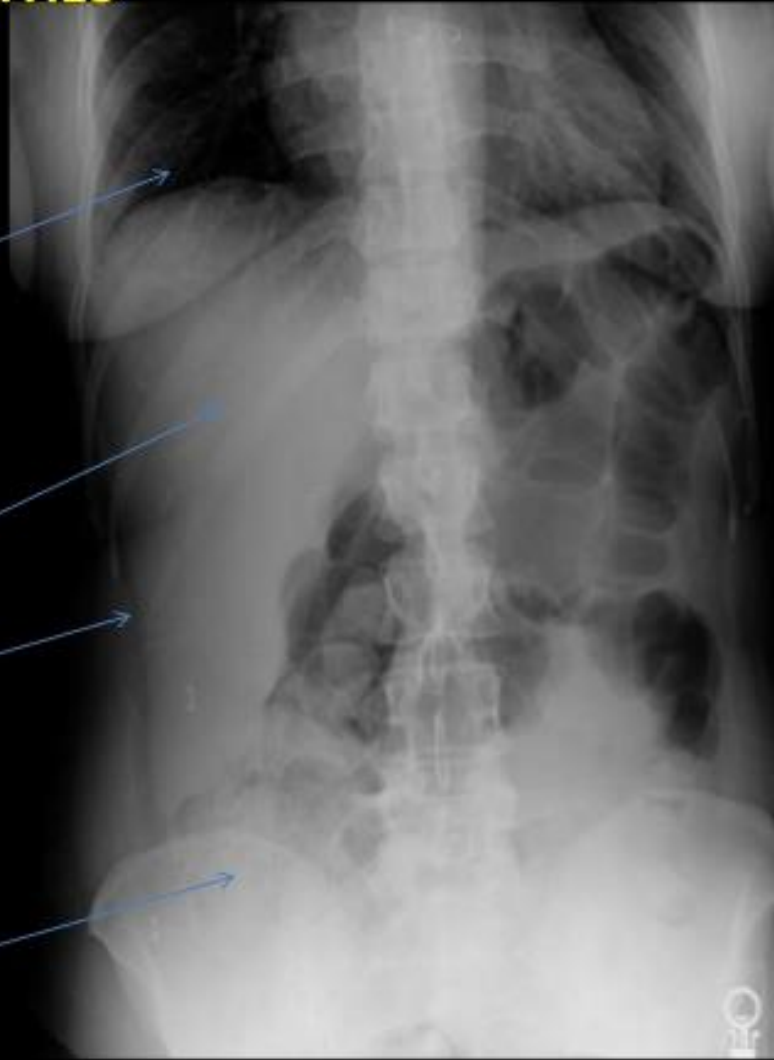
X - RAY --- FOUR BASIC DENSITIES

Air.

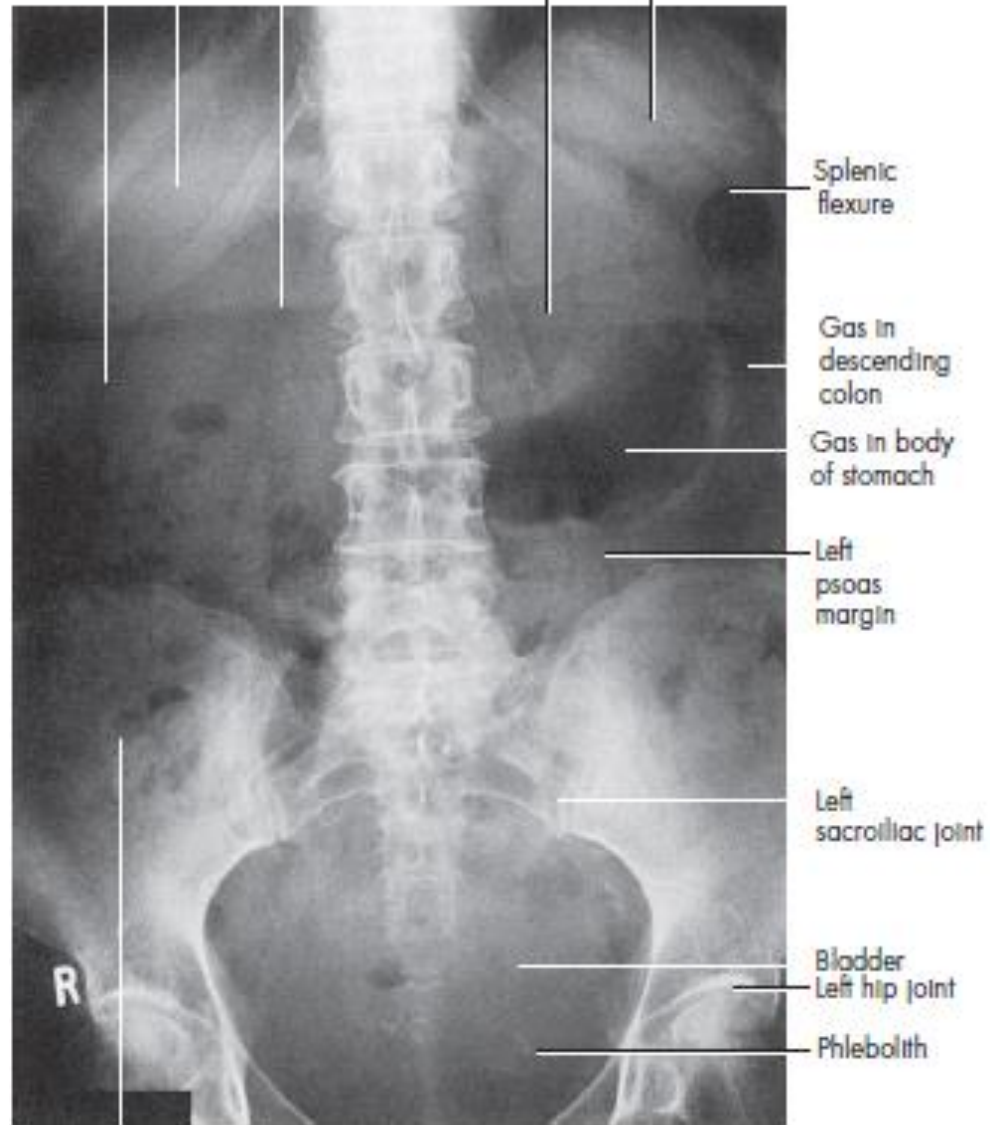
Soft tissue.

Fat.

Bone.

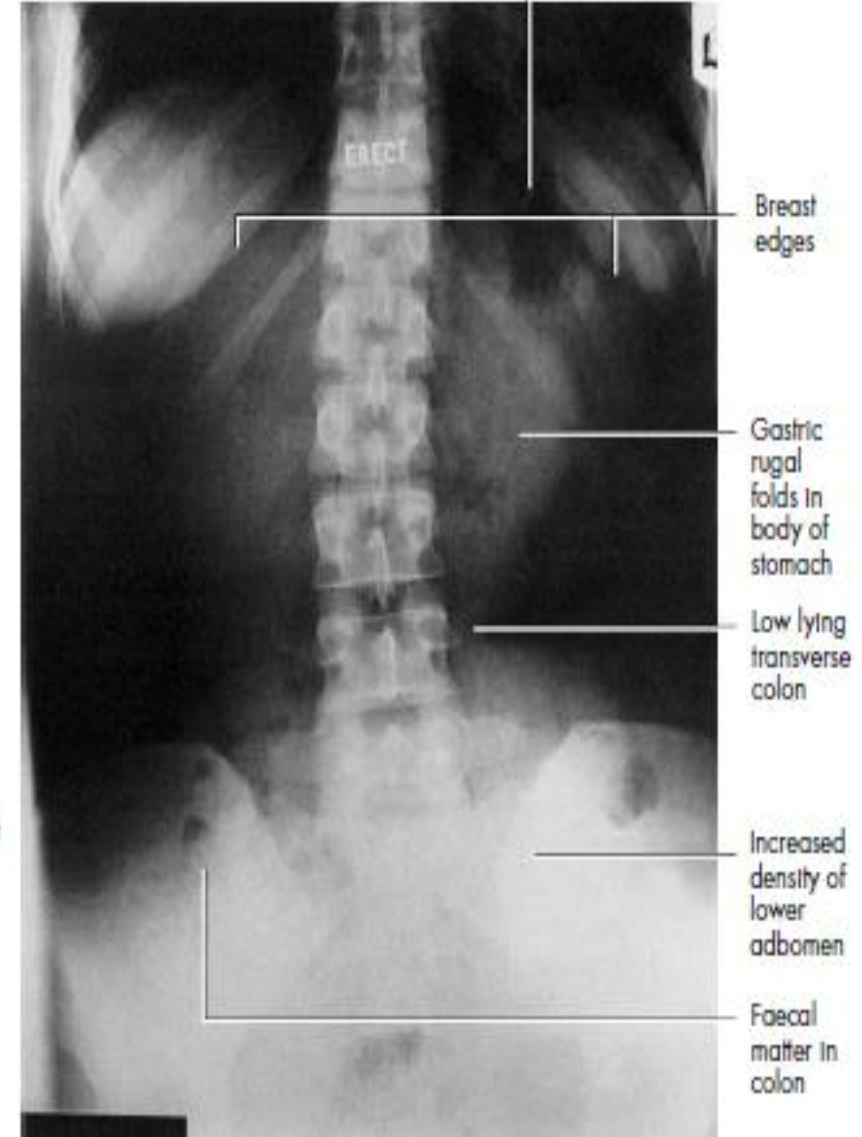


Hepatic flexure Liver Skin fold Left kidney Spleen



Fluid faeces and gas in caecum

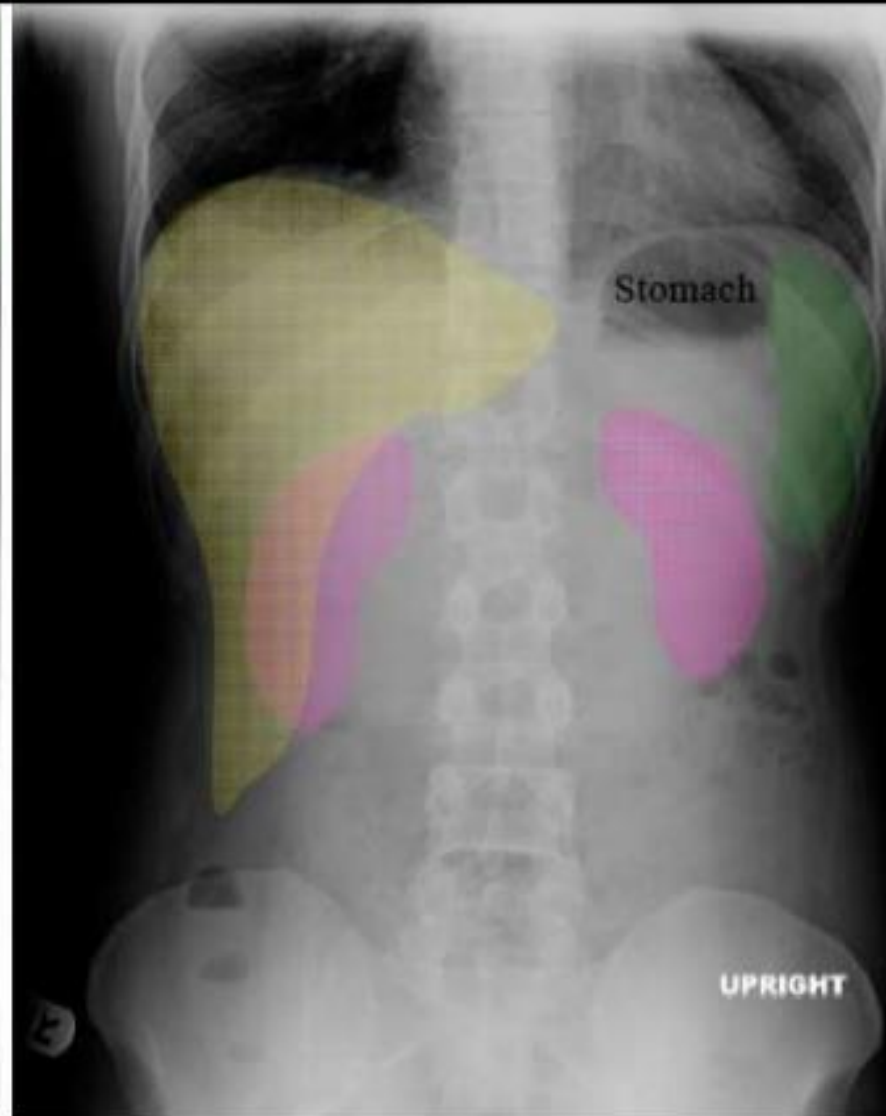
Gas in fundus of stomach



Plain Film Soft tissues : Liver, Spleen, & Kidney.



Soft Tissue Structures: Subtle on KUB.



The Abdominal Plain Film- Differentiating Large and Small Bowel

Characteristic	Small Bowel	Large Bowel
Position	Central abdomen	circumferential- the large bowel tends to <i>frame</i> the small bowel
Contents	fluid-like succus entericus and air	faeces of variable consistency from liquid to hard formed
Mucosal/Wall Pattern	- Can have a random faceted/tessellated appearance when air-filled (but not dilated). - Encircling valvulae conniventes visible depending on degree of air filling/distention. <u>Valvulae conniventes</u> more widely spaced in ileum - Wall pattern can be effaced if distended	<u>Haustral folds</u> interspaced with Plicae semilunaris - Wall pattern can be effaced if distended
Size	Up to 30mm	- Up to 50-60mm - Up to 90mm for the caecum

The 3,6,9 Rule

The maximum diameter of the bowel is shown below

	Maximum Normal Diameter
small bowel	30mm
large bowel	50-60mm
caecum	90mm

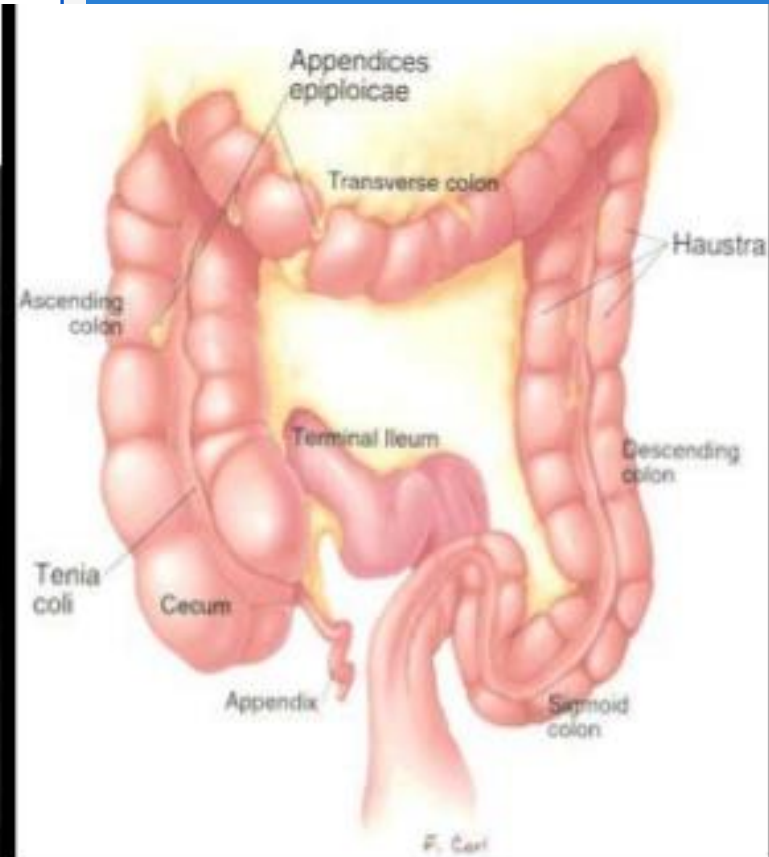
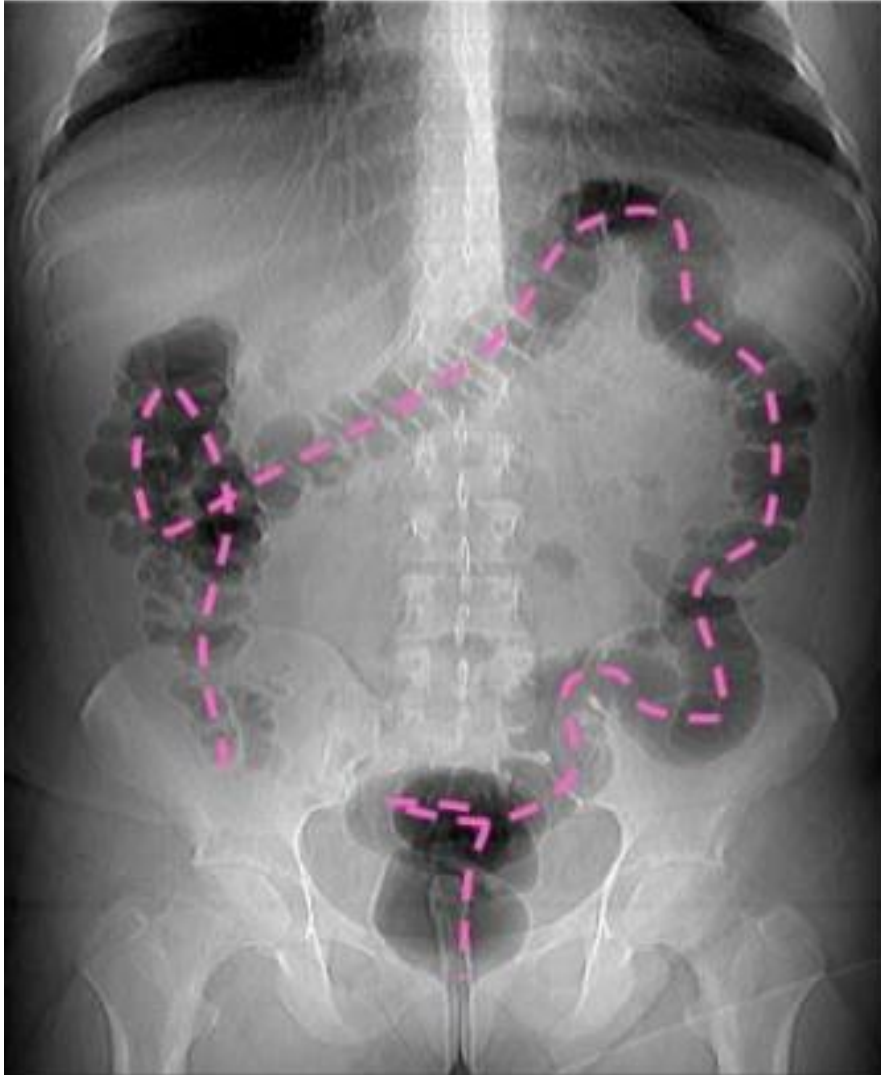


Figure 3. Valvulae conniventes



Haustral Pattern

Small vs. Large Intestine



- ***Colon has sacculations called haustra as teniae coli are shorter than the colonic wall***
- ***Colon is relatively peripheral but can be very mobile***

Pathological findings on plain films

```
graph TD; A[Pathological findings on plain films] --> B[GAS can be pathological or normal]; A --> C[CALCIFICATION];
```

GAS can be pathological or normal

- Intra-luminal
- Extraluminal
 - Intra-peritoneal
 - In portal
 - In biliary tree (**Pnemobilia**)

CALCIFICATION

- Phleboliths
- Vascular calcifications
- Calcified LNs
- GBS
- RS / UBS
- Splenic / hepatic granulomas
- Appendicoliths / enteroliths
- Calcified adrenals

Intraluminal gas

Begin by looking at the amount and distribution of gas in the bowels (**intraluminal gas**). There is considerable normal variation in distribution of bowel gas.

On the erect AXR, the **gastric gas bubble** in the left upper quadrant of the film is a normal finding. Gas is also normally seen within the **large bowel**, most notably the **transverse colon and rectum**.

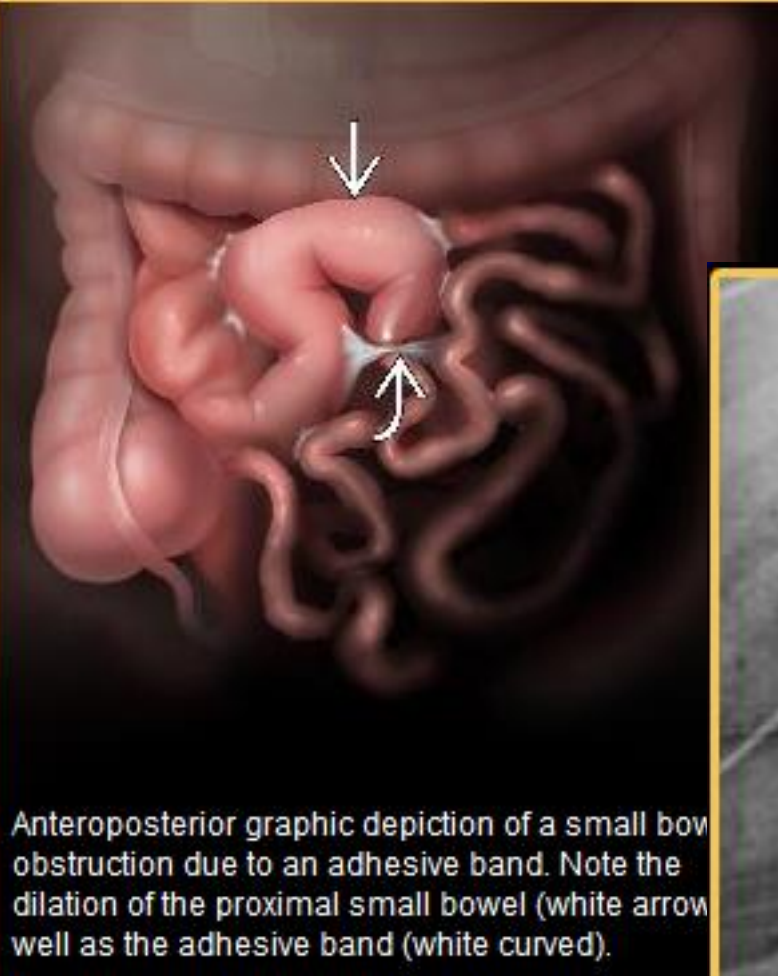
Important characteristics of bowel loops to bear in mind are their **size and distribution** (where they are situated in relation to other structures). Normal small bowel should measure less than 3 cm in diameter, whereas normal colon should measure less than 5 cm in diameter.

Small Bowel Obstruction

- Dilated SB (> 3 cm): SUPINE VIEW -
- Transition zone between normal and abnormal bowel critical to define site and cause of obstruction -
- Multiple air-fluid levels (five-two) , (two-five) rule: ERECT VIEW
seen on upright or decubitus abdominal X-rays
 - 2-5 rule: at least two air-fluid levels, each > 5 cm in length.
 - 5-2 rule: at least five air-fluid levels, each > 2 cm in length

Small Bowel Obstruction

Most common cause of small bowel obstruction: adhesions



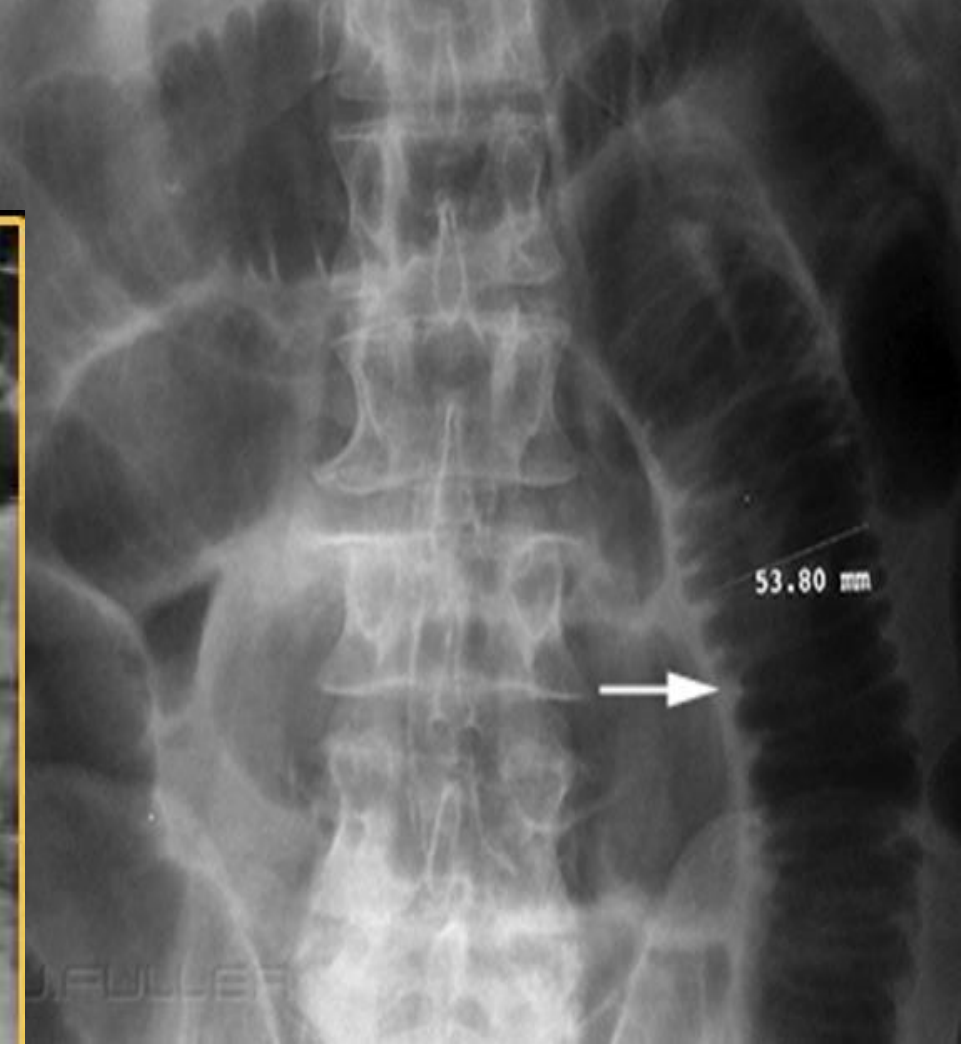
Anteroposterior graphic depiction of a small bowel obstruction due to an adhesive band. Note the dilation of the proximal small bowel (white arrow) as well as the adhesive band (white curved).



Air fluid level

Upright radiograph shows dilated small bowel with air-fluid levels and no colonic gas.

Small bowel dilatation



Not all air-fluid levels mean there is bowel obstruction.

Large bowel dilatation

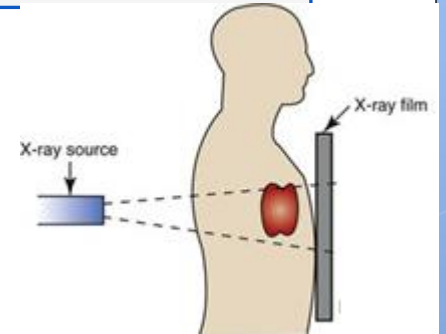
Located peripherally and have haustrations

Most common cause of large bowel obstruction: colorectal cancer



Diameter more than 6 cm

Extraluminal gas / intra-peritoneal ...



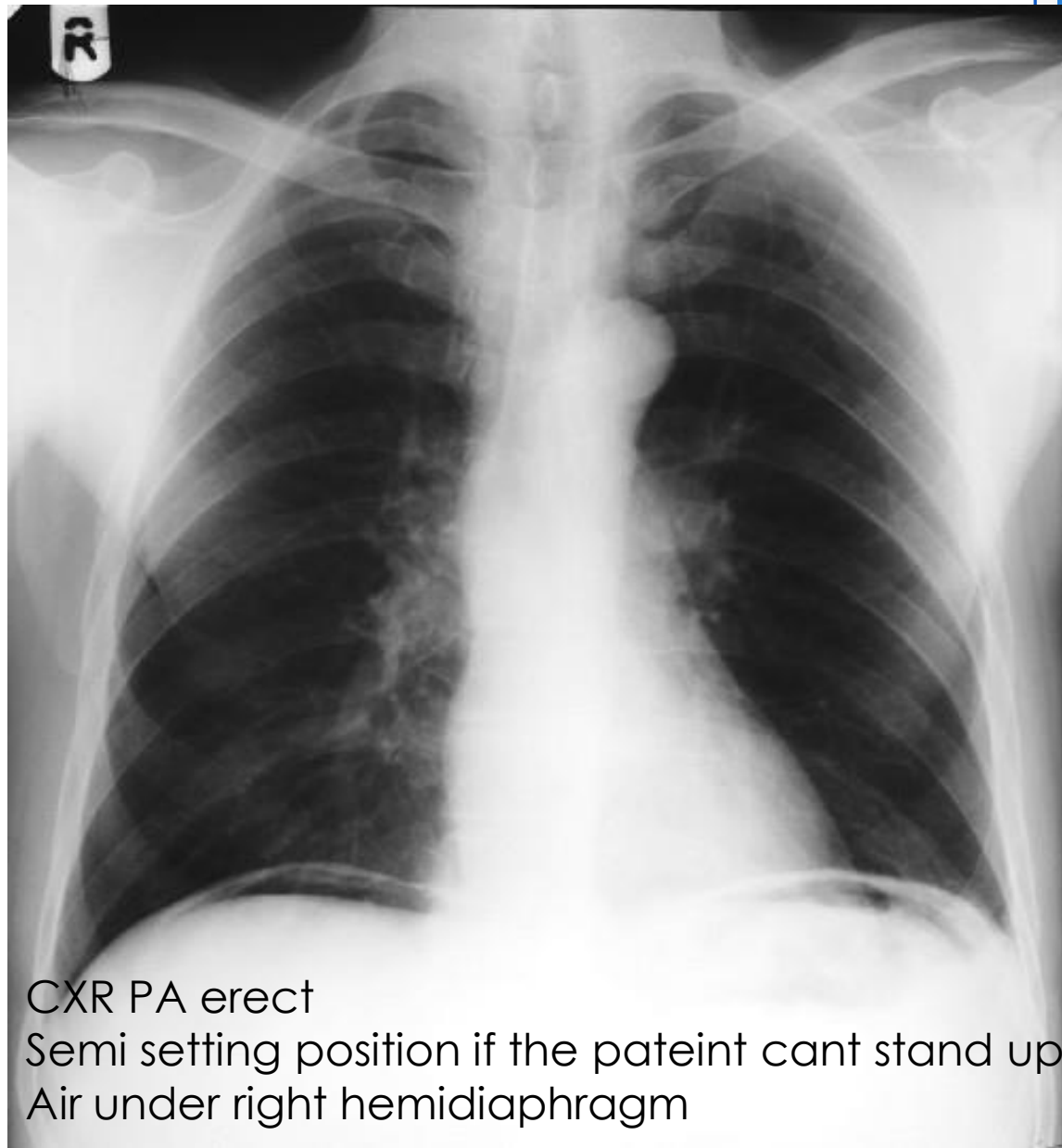
Gas outside the bowel lumen is invariably abnormal. The largest volume of gas you might see is likely to be under the right diaphragm on CXR: this occurs after a viscus has been perforated. This gas within the peritoneal cavity is termed **pneumoperitoneum**. 10

Gas outside bowel lumen often abnormal & its location can usually be assessed by plain films. 10

Common cause of spontaneous pneumoperitoneum is perforated peptic ulcer 10

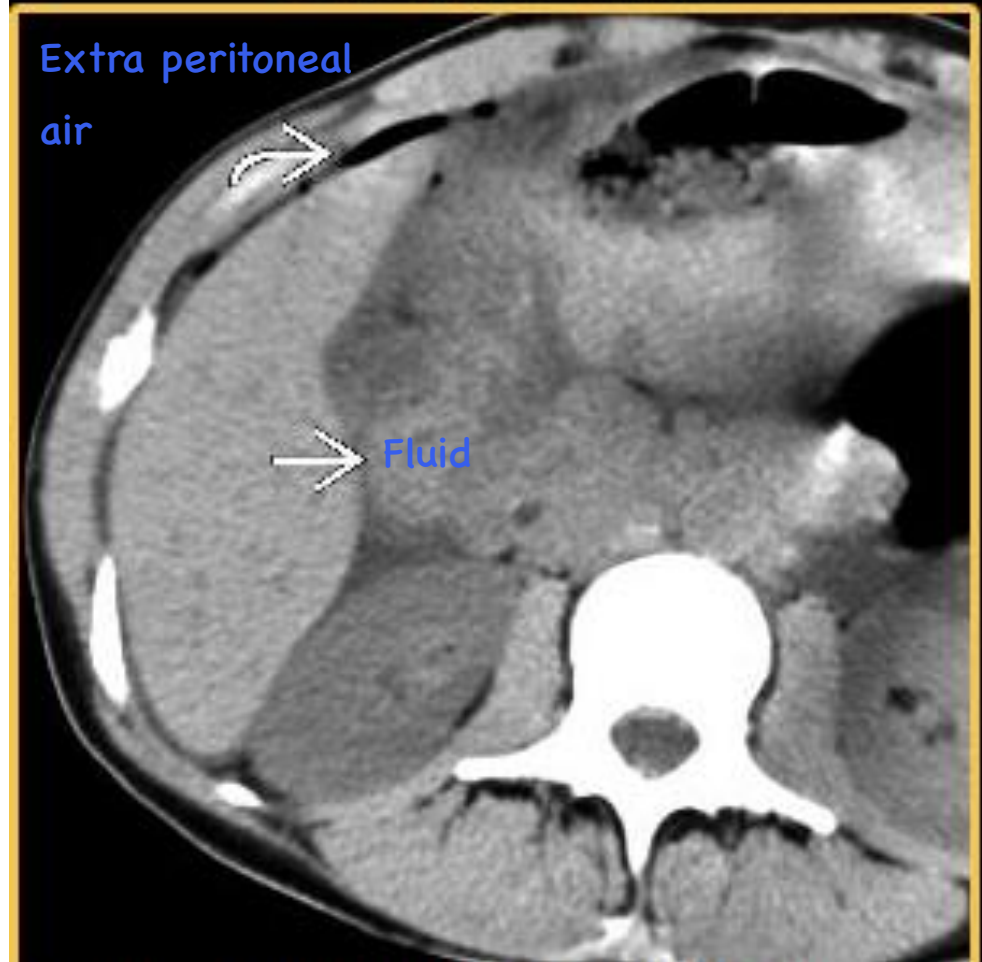
Free intraperitoneal air is a normal finding after a laparotomy (7 days) 10
7 days in adult and 10 days in paediatric patients

Pneumoperitoneum



CXR PA erect
Semi setting position if the patient can't stand up
Air under right hemidiaphragm

Duodenal Ulcer



Axial NECT shows mural thickening of the 2nd part of the duodenum (white arrow), with infiltration of adjacent fat planes and free intraperitoneal gas (white curved).

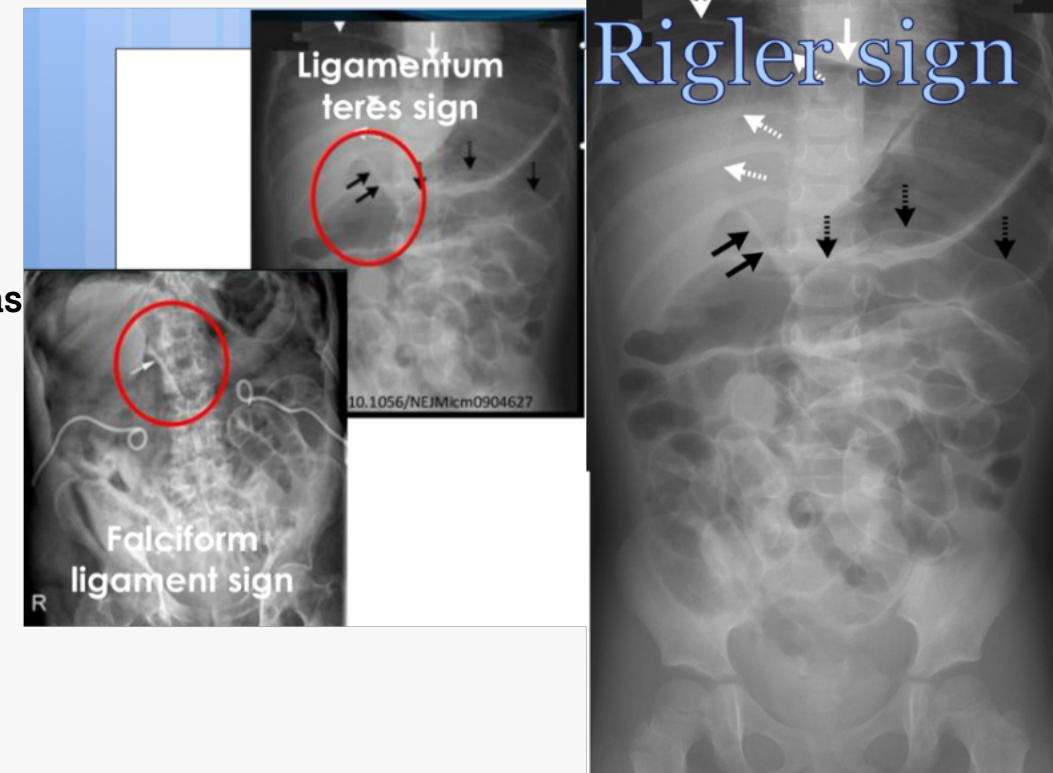
(Dirty fat planes)

The plain-film radiograph of the abdomen showed several signs of free intraperitoneal gas. These included:

1. **the falciform-ligament sign:** due to air accumulation in the right upper quadrant (the subphrenic area and ventral surface of the liver) (solid white arrows) visible as a longitudinal linear density on the ventral surface of the liver (dashed white arrows)
2. **the ligamentum teres sign**, visible as a linear density running along the inferior edge of the falciform ligament (solid black arrows).
3. **Rigler sign:** Prominent bowel walls surrounded by both intra and extraluminal air (dashed black arrows) **making the intestinal wall borders clearly demarcated.**

Pediatrics supine X-ray sign of intraperitoneal gas:

- Football sign: the abdomen looks distended and black. The spine looks whiter (more radio-opaque) than usual due to the presence of gas



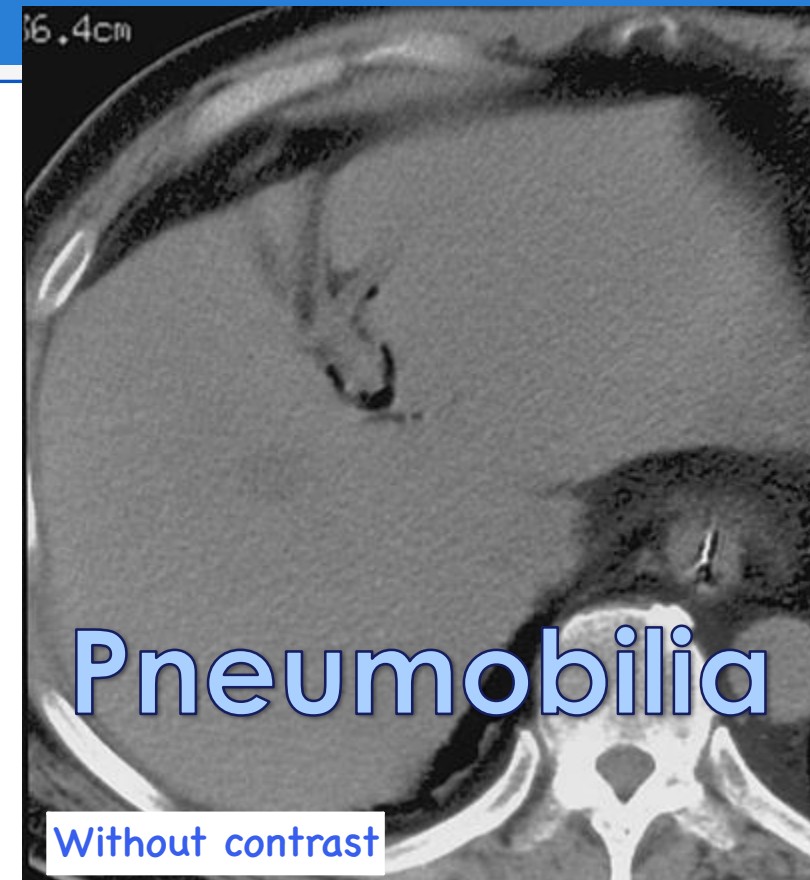
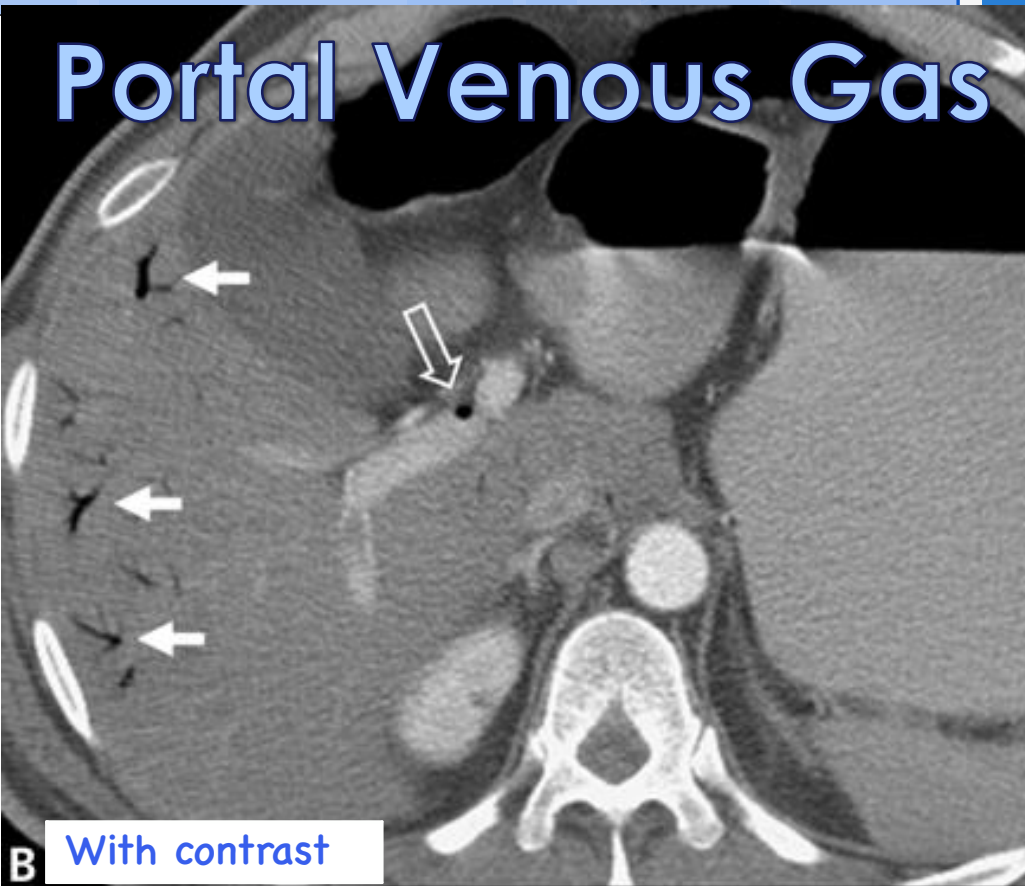
Gas In the biliary tree / portal vein ...

Gas in the right upper quadrant within the biliary tree is a “normal” finding after sphincterotomy, ERCP or biliary surgery, **but it can also be pathological in cases such as gallstone ileus or** when there is a fistula between the biliary tree and the gut.

Beware of gas in the portal vein, as this can look very similar to biliary air. Gas in the portal vein is always pathological and frequently fatal. It occurs in ischemic states, such as toxic mega colon, and it may be accompanied by gas within the bowel wall (intramural gas).

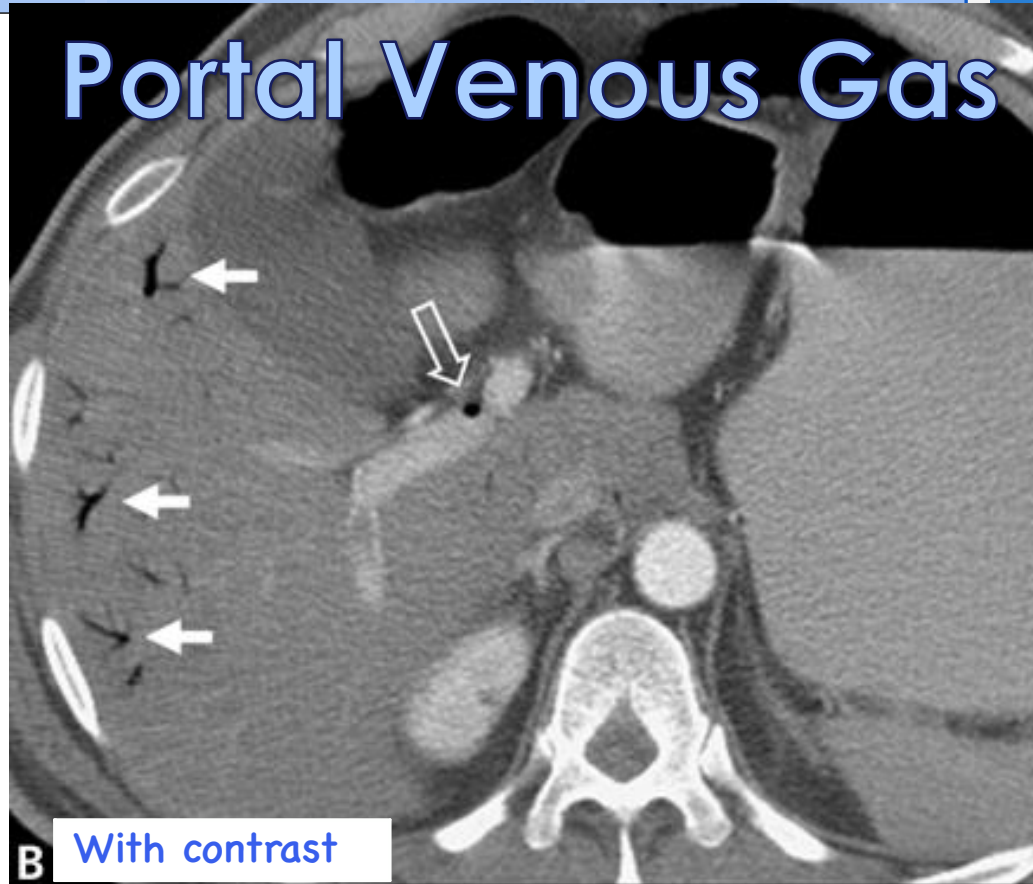
How to differentiate on CT scan:

- **Portal vein gas: appears in the periphery of the liver.**
- **Biliary tree gas: appears more centrally along the biliary ducts.**



Portal Venous Gas; Contrast CT image reveals gas in the portal vein, seen as air-density tubular structures extending **to the periphery of the liver**. Gas in the biliary tree (Pneumobilia) is central and does not extend into the peripheral 2 cm of the liver. In this case, portal venous gas was associated with infarction of the small bowel.

Portal Venous Gas



Abdominal CT scan showing gas in the portal vein; notice the gas at the periphery of the liver (white solid arrows)



Abdominal CT showing gas in the biliary tree (the crescent shaped hypodense area). Notice that there is no gas at the periphery of the liver.

Biliary-Enteric Anastomosis



Frontal radiograph shows classic radiographic appearance of pneumobilia with a branching gas pattern (white arrow) limited to the porta hepatis. Small bowel and liver transplantation.

Air within the hilum of the liver

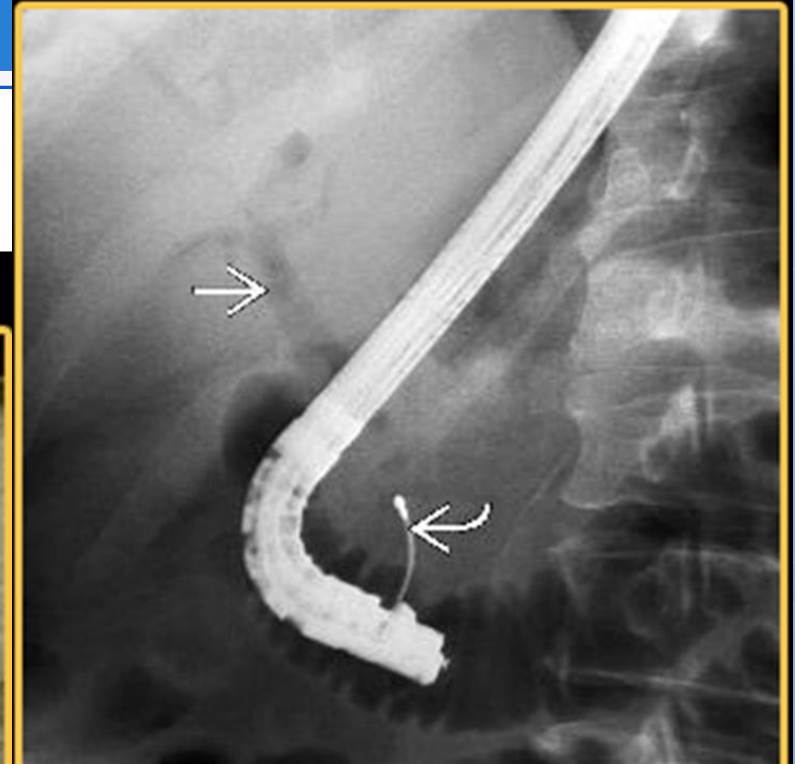
Gas in Bile Ducts

Biliary-Enteric Anastomosis



Axial NECT shows pneumobilia (white arrow) in a patient who had biliary-enteric anastomosis as part of a liver & small bowel transplantation.

Sphincterotomy



Oblique ERCP shows gas in the bile ducts (white arrow) and the endoscope with a sphincterotomy device (white curved) in place.

- gallstone ileus
- Iatrogenic ERCP
- Post some surgeries that connect biliary tree to the GIS (choledocho Jejunostomy, ileostomy)

Calcification ...

Abdominal Calcifications

Appear as radio-opaque substances on the abdominal film.

To define the type of pathology, we locate its anatomical site.

Types of pathologies:

1. pelvic vein phleboliths (calcified thrombi): mostly 5mm or less with a central radio-lucent area present in the pelvic area. Usually multiple and small and found above symphysis pubis

2. vascular calcification:

- Calcification present in walls of aortic aneurysm
- Ring calcification may involve splenic & renal arteries

3. Calcified lymph nodes:

- Mostly from granulomatous disease
- Mesenteric lymph nodes are the most commonly calcified

4. Gallstone & gall bladder.

- gallstone 15 % radio-opaque
- calcification in the gall-bladder wall (porcelain GB)

5. Urinary tract calcifications (stones)

- 85% radio-opaque
- Renal calculi are differentiated from gallstones by oblique projections that confirm their posterior position (more ant. For G.B.S)
- Urinary bladder calculi usually lie near the midline of the pelvis.

6. liver & spleen granulomas: healed foci of T.B , histoplasmosis

7. Appendicoliths&enteroliths: most are round or oval & have concentric laminations

8. Calcified adrenal glands: associated with adrenal hemorrhage , T.B., and Addison's disease.

9. Pancreatic calcifications

- Chronic pancreatitis
- Hereditary pancreatitis

10. calcified cysts: echinococcus (hydatiform cysts)

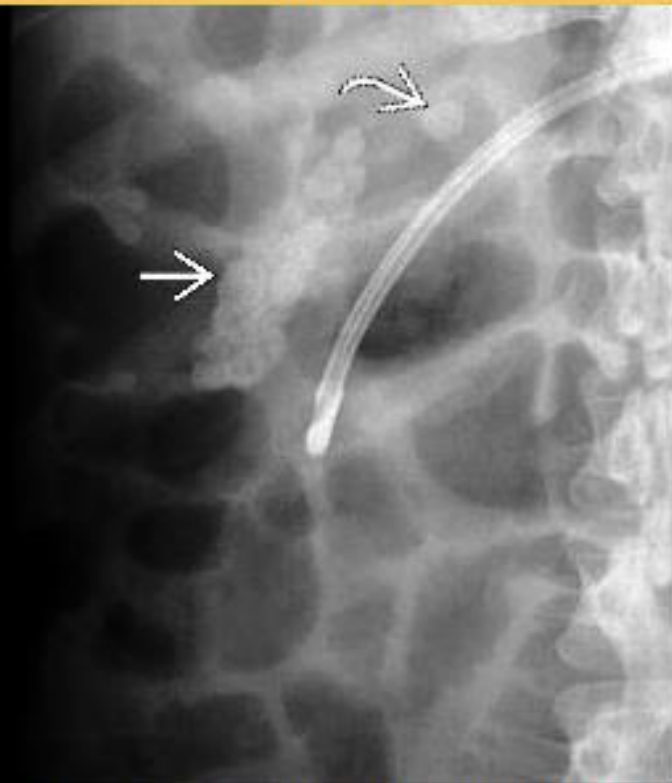
11. Tumor calcification

- Uterine leiomyomas (coarse or popcorns)
- Benign cystic teratomas (teeth)

12. Soft tissue calcifications:

- Old hematomas
- Calcification in buttocks may be seen following injection certain medications

Gallstones



Frontal radiograph shows a feeding tube in the duodenum and a cluster of dozens of gallstones that fill the gallbladder (white arrow) and obstructed the GB neck (white curved).

% of radio-opaque gallstones?

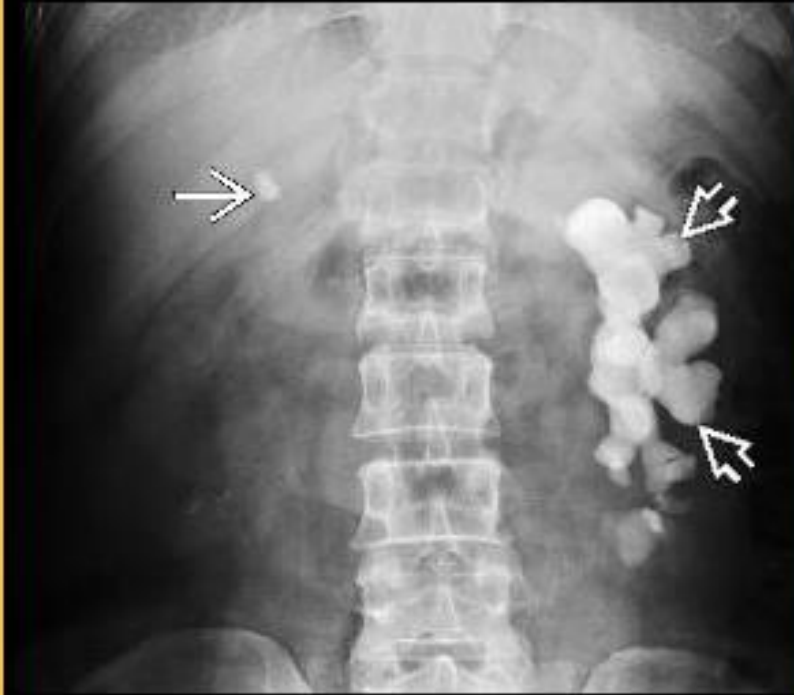
15%

EXDDX: Abdominal Calcifications



Addison's disease, X-ray
calcified adrenal glands

Urolithiasis



Anteroposterior radiograph shows a typical punctate calcified stone (white arrow) in the right kidney & a large "staghorn" calculus (white open) in the left.

% of radio-opaque urinary stones?

%85

Head of pancreas calcifications

Chronic pancreatitis



Round opacity with calcified rim

Arterial Calcification and Aneurysm



Frontal radiograph shows a spherical eggshell calcification (white arrow) in the pelvis; large common iliac artery aneurysm.

Abdominal Incision & Injection Sites



Subcutaneous calcification

Frontal radiograph shows a cluster of calcified injection granulomas (white arrow) overlying the lower abdomen, but located within the subcutaneous fat of the buttocks.

cluster of small, round calcifications in the lower abdomen overlying the buttocks.

— body's reaction to repeated intramuscular injections.

Located within subcutaneous fat, away from visceral organ

Uterine Leiomyoma (Fibroid)



Frontal radiograph shows a small pelvic "popcorn" type calcification (white arrow), one of the common forms of calcification in a degenerated uterine fibroid (leiomyoma).

EXDDX: Abdominal Calcifications

Appendicolith

Located in the right lower quadrant, overlying the cecal area.



Phleboliths



Frontal radiograph shows multiple phleboliths in the pelvis, having their typical distribution, mainly below the iliac spines, some with central lucency (white arrow).

pelvic vein phleboliths (calcified thrombi)
mostly 5mm or less with central lucent

FLUOROSCOPY

**Filling defect /
Ulceration /
stricture ...**

Contrast Agents ...

A diagnostic image is composed of differences in contrast between tissues which result from differences in radiation reaction in the tissue.

Contrast media are so called as they increased the image contrast of anatomical structures which are not normally easily visualized.

Iodine-based and barium-sulfate compounds are used in x-ray and computed tomography (CT) imaging exams.

Barium sulphate

Most common

Barium sulphate is best contrast media for GIT;
excellent opacification.

good coating for mucosa.

completely inert.

inexpensive.

NOT Water soluble, has high osmolar weight

contraindicated in suspected perforations/ obstruction.



Iodinated contrast media

Low osmolar weight (LOCM)

Iodine based contrast media are usually classified as ionic or non-ionic. Only non ionic C.M is used nowadays in diagnostic radiology. It is primarily used to visualize vessels, and changes in tissues on radiography and CT, but can also be used for tests of the urinary tract, uterus and fallopian tubes.

Can be used safely in suspected perforation

disadvantages:-

Anaphylactoid reactions.

Contrast-induced nephropathy. **Contraindicated in cases of renal failure**

Expensive .



Types of contrast studies:

1. Single contrast method

Technique: we inject the contrast material and then take the image.

The bowel filled only with barium, no air introduced.



2. Double contrast technique

Technique: here, we inject the contrast material, then we inject air. After that, we take the image. Injecting air will distend the lumen and this will help us visualize the mucosa better. Usually used in adults; pediatric patients rarely have mucosal abnormalities

the mucosa is **coated with barium** and the stomach or colon **distended by introducing gas**, often combination with short acting smooth muscle relaxant

Double contrast shows more mucosal detail



Filling defect —▶ Defined as an area that does not take contrast as it should normally do.

- intraluminal filling defect
- intramural filling defect
- extramural compression

Ulceration

- Benign
- malignant

Stricture

- Benign
- malignant

Types of Filling defect

1)-an **intraluminal** filling defect (**food particle, stone**) surrounded by barium all around it.

2)-an **intramural** filling defect arises from the wall of the bowel (eg: **a carcinoma or leiomyoma, diverticulum, polyp**) *pathology inside the wall* it causes an indentation from one side only and making a sharp angle with the wall and is not completely surrounded by barium.

3)-an **extra mural** *→ external pathology decreasing the lumen's size* compression on bowel wall like **enlarged pancreas or lymph nodes**. Also give a narrowing from one side only but make shallow angle with wall, the mucosa is preserved but stretched over the filling defect.



(a) Intraluminal



(b) Intramural



(c) Extramural

Stricture

A stricture is annular narrowing (must be differentiated from the transient narrowing which occurs with normal peristalsis).

Types: 10

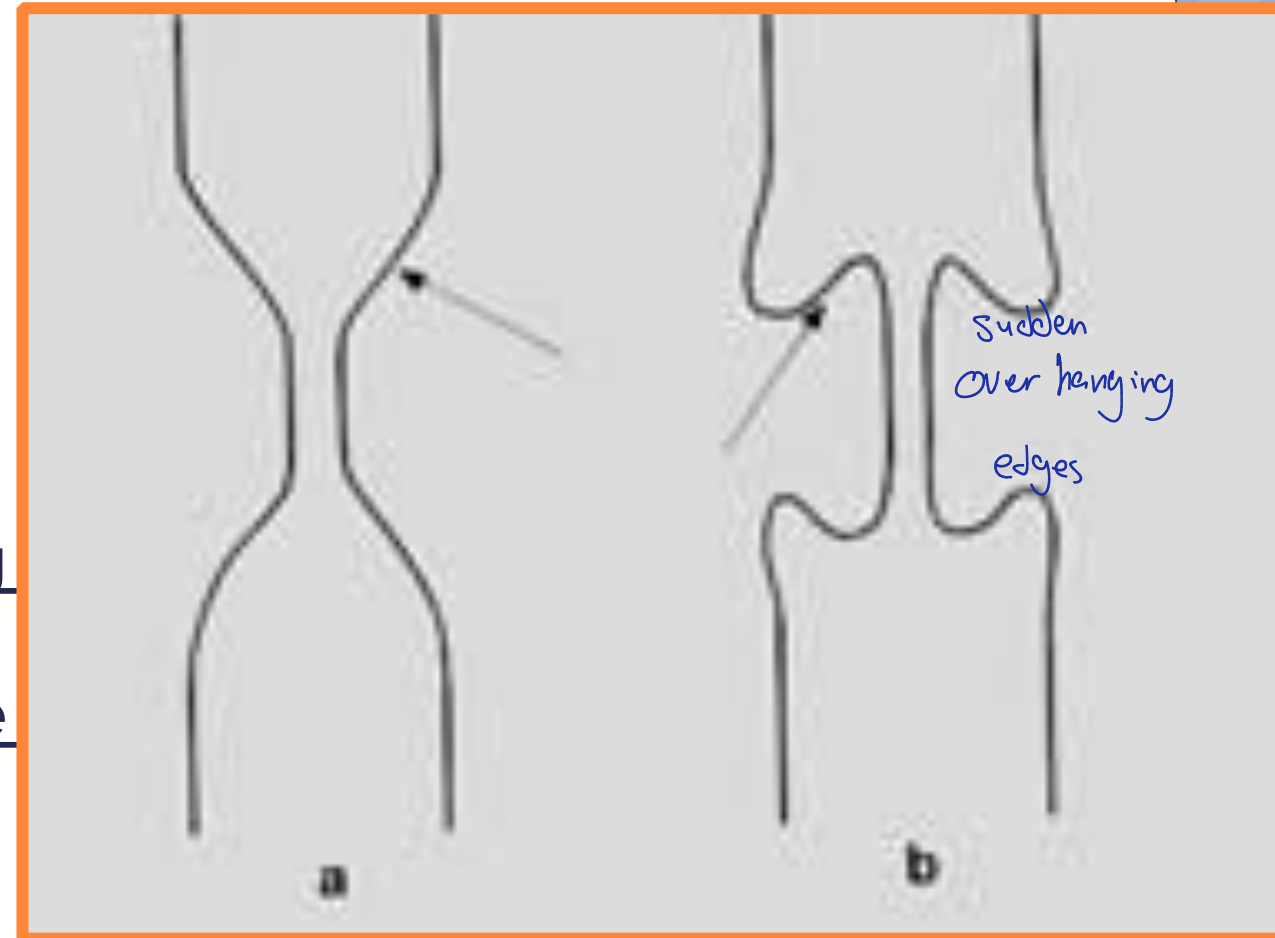
-smooth tapering ends, regular 10

① outline, absence of malignant fx
"Benign"

-end abruptly and have over hanging edges giving appearance

② 'shouldering' (shouldering is a feature of malignancy), apple-core

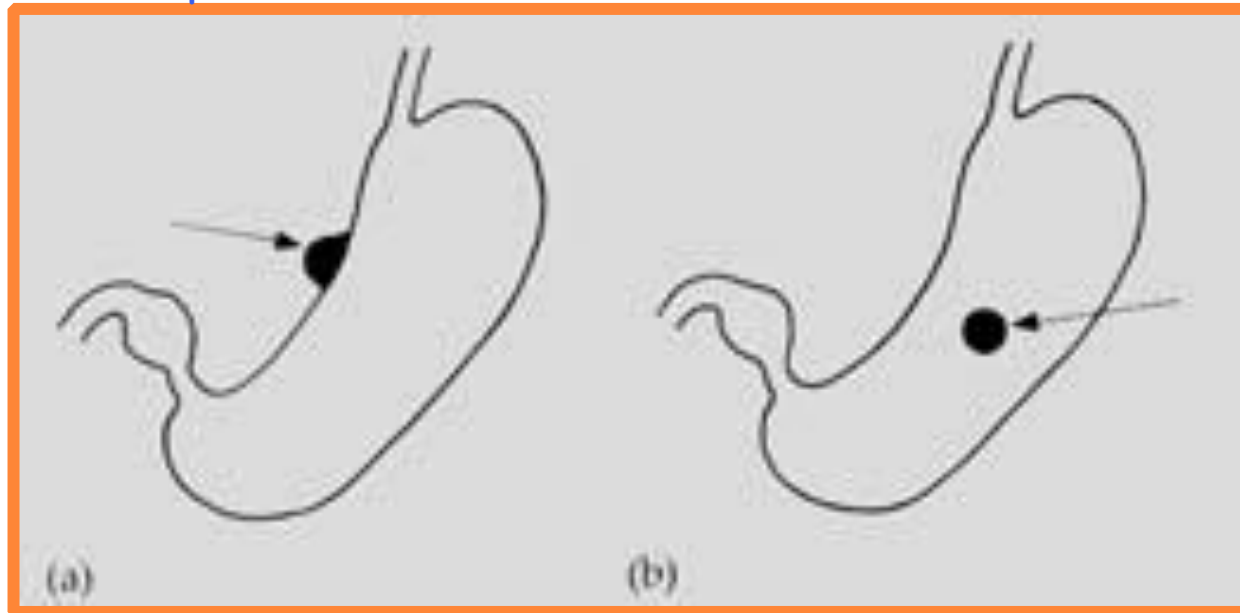
"Malignant"



Ulceration

An ulcer is a breach of a mucosal surface which becomes visible when the crater contains barium.

as a depression on the mucosal surface



2 types

Benign ^① vs malignant ^②:
Look at the surrounding

If mucosal folds are lost,
featureless leathery
appearance...
malignant.

Normal gastric rugae ...
benign

The Esophagus

plain films :

do not normally show the oesophagus unless it is very dilated (eg: achalasia)
but useful to demonstrate F.B.

Barium swallow:

- i) oesophagus full with barium to show outline
- ii) oesophagus empty to show the mucosal pattern.

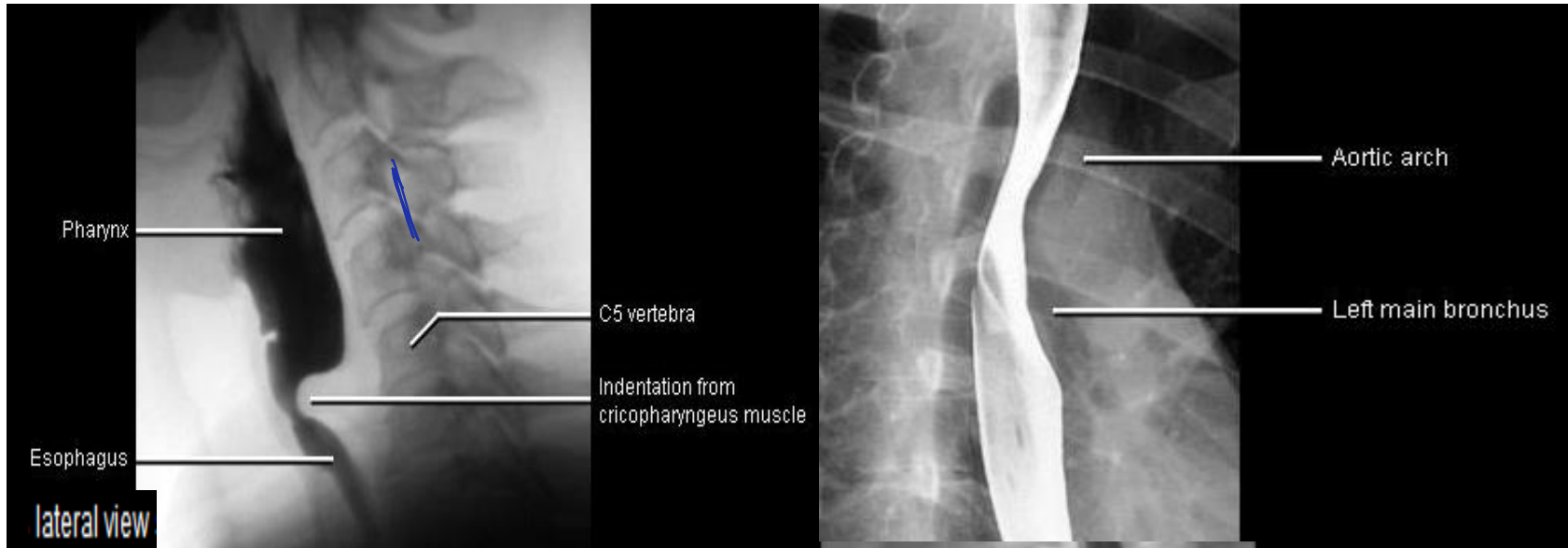
Normal Impressions on Esophagus

Physiologic areas of narrowing or constriction:

- cricopharyngeus muscle (upper esophageal sphincter) on the posterior aspect of cervical esophagus.
- By arch of aorta (left anterolateral surface of esophagus)
- By left main bronchus
- By diaphragm

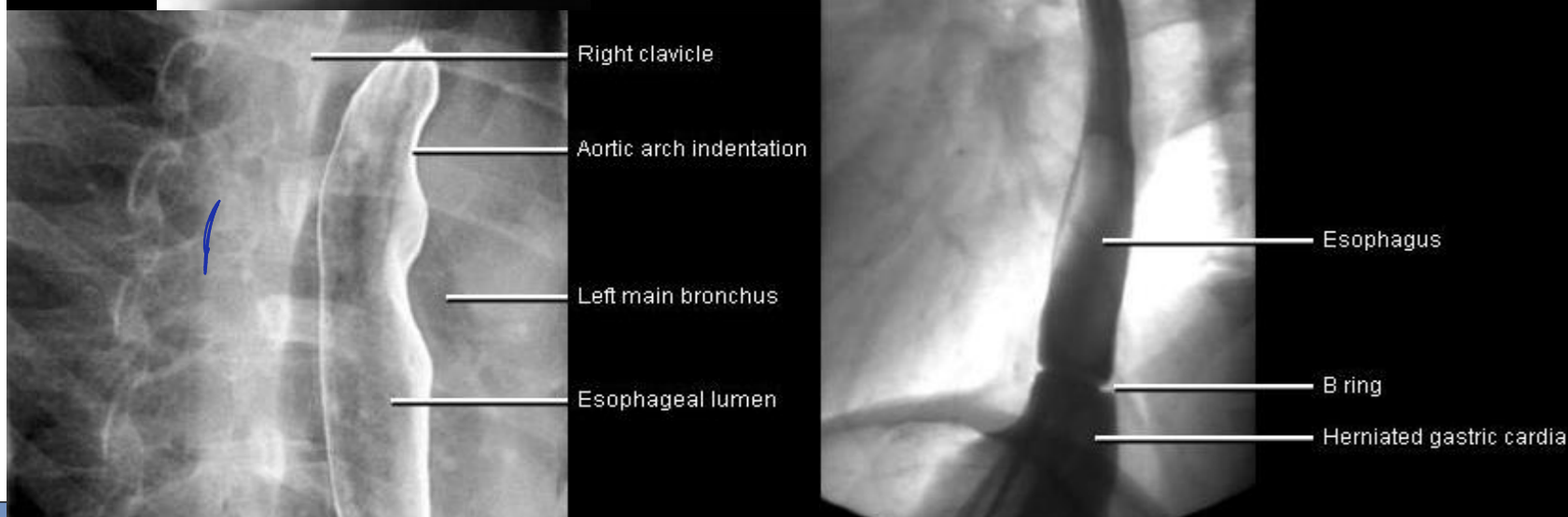
Normal Impressions on Esophagus

Post

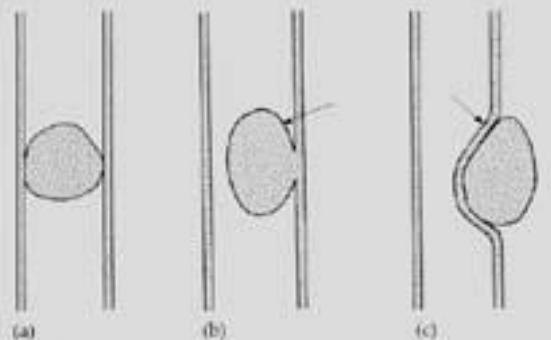
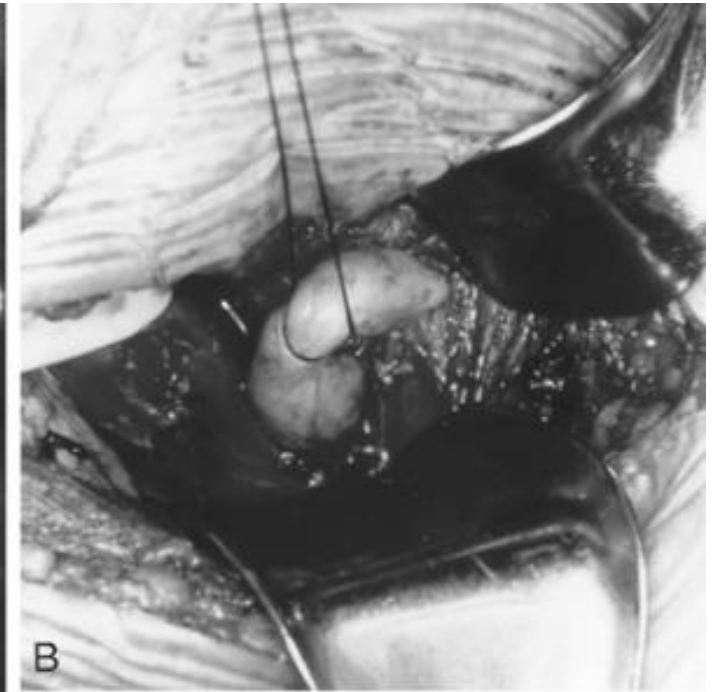
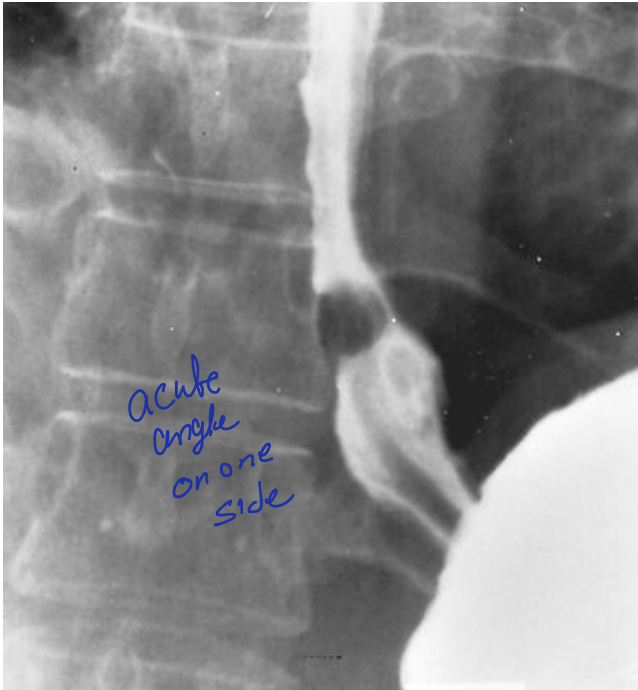


Ant

is maligned spine



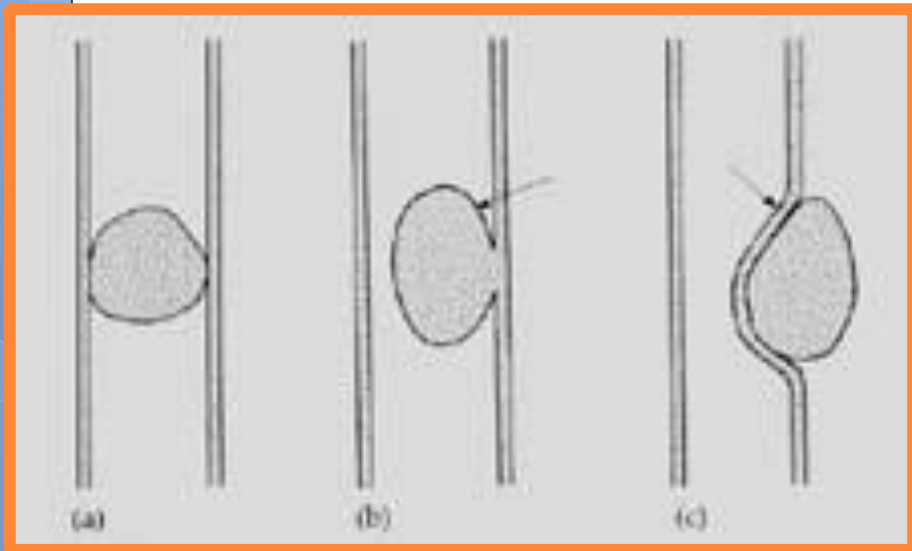
Filling defects on barium swallow



An intramural filling defect

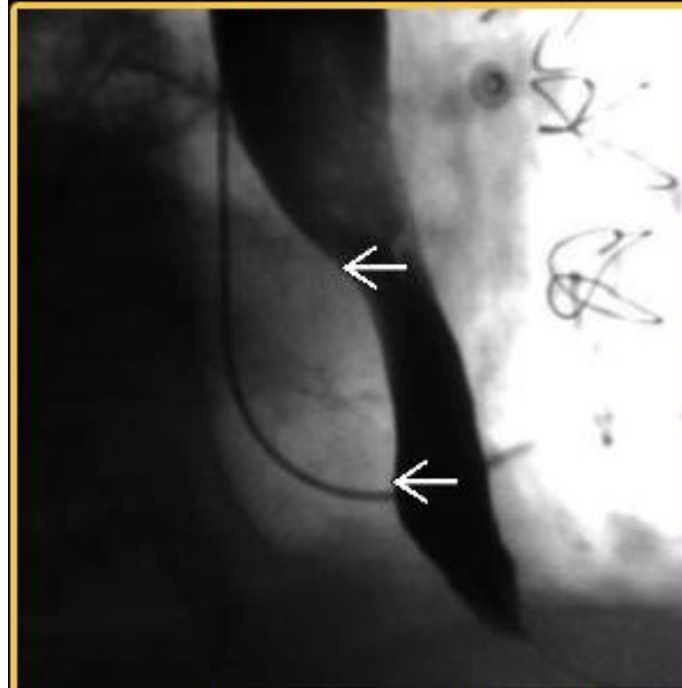
Filling defects on barium swallow

Extrinsic Mass, Esophagus



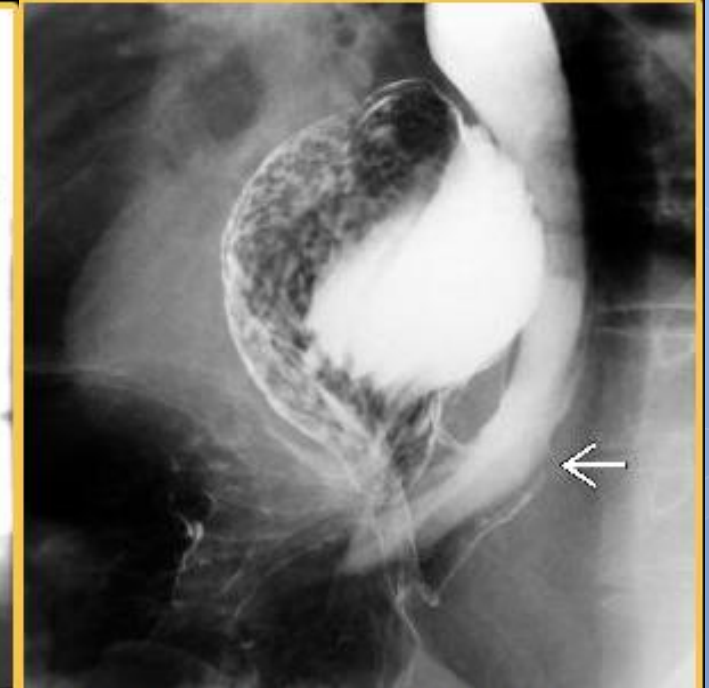
Extra luminal

Aortic Aneurysm



Oblique esophagram shows extrinsic indentation (white arrow) along the posterior wall of the distal esophagus by a dilated, ectatic aorta, in an elderly man.

Hiatal Hernia



Esophagram shows displacement of the distal esophagus by a large type 3 paraesophageal hernia. The gastroesophageal junction (white arrow) is in the chest.

Abnormal barium swallow

Stricture - main cause of dysphagia

Four main causes of stricture:

- 1- peptic
- 2- carcinoma
- 3- achalasia
- 4- corrosive

In order to distinguish between these possibilities it is useful to answer the following:

- 1-where is the stricture?
- 2-What is the shape?
- 3-How long is it?
- 4-Is there a soft tissue mass?

Esophagitis, Reflux



Graphic shows a small type 1 ("sliding") hiatal hernia, associated with foreshortening of the esophagus, ulceration of the mucosa, and tapered stricture of the distal esophagus.

Benign stricture

Smooth,
Gradual
tapering

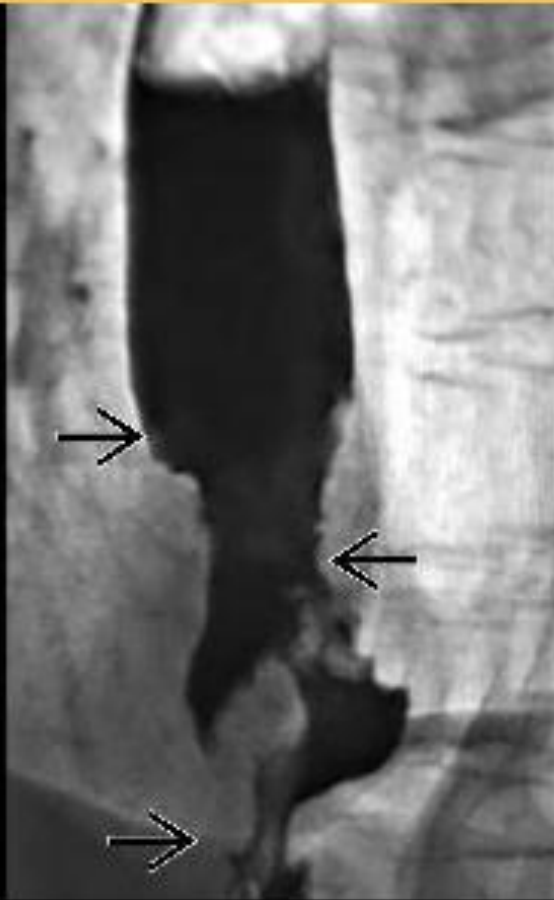


A supine spot film from a barium esophagram demonstrates free and repeated reflux (black arrow) and a stricture at the gastroesophageal junction (black curved). Tertiary contractions and diminished primary peristalsis were also noted during fluoroscopy.

Esophageal Carcinoma

Malignant stricture

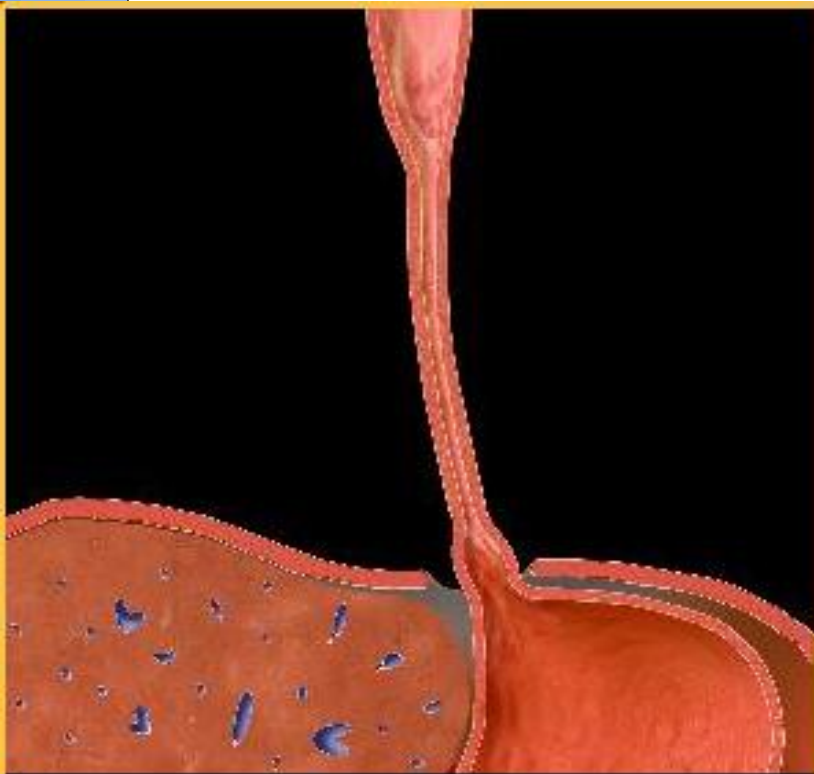
Abrupt transition, apple-core appearance



Esophagram shows an "apple core" constricting lesion (black arrow) of the distal esophagus. There is an abrupt transition, or shoulder, at the proximal end of the tumor as it abuts normal esophagus. The mucosa through the tumor is destroyed with nodular contours.

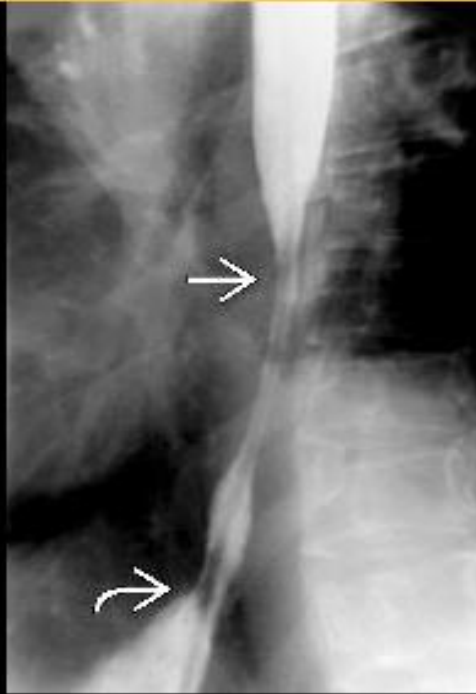
Esophageal Strictures

Benign stricture with esophageal ulceration

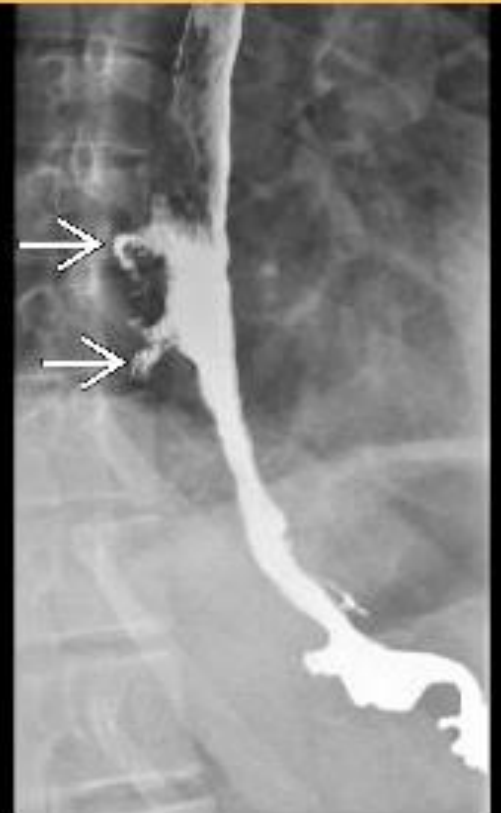


Graphic shows a long stricture of the esophagus and ulceration of the mucosa. The stomach is pulled up into the chest due to foreshortening of the esophagus by fibrosis &/or spasm.

Caustic Esophagitis



Oblique esophagram shows long smooth stricture (white arrow) of distal half of esophagus, with a shortened esophagus causing hiatal hernia (white curved).



Esophagram 1 week following a lye ingestion shows a long stricture with deep ulcerations (white arrow).

Achalasia

Definitions

Primary achalasia: Primary motility disorder of the esophagus (smooth muscle)

Secondary or pseudoachalasia: Involvement of gastroesophageal junction by other abnormalities (Chagas disease, tumor)

Diffuse mediastinal widening with air-fluid level suggests achalasia

Esophagram key to evaluate motility, reflux, and aspiration

Radiographic Findings

Mediastinal widening (double contour)

Marked dilated esophagus

Retro-tracheal air-fluid level

"Bird-beak" deformity of distal esophagus

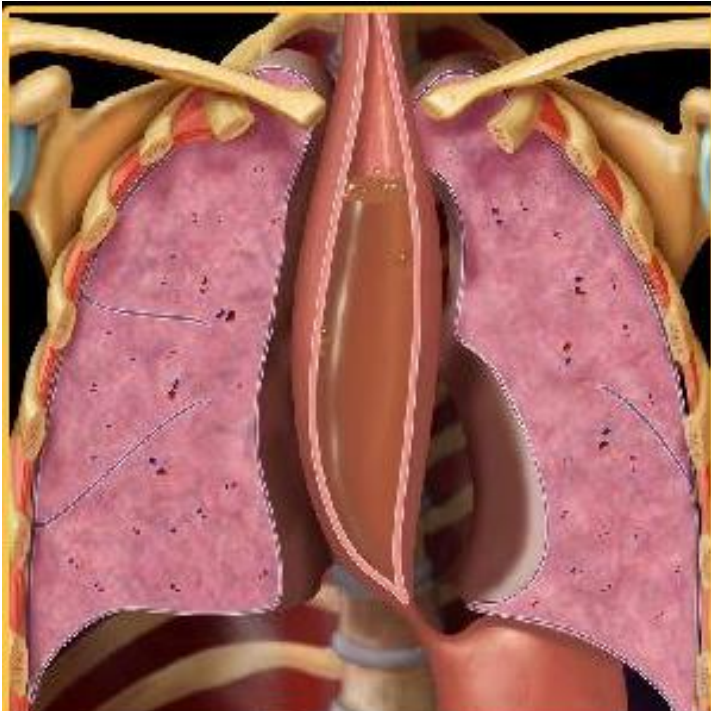
Little or absent gastric air bubble

PA chest X-ray showing
widened mediastinum,
dilated esophagus, and air
fluid level.



PA chest radiograph demonstrating a relatively small gas–fluid level in the mediastinum in a patient with achalasia. Note the soft-tissue density mass representing the distended oesophagus inferior to the fluid level

Achalasia, Esophagus



Graphic shows Achalasia. Esophagus is markedly dilated with an air-fluid level at the upper esophagus and beaking at the esophagogastric junction. Air-fluid level in the stomach typically absent.

Modality: barium swallow

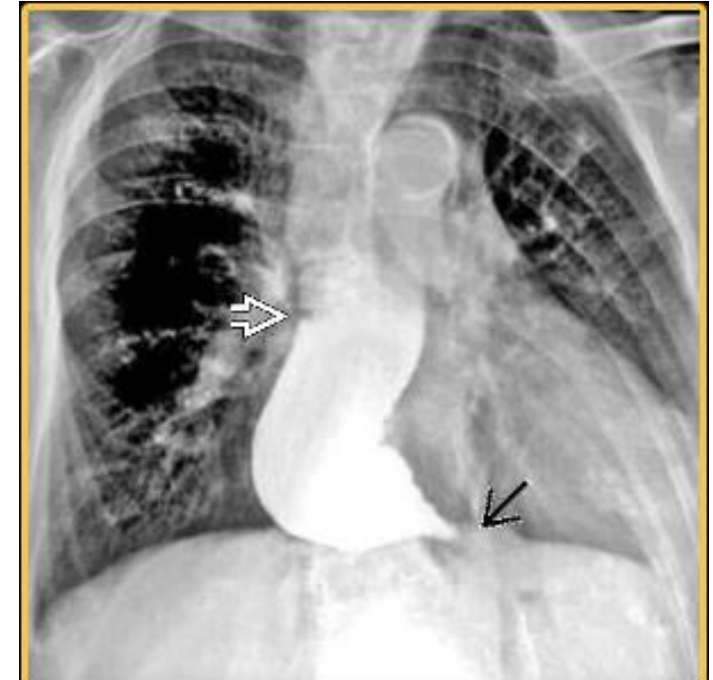
Describe the finding: distal narrowing, gradual, tapering with proximal dilatation

Sign: bird-beak sign/ rat tail sign



Esophagram shows a typical appearance of achalasia, pre-Heller myotomy, with "bird-beak" deformity of the distal esophagus (white arrow), marked dilation of the proximal esophageal lumen, and absent peristalsis.

Bird-beak" deformity



Upright frontal esophagram shows a dilated esophagus with an abrupt taper ("bird-beak") just above the GE junction (black arrow). Note the absent gastric air bubble and the fluid-barium level (white open) within the esophagus.

rat tail sign
Achalasia



Bird beak sign
Achalasia



Hiatus hernia

Is a herniation of the stomach into the mediastinum through the oesophageal hiatus in the diaphragm.

2 general types

- Sliding (axial) hiatal hernia, **most common***

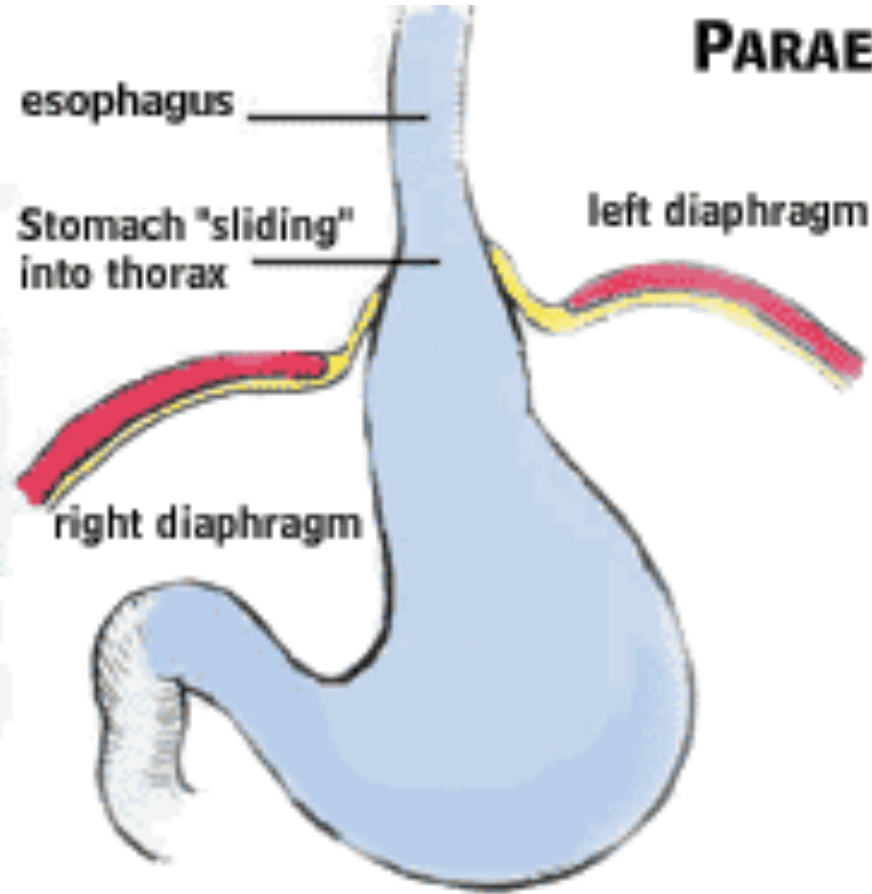
Gastroesophageal (GE) junction and gastric cardia pass through esophageal hiatus of diaphragm into thorax

- Paraesophageal (rolling) hernia rare*

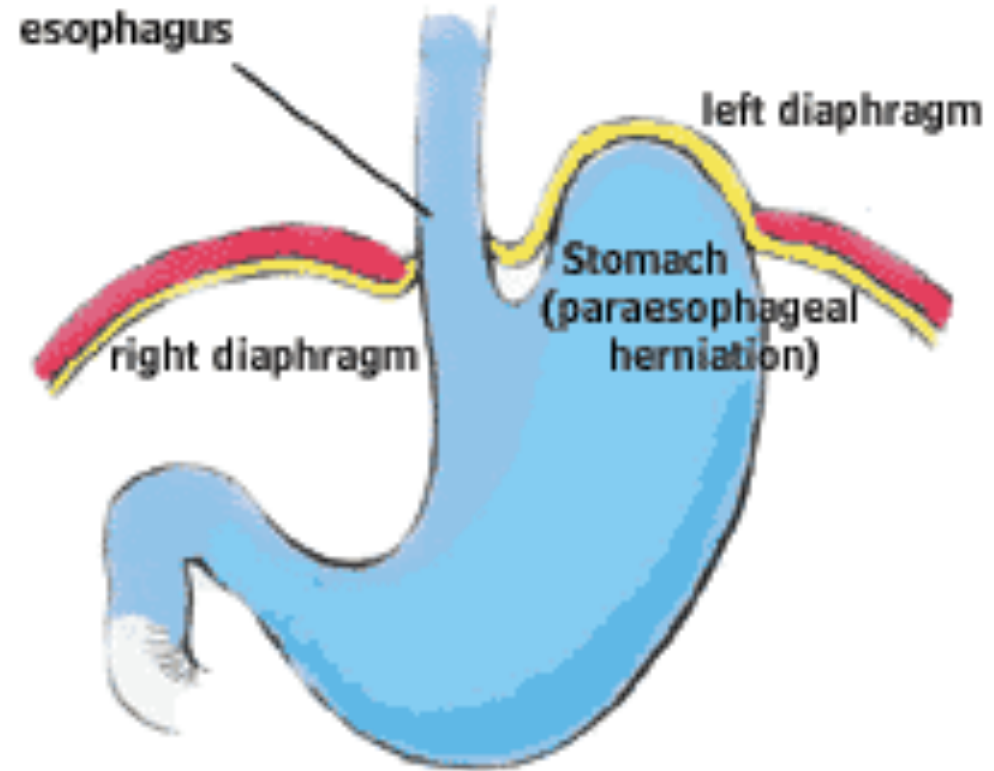
Gastric fundus ± other parts of stomach herniate into chest while **GEJ in normal position**.

To diagnose a hernia, we need a barium meal. A barium meal reaches the stomach and the first part of the duodenum.

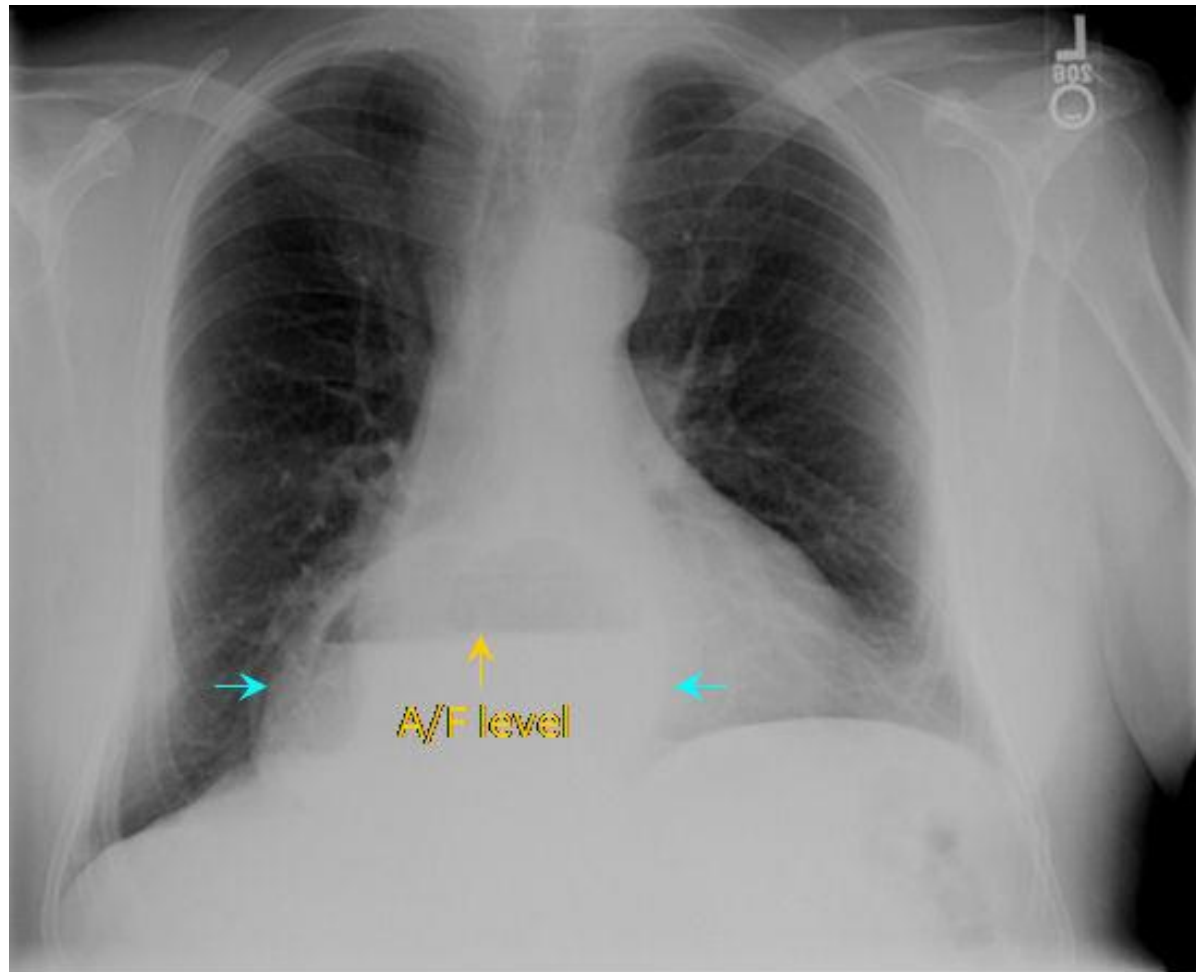
PARAESOPHAGEAL (HIATAL) HERNIA



Type 1. The stomach & intra-abdominal esophagus slide through the diaphragmatic hiatus.



Type 2. The stomach herniates through the diaphragmatic hiatus, adjacent to the esophagus.



Frontal



Lateral

On conventional xray

Sliding (axial) hiatal hernia

Hiatal Hernia

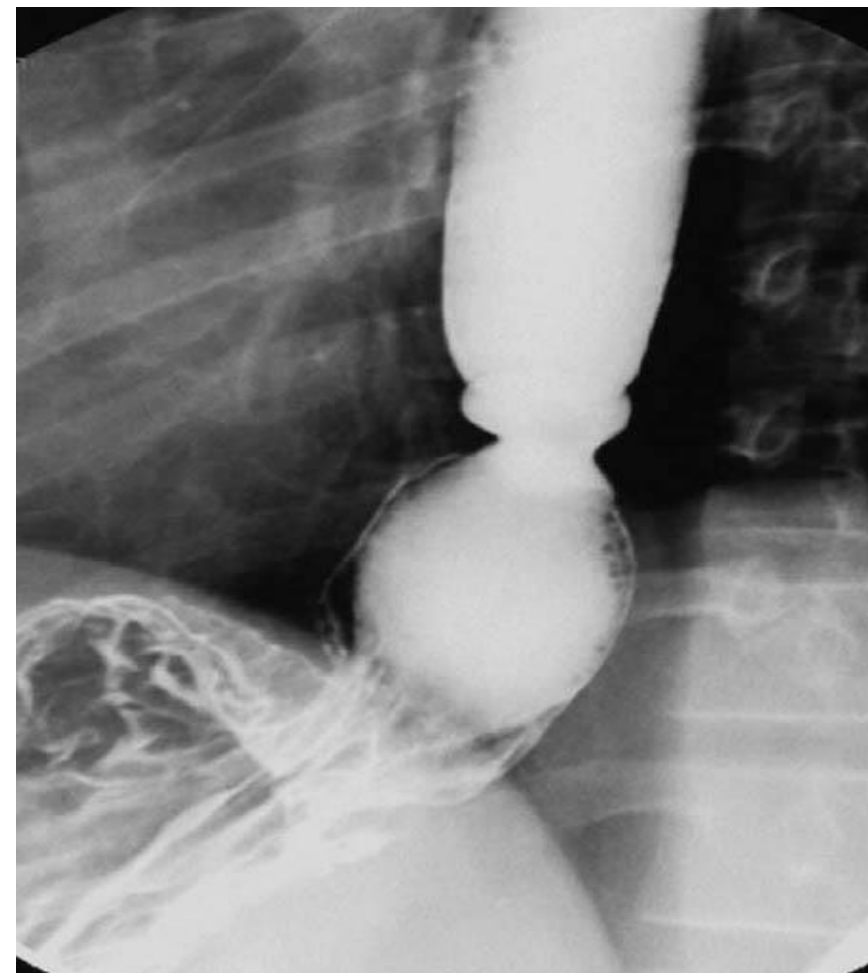


Type II paraesophageal hernia. The gastric fundus has herniated into the chest, but the gastroesophageal junction (white arrow) remains below the diaphragm.

Paraesophageal hernia



Upper GI in a patient with type IV PEH. An intrathoracic stomach shows that while an air-fluid level is present within the stomach, there is no evidence of twisting or obstruction of the stomach. However, this patient is at risk for volvulus & strangulation.



Sliding hiatal hernia

The stomach and duodenum

Barium meal is the standard contrast medium to examine the stomach and duodenum.

Patient drinks about 200 ml of barium.

Better mucosal detail, the stomach is distended by giving a gas producing agent .

Intravenous injection of a short acting smooth muscle relaxant

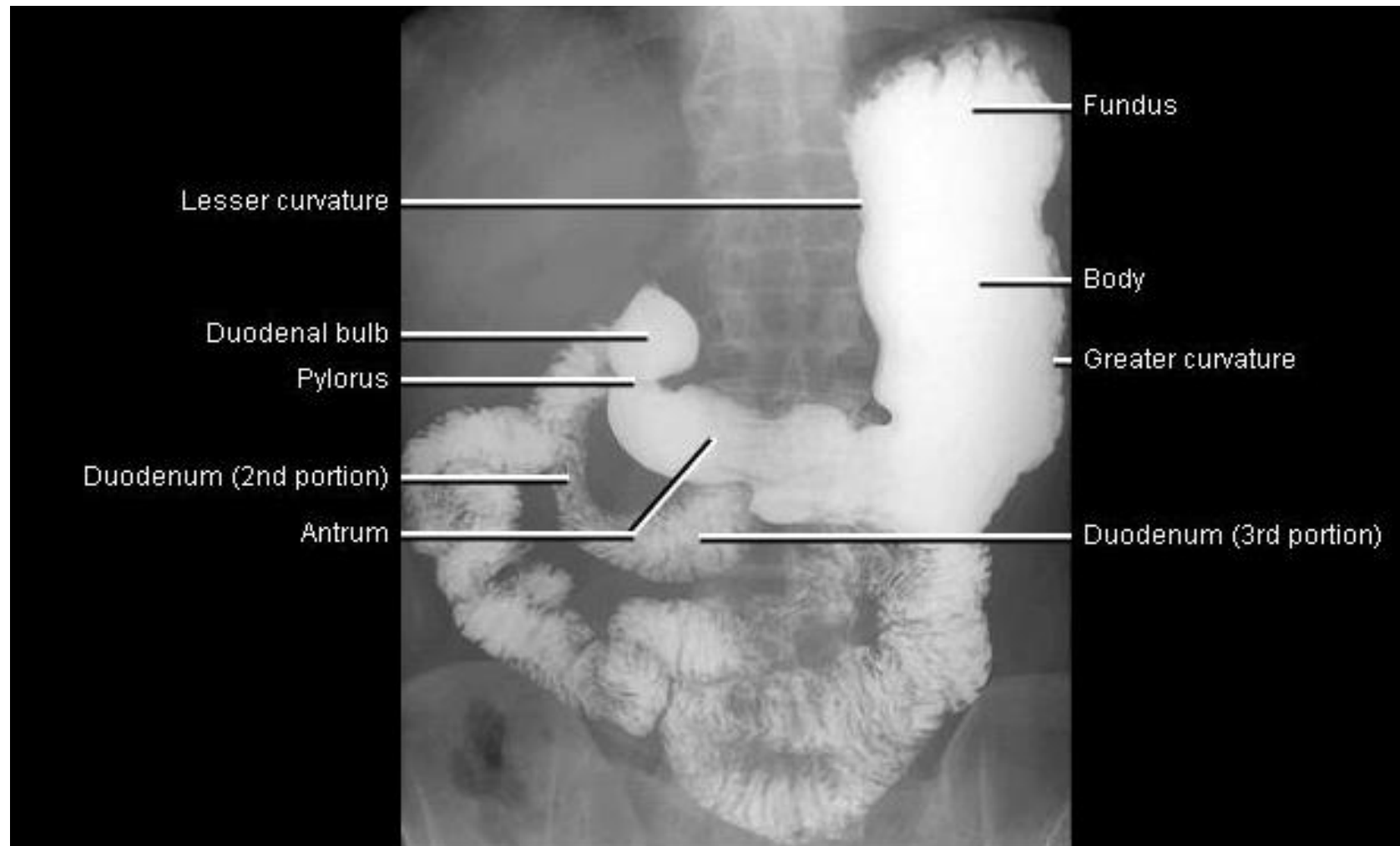
Fasting patient for at least 6 hours.

The stomach and duodenum

- To study the stomach and the first part of the duodenum, we use a barium meal.
- The stomach looks regular. The lesser curvature has a smooth surface. The greater curvature is usually irregular due to the presence of large amounts of rugae.
- There is a physiological constriction at the level of the pyloric sphincter.
- The duodenum forms a C-shaped loop around the head of pancreas
- The duodenum has a triangular shaped structure called the duodenal cap.

Normal barium meal

Normal Stomach



Abnormal barium meal

Intraluminal defects:

- food or blood
- hair forming ball or bezoar

Polyps:

- Single or multiple, sessile or have a stalk.

Polyps classified into 3 types based on pathology

Hyperplastic, adenomatous, & hamartomatous

Carcinoma:

- **produce an irregular filling defect with alteration of mucosal pattern**

- carcinoma diffusely involving the stomach is known as linitis plastica ("leather bottle"): Irregular narrowing/rigidity

.

Gastric Carcinoma



Graphic shows a large mass with a broad base and irregular surface.



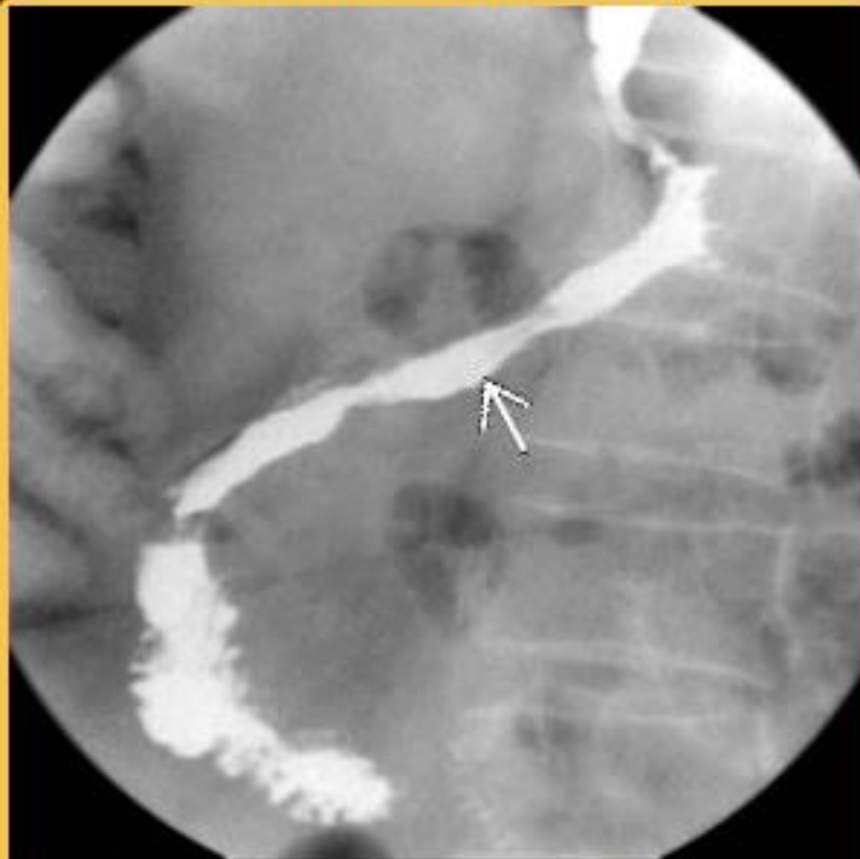
Upper GI series shows large mass (black arrow) with a broad base and an irregular nodular surface.



Upper GI series shows a mass (white arrow) as a filling defect in the barium pool on this supine film.

Linitis Plastica, Limited Distensibility

Gastric Carcinoma



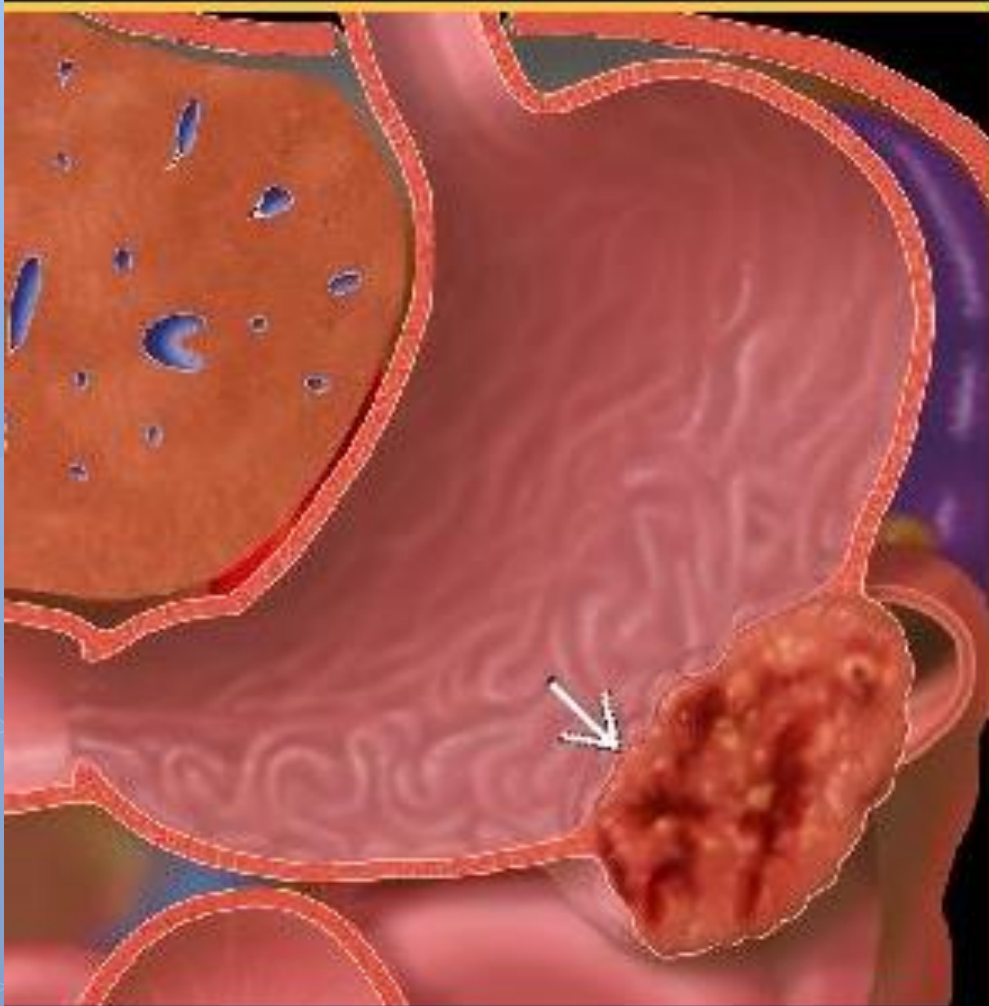
Upper GI shows a remarkably contracted and nondistensible stomach (white arrow) due to diffusely infiltrative gastric carcinoma, a classic linitis plastica appearance in an 82 year old man.

Metastases and Lymphoma, Gastric



Frontal upper GI shows nondistensibility of the distal body and antrum (white arrow) with retained food debris indicating gastric outlet obstruction; metastatic breast cancer in a 67 year old woman.

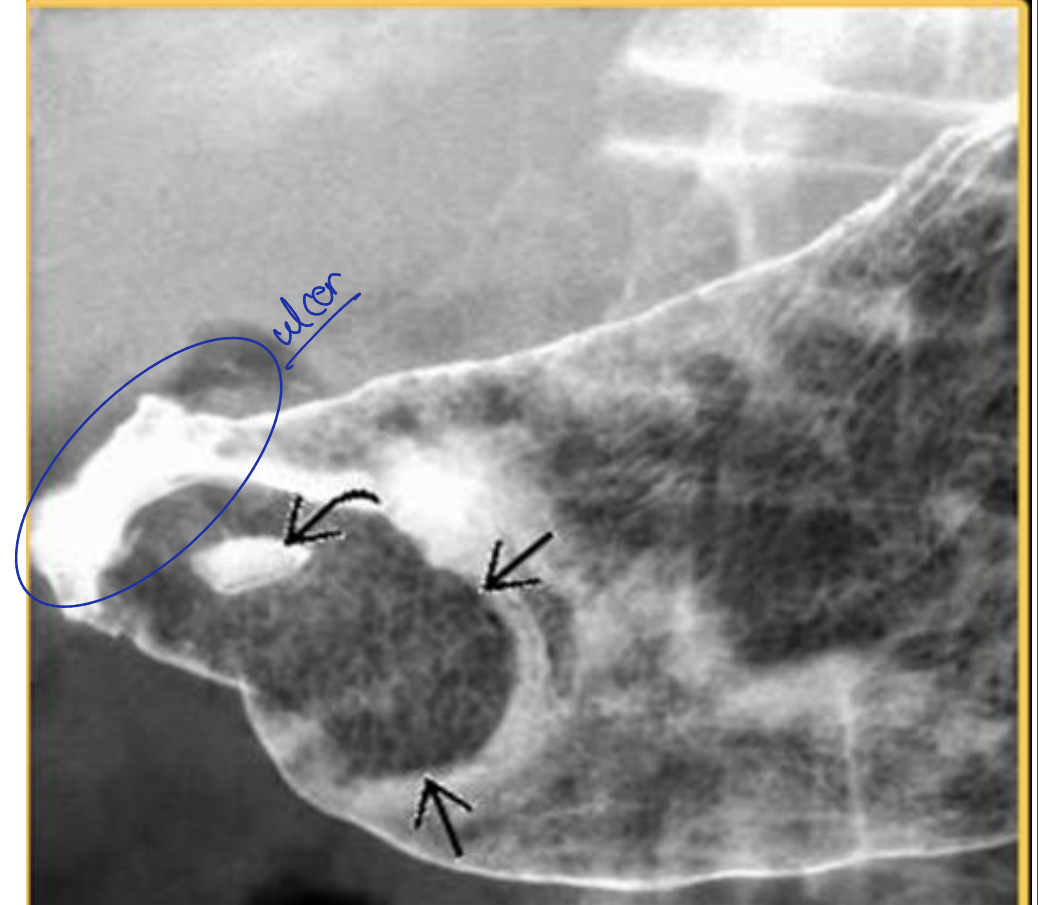
GIST, Gastric



Anatomic depiction of a gastric stromal tumor shows an exophytic submucosal mass (white arrow) with internal necrosis.

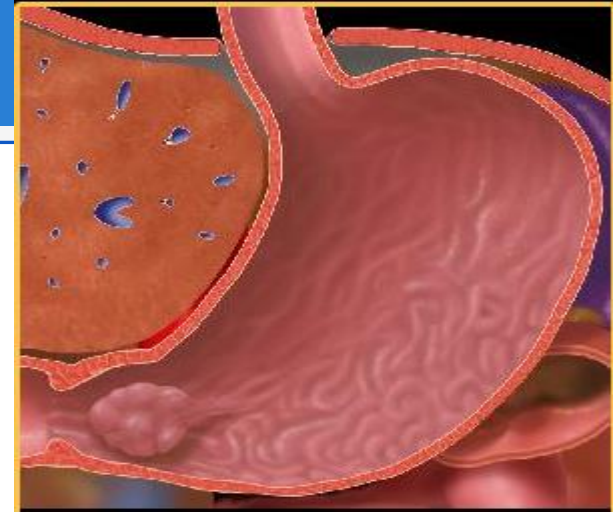
Intramural filling defect.

Mass with ulcer



Upper GI series shows a gastric antral mass (black arrow) with a central ulceration (black curved), typical of a gastric GIST. Note the otherwise intact mucosa over the mass, even with preservation of the areae gastricae.

Gastric Polyps



Film from an upper GI series in a 57-year-old man shows multiple small, sessile polyps (white arrow) in the gastric body. The appearance and age of the patient are typical for hyperplastic polyps.



Upper GI series shows a large adenomatous gastric polyp (black arrow).



an upper GI series demonstrate innumerable polyps
Hamartomatous Polyposis (Peutz-Jeghers Syndrome)

Gastric Ulcer



Graphic shows a gastric ulcer with smooth gastric folds radiating to the edge of the ulcer crater. Note the infolding of the gastric wall "pointing" toward the ulcer, known as the incisura sign.

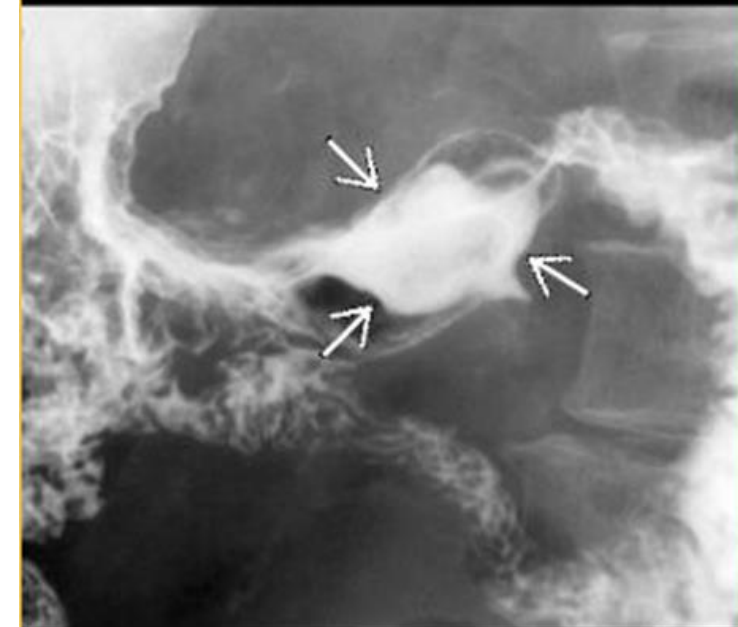


Upper GI series shows barium pool in ulcer crater (white arrow) with smooth folds radiating to the edge of the ulcer.

Benign

Malignant

Gastric Carcinoma



Upper GI shows a large antral ulcer (white arrow) (fixed collection of barium). The surrounding mass is less evident, although fluoroscopy showed a stiff, nonperistaltic distal body and antrum that was found to be a large carcinoma at surgery.

Distinguishing features between benign and malignant gastric ulcer

BENIGN ULCER

- 1-the ulcer projects beyond the lumen of the stomach.
- 2-the edge of the ulcer is **regular** and round when seen enface
- 3-usually on lesser curve, rarely on greater curve
- 4-**radiating mucosal folds** reach or near to the edge of the ulcer

MALIGNANT ULCER

- 1-the ulcer occurs within an **irregular filling defect**.
- 2-the edge of the ulcer is irregular
- 3-occur anywhere but ulcer on antrum and on greater curve are suspicious
- 4-the **mucosal folds are obliterated** some distance from the edge of the ulcer

The small intestine

The standard contrast examination for the small intestine is the barium, **small bowel follow-through**.

The patient drinks about 200 – 300 ml of barium and its passage through the small intestine is observed by taking films at regular intervals until the barium reaches the colon.

Transit time is very variable.

Patient lying prone during filming.

The normal barium follow-through

The small intestine occupies the central and lower abdomen, usually framed by the colon.

The terminal ileum enters the medial aspect of the caecum through the ileocaecal valve.

The small bowel diameter is normally not more than 25 mm.

Transverse folds of mucous membrane project in lumen of the bowel and barium lies between these folds, which appear as lucent filling defects of about 2-3 mm in width (valvulae conniventes).

The mucosal folds are largest and most numerous in the jejunum and tend to disappear in the lower part of the ileum.

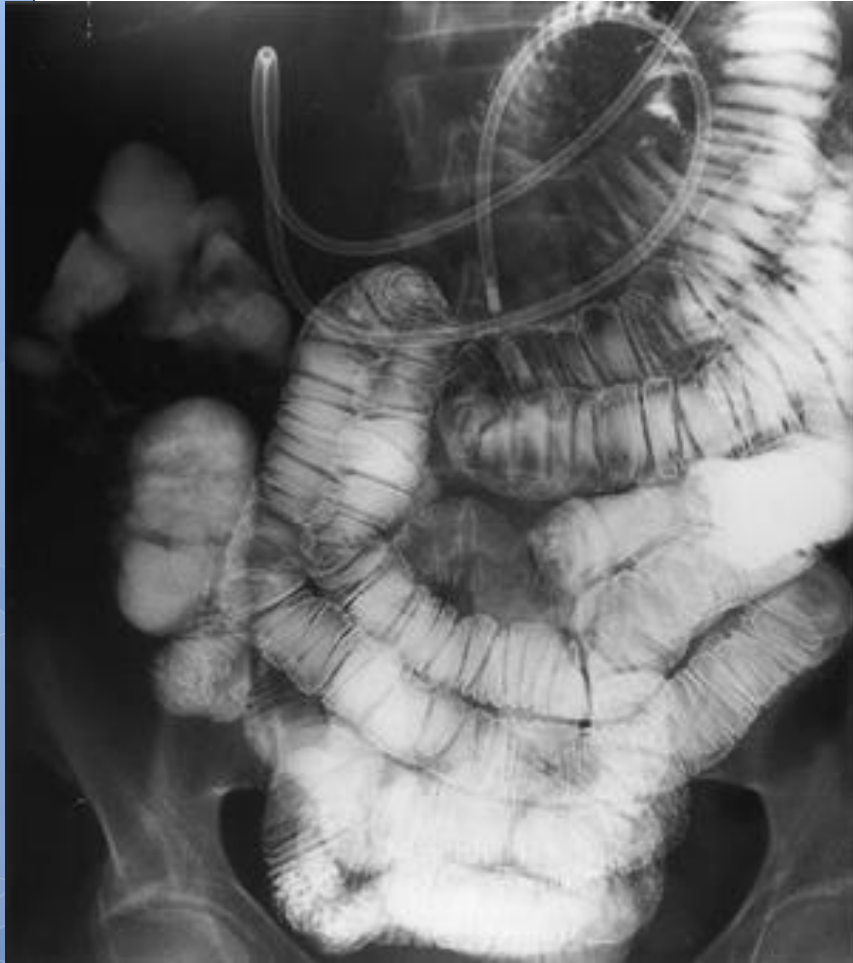
small bowel enema

An alternative method of examining the small bowel is the so-called small bowel enema (enteroclysis) which distends the bowel and gives excellent mucosal detail.

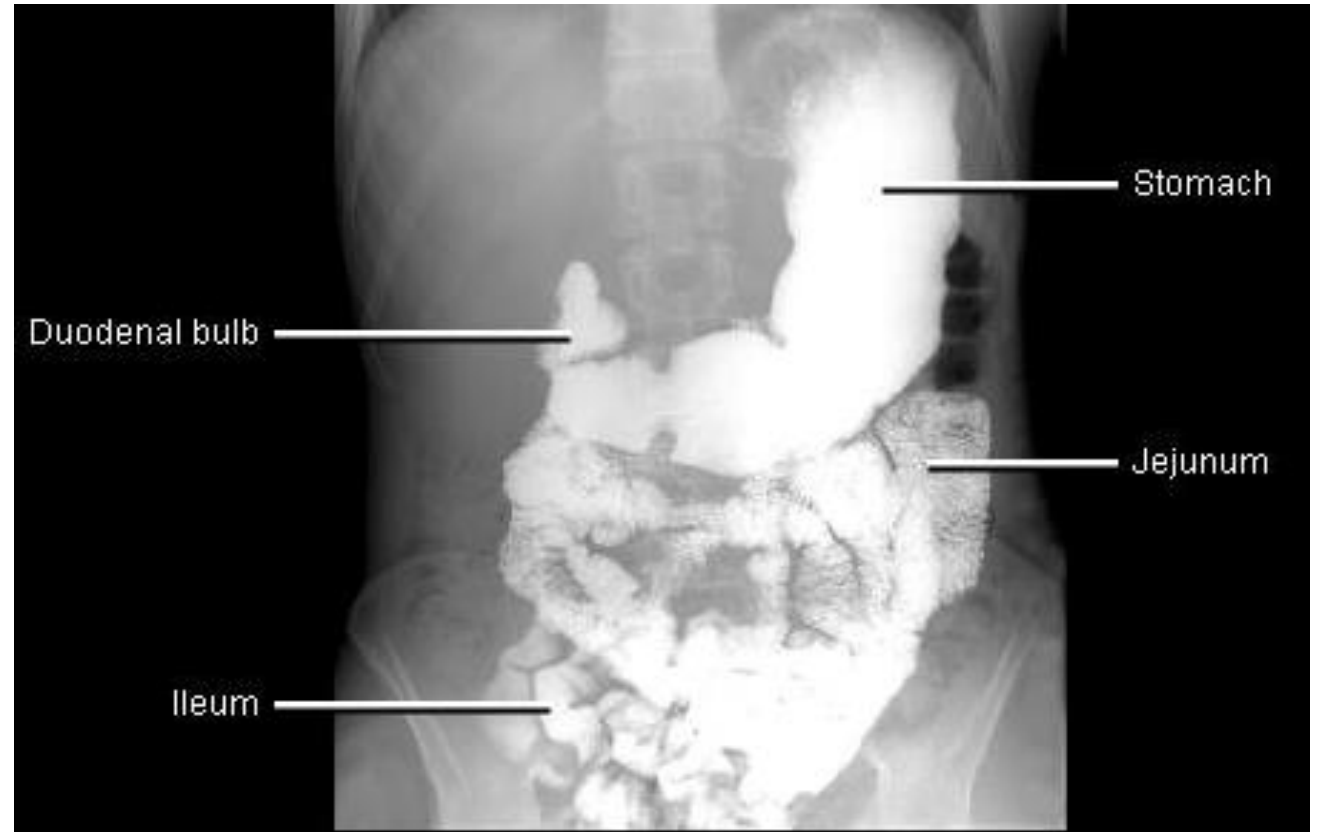
The technique is appropriate for structural deformities eg: Chron's disease or tumour.

Not used for malabsorption syndromes.

Enteroclysis, Normal Small Intestine



Double contrast



Single contrast

The abnormal barium follow-through

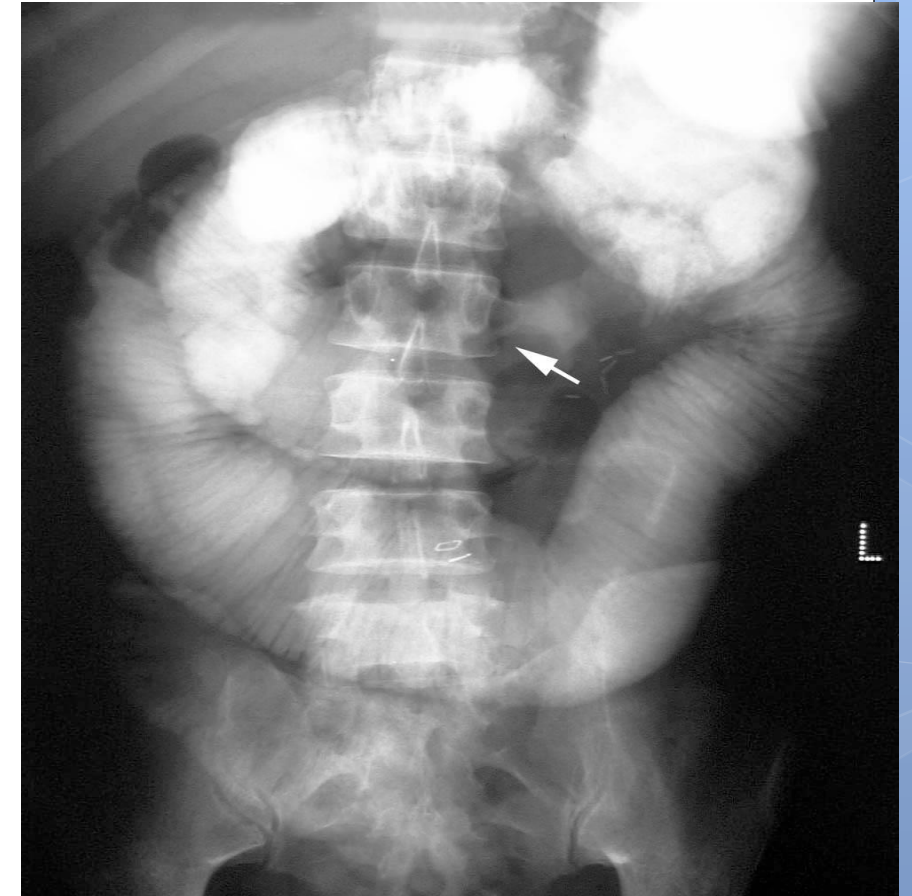
Dilation:

⑩ over 30 mm is definitely abnormal.

Indicates: malabsorption

Paralytic ileus

Small bowel obstruction.



Water-soluble contrast upper GI examination in a patient with clinical features of small-bowel obstruction and a history of surgery for large bowel cancer. The contrast-enhanced study shows dilated loops of small bowel, with stretching of the mucosal folds and a narrowed segment ending in a beak (arrow). At surgery, a small-bowel obstruction from extrinsic compression was found to be the result of mesenteric metastases.

The abnormal barium follow-through

Mucosal abnormality

The folds become thickened in many conditions

eg:

- malabsorption starts with oedema and haemorrhage in the bowel wall.
- Inflamed.
- Infiltrated.

Narrowing

Common causes are :

- Crohn's disease
- Tuberculosis
- Lymphoma
- Strictures do not contain normal mucosal folds and usually result in dilation of the bowel proximally.
- Normal narrowing caused by peristaltic waves.

The abnormal barium follow-through

Alteration in position

Congenital malrotation, common in this condition volvulus associated with abnormal mesenteric attachments.

Displacement by mass.

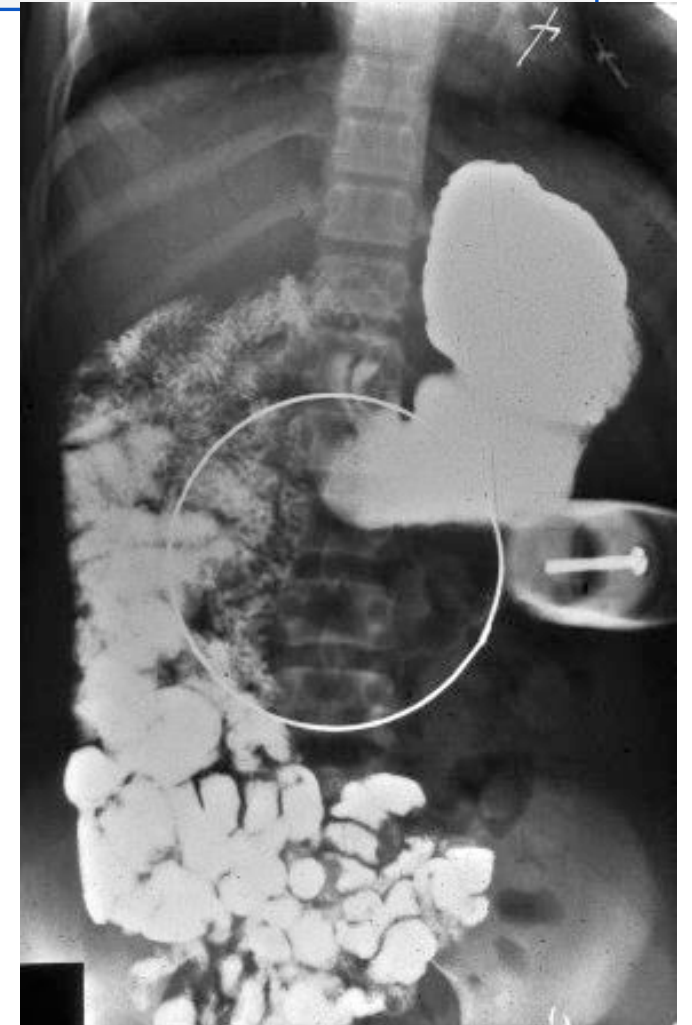
Ulceration

The outline of the small bowel should be smooth.

ulcers appear as spikes projecting outwards which may be shallow or deep.

Seen in Crohn's disease, tuberculosis, lymphoma.

A cobblestone appearance (combination between ulceration and mucosal oedema).



Upper GI contrast study showing a **malrotation** with lack of normal C-shaped duodenum and the small bowel "hanging" on the right side of the abdomen.

Large intestine

- single contrast technique
- double contrast technique -

Washout is most important to rid the colon of the faecal material which might otherwise mask small lesions and cause confusion by simulating polyps.

Calibre decrease from caecum to the sigmoid colon.
Lips of ileocaecal valves

Haustra can usually be recognised in the whole of the colon as though may be absent in the descending and sigmoid regions.

The abnormal barium enema

Narrowing of the lumen; spasm often seen in normal patient or in conjunction with diverticular disease, inflammatory disorders abolished by IV smooth muscle relaxant eg: buscopan, glucagons.

Strictures : main causes:

- carcinoma
- diverticular disease
- Crohn's disease
- Ischaemic colitis

Different types of strictures

- Neoplastic stricture -
Shouldered edges, an irregular lumen and rarely more than 6 cm.
- Benign stricture have tapered ends, relatively smooth outline and may be any length.

- 10 **Site** of stricture can help limiting to the D/D.
- 10 Diverticular disease are almost always confined to the sigmoid colon.
- 10 Ischaemic strictures are usually confined between splenic flexure and the sigmoid colon.
- 10 Crohn's disease and tuberculosis have predilection for the caecum.

The abnormal barium enema

Dilation

Causes of dilation of the colon are:

- obstruction
- paralytic ileus
- volvulus
- ulcerative colitis with toxic dilation
- Hirschsprung's disease and megacolon

Filling defects

- polyps.
- neoplasm
- faeces (surrounded by barium and freely moveable) so all enema should be done to clean the colon.

Ulceration

Two major causes of the Ulcers of the colonic mucosa

- ulcerative colitis
- crohn's disease

Crohn Disease

More severe disease with transmural inflammation

is an idiopathic inflammatory bowel disease (IBD), characterised by widespread gastrointestinal tract and systemic involvement.

Epidemiology

The diagnosis is typically made between the ages of **15 and 25 years** of age, with no gender predilection. There is a **familial** component and incidence also varies with geographical location.

Clinical presentation

Clinical presentation is typically with **chronic diarrhoea and recurrent abdominal pain**. Alternatively patients may present with one of the many complications or extraintestinal manifestations (see below).

Association with fistulas and peri-anal disease.

Pathology

Crohn's disease remains **idiopathic**, although infective agents have been gaining in popularity as possible candidates, including the measles virus and atypical mycobacterium. As there are definite genetic factors at play, multiple factors are likely to contribute.

Extraintestinal manifestations include: 10

skin 10

erythema nodosum 10

pyoderma gangrenosum 10

joints 10

arthritis 10

ankylosing spondylitis 10

sacroiliitis 10

eyes 10

episcleritis 10

iritis 10

uveitis 10

10 liver and biliary system

10 pericholangitis

10 primary sclerosing cholangitis (PSC) (more common in ulcerative colitis)

10 autoimmune hepatitis

10 cirrhosis

10 gallstones, seen in 30 - 50% 8

10 hepatic abscess 8

10 pancreatitis

10 renal tract : renal calculi containing oxalate

Radiographic features

The characteristic of Crohn's disease is the presence of **skip lesions**.

The frequency with which various parts of the gastrointestinal tract are affected varies widely 5:

small bowel : 70 - 80 % 5-6

small and large bowel : 50 %

large bowel only : 15 - 20 %

Barium small bowel follow-through:

mucosal ulcers

aphthous ulcers or deeper transmural ulcers

typically either longitudinal or circumferential in orientation

when severe leads to cobblestone appearance

may lead to sinus tracts and **fistulae**

widely separated loops of bowel due to fibro-fatty proliferation
(creeping fat) 2

thickened folds due to oedema

partial obstruction

CT

fat halo sign

comb sign

bowel wall enhancement

bowel wall thickening (1 - 2cm) which is most frequently seen in the terminal ileum (present in up to 83% of patients) 8.

strictures and fistulae

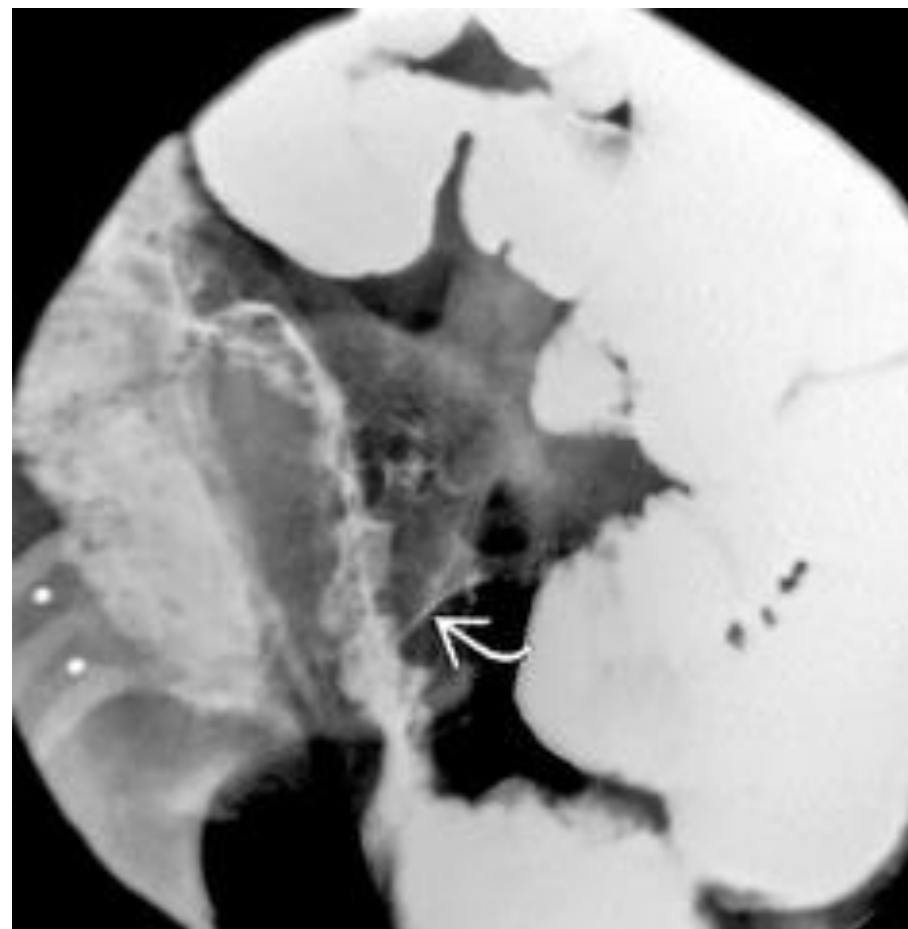
mesenteric / intra-abdominal abscess or phlegmon formation 8

abscesses are eventually seen in 15 - 20% of patients 8

CT is also able to give valuable information on:

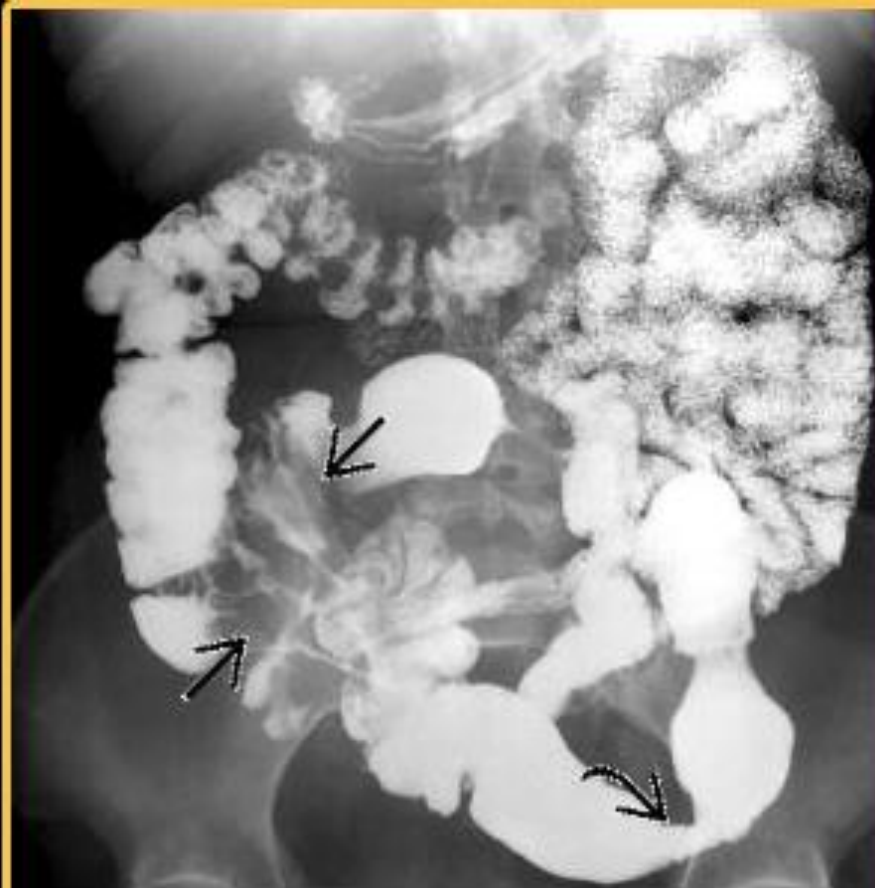
perianal disease

hepatobiliary disease



Small bowel follow through shows longitudinal and transverse ulcerations of the ileal mucosa ("cobblestoning") and luminal narrowing. The opacified sinus tract (white curved) is also seen.

Crohn Disease



SBFT in a 26-year-old woman presenting with RLQ pain and fever demonstrates severe small bowel strictures, fistulas (black arrow), and ulceration with skip areas (black curved).



Small bowel follow through shows chronic Crohn disease. Note the mucosal "cobblestoning" (white arrow) and wide separation of the loops from creeping fat (white open).

Crohn Disease



SBFT shows a "cobblestone" appearance of a terminal ileum, due to longitudinal, transverse ulcerations (white arrow).

*Skipped
lesions*



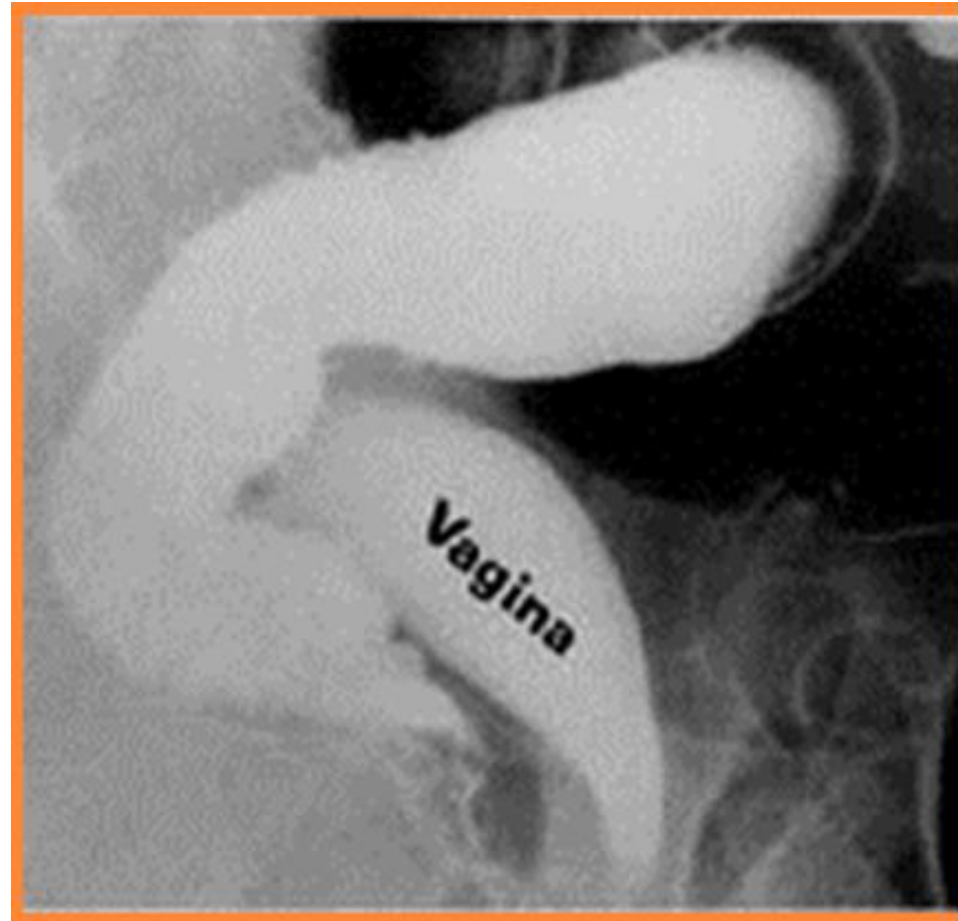
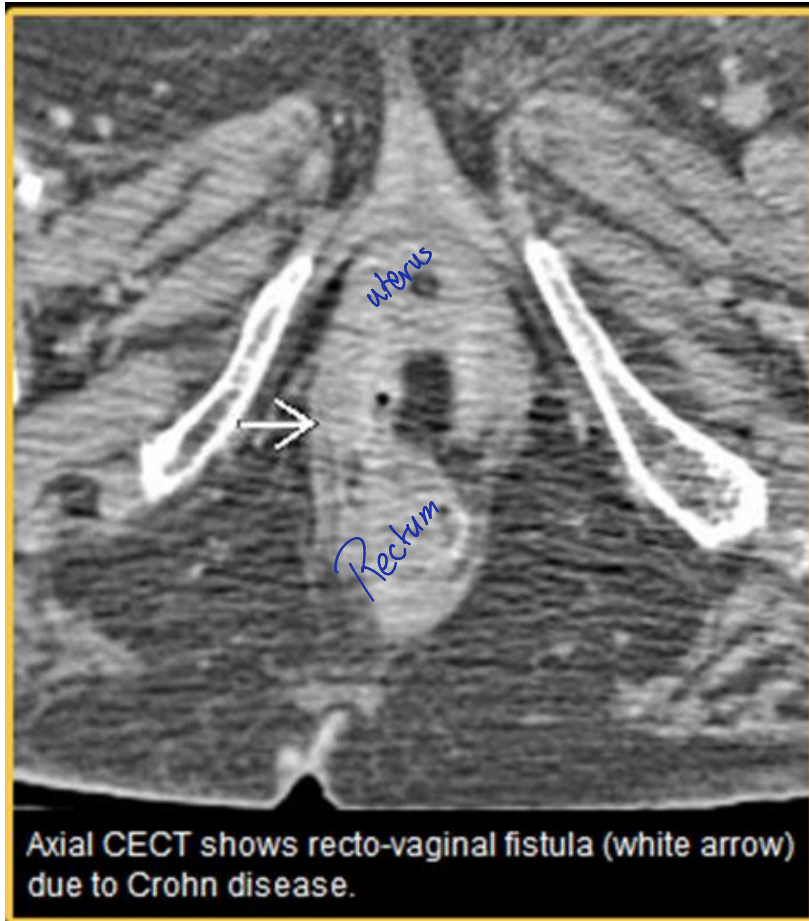
Coronal CT enterography curved planar reconstruction through the diseased segment of the terminal ileum in the same patient reveals skip areas of involvement with 2 areas of stricture formation (white arrow).

Crohn disease. CT scan obtained with oral contrast material shows low-attenuation submucosal fat in the ascending colon (arrow) and fibrofatty proliferation of adjacent mesenteric fat (*).



Crohn Disease

RECTOVAGINAL FISTULA



Ulcerative Colitis

Ulcerative colitis (UC) is an inflammatory bowel disease which predominantly **affects the colon**, but also has extraintestinal manifestations.

Epidemiology

Typically ulcerative colitis manifests in **young** adults (15 - 40 years of age) and is more prevalent in **males**. A combination of environmental and genetic factors are thought to play a role in the pathogenesis, although the condition remains idiopathic.

Clinical presentation

Clinically patients **have chronic diarrhoea associated with tenesmus, pain and fever**

Pathology

Unlike Crohn's disease which is characteristically a **transmural disease**, ulcerative colitis is usually **limited to the mucosa** 1. Chronic disease is associated with a significantly **elevated malignancy risk**, of up to 0.5 - 1.0% per year after 10 years of disease.

The diagnosis is often made with endoscopy, which also allows biopsy of any suspicious areas.

Associations

primary sclerosing cholangitis (PSC)

moya moya phenomenon

ankylosing spondylitis

Radiographic features

Involvement of the rectum is almost always present (95%) 1, with the disease involving variable amounts of the more proximal colon, in continuity.

The **entire colon** may be involved, in which case oedema of the terminal ileum may also be present (so-called back-wash ileitis).

In very severe cases, the colon becomes atonic, with marked dilatation, worsened by bacterial overgrowth. This leads to toxic megacolon which although uncommon has a poor prognosis.

Plain film

Mural thickening is common, **with** thumbprinting also seen in more severe cases.

Barium enema

Mucosal inflammation lends a granular appearance to the surface of the bowel. As inflammation increases, the bowel wall and haustra thicken.

Mucosal ulcers are undermined (button-shaped ulcers). When most of the mucosa has been lost, islands of mucosa remain giving it a pseudo-polyp appearance.

In chronic cases the bowel becomes featureless with loss of normal haustral markings, luminal narrowing and bowel shortening (lead pipe sign).

Colorectal carcinoma in the setting of ulcerative colitis is more frequently sessile and may appear to be a simple stricture.

CT

CT will reflect the same changes that are seen with a barium enema, with the additional advantage of being able to directly visualise the colonic wall, the terminal ileum and identify extra-colonic complications, such as perforations or abscess formation. It is important to note however that CT is insensitive to early mucosal disease.

In chronic cases, submucosal fat deposition is seen particularly in the rectum (fat halo sign). Also in this region, extramural deposition of fat, leads to thickening of the perirectal fat, and widening of the presacral space 1,2.

Colorectal carcinoma is often sessile. Focal loss of mural stratification or excessive mural thickness (> 1.5 cm) should prompt endoscopic evaluation

Ulcerative Colitis



Graphic illustration demonstrates innumerable "collar button" ulcers and a loss of haustra throughout the descending and sigmoid colon.



Single-contrast barium enema (BE) shows innumerable "collar button" ulcers and loss of haustra throughout the descending colon.



Single-contrast BE shows an ahastral colon due to chronic UC. Note the apple core stricture of the transverse colon (white arrow) due to adenocarcinoma.

Ulcerative Colitis



Single-contrast barium enema (BE) shows prominent, thickened haustra in the right colon, but diminished haustra in the left colon.



Axial CECT shows a narrowed lumen and the thickened wall of the sigmoid colon with submucosal edema and engorged vessels.

Ulcerative Colitis



Axial CECT shows an acute UC flare. Note the marked diffuse colonic wall thickening with hyper-enhancement of mucosa (white arrow). The low attenuation in the bowel wall is due to submucosal edema.



Coronal CECT in the same patient shows thumbprinting of the bowel wall from submucosal edema (white open).

Differences between crohn disease and ulcerative colitis



CROHN DISEASE

- 1) Rectum involved in half the cases
- 2) Colon may be affected segmently (skip lesion)
- 3) Ulcer deep
- 4) Some cases show asymmetrical loss of haustra

ULCERATIVE COLITIS

- 1) Rectum involved in all the cases
- 2) Colon always affected continuously
- 3) Ulcer shallow
- 4) Symmetrical loss of haustra is the rule

Differences between crohn disease and ulcerative colitis

5)Fistulae are feature
6)Anal or perianal lesions frequent
7)Small bowel involvement common particularly terminal ileum with narrowing the ileo-ceacal valve.

5)Fistulae very rare
6)Anal or perianal lesions uncommon
7)Small bowel normal -dilatation of the terminal ileum may be seen.

Diverticular disease

Definitions

Asymptomatic **outpouching** of colonic mucosa and submucosa,
most commonly in **sigmoid colon**

General Features

Best diagnostic clue: Rounded or oval colon wall outpouchings

Location

Primarily sigmoid colon, but may occur in any segment except rectum

Size: 5-10 mm

Fluoroscopic Findings

Contrast enema

Better detected with air contrast than single contrast

Diverticulum with large neck; may resemble sessile polyp

Air-filled diverticula project out from bowel lumen

Appearance of diverticula varies depending on degree of air vs. barium in diverticulum

CT Findings

Outpouching filled with air, stool, or contrast agent

Normal pericolic fat planes

No pericolic fluid or fat stranding

Diverticulosis, Colonic



Graphic illustrates sigmoid diverticula, luminal narrowing, and wall thickening (circular muscle hypertrophy). There is a pericolic abscess due to the perforated diverticulum, but the rectum is spared.

CT scan



Axial CECT in a 74-year-old asymptomatic man, scanned for routine surveillance of a known carcinoid tumor of the small bowel, demonstrates numerous air-filled diverticula involving the sigmoid colon (white arrow).

Double contrast



Sigmoid Volvulus

Causes:

- constipation
- laxative overuse

Definitions

Torsion or twisting of sigmoid colon around its mesenteric axis

General Features

Best diagnostic clue: Dilated sigmoid colon with inverted "U" configuration and absent haustra

Location: Midline; **directed toward RUQ or LUQ**; elevation of hemidiaphragm

Radiographic Findings

Radiography

Sigmoid volvulus

Diagnostic in 75% of cases

Closed loop obstruction: Segment of bowel obstructed at 2 points

Absent rectal gas in spite of prone or decubitus views

Inverted "U" shape with absent haustra

CT

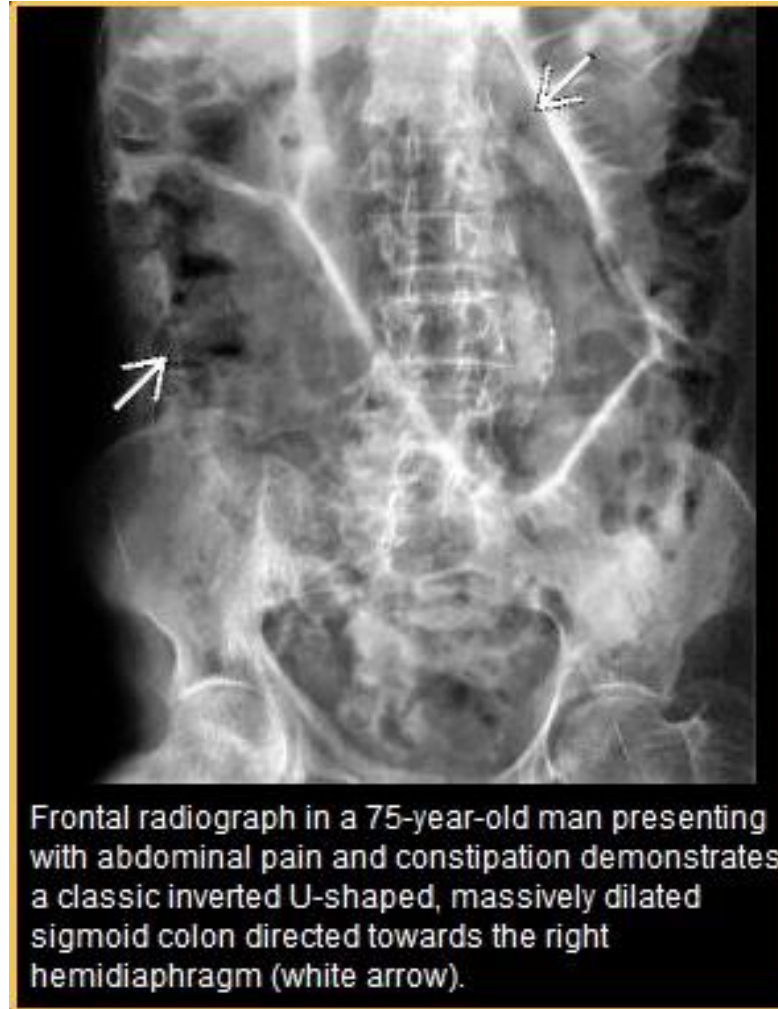
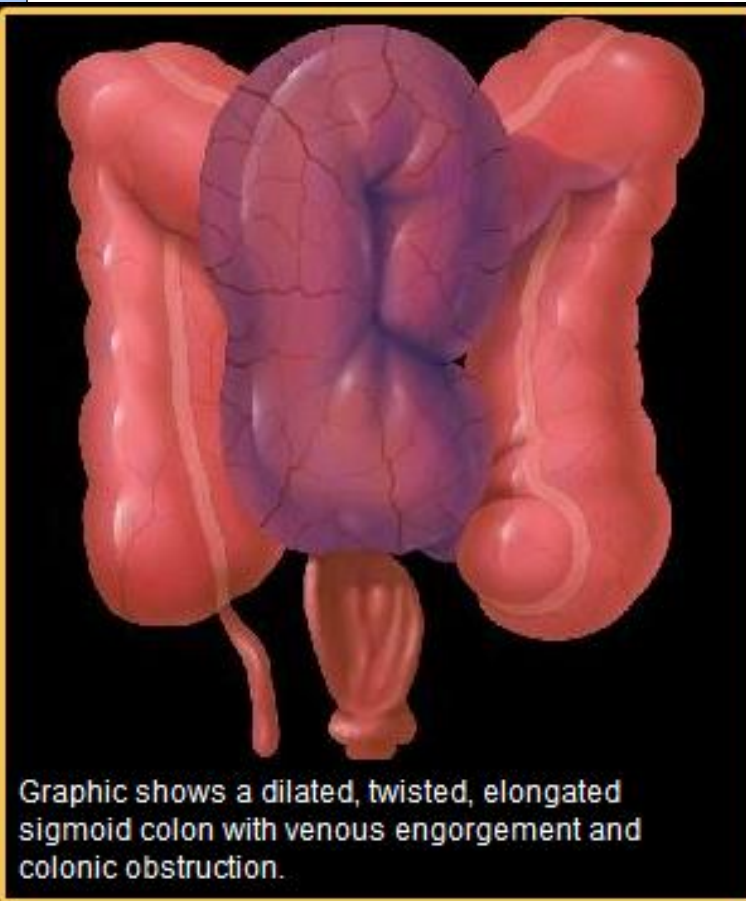
"Beaking": Progressive tapering of afferent and efferent limbs leading into twist

"Whirl" sign: Tightly twisted mesentery and bowel

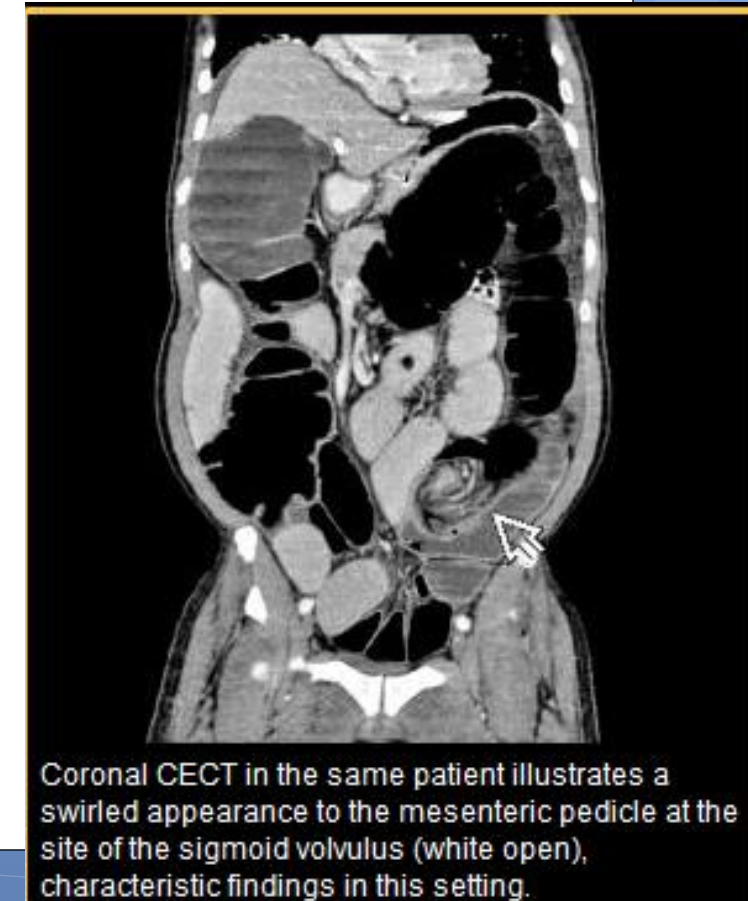
Compound volvulus: Medial deviation of distal left colon with pointed appearance of medial border

Sigmoid Volvulus

Coffee bean sign on X-ray



Whirlpool sign on CT scan



Sigmoid Volvulus

Coffee bean shaped



Cecal Volvulus

Definitions

Rotational twist of right colon on its axis

General Features

Best diagnostic clue: Dilated, twisted cecum with **tip pointing to LUQ**

Imaging Recommendations

Best imaging tool: Contrast enema or CT

Radiographic Findings

Radiography

Dilated, air-filled cecum in LUQ

Single, long air-fluid level

Medially placed ileocecal valve → soft tissue indentation → gas-filled cecum with kidney or **coffee bean shape**

Markedly distended gas or fluid-filled small bowel, little gas in distal colon

CT Findings

CECT

"Beaking": Progressive tapering of afferent and efferent limbs leading into twist

"Whirl" sign: Tightly twisted mesenteric vessels

Cecal Volvulus



Graphic shows a twist (volvulus) (white arrow) of the ascending colon, obstructing the lumen and blood supply. The cecum (white curved) on the mesentery is dilated and displaced toward the LUQ.



Supine radiograph shows a dilated cecum in the mid-abdomen pointed toward the left upper quadrant.



Axial CECT in the same patient shows the dilated small bowel extending down to the cecum (white open) in the left mid-abdomen. Note the compressed, stool-filled sigmoid colon (white arrow) deviated by the dilated cecum. The fact that the cecum is not visualized in the RLQ is a clue that this dilated structure represents a twisted cecum.

Whirlpool sign midgut volvulus



Colon Carcinoma

Malignant transformation of colonic mucosa

Imaging

Location: Cecum (10%), ascending colon (15%), transverse colon (15%), descending colon (5%), sigmoid colon (25%), rectosigmoid colon (10%), rectum (20%)

Radiology is critical for screening, diagnosis, treatment, and follow-up of colorectal carcinoma

Detection: Double contrast barium enema

Early cancer: Sessile (plaque-like) lesion or thick, short polyp

Advanced cancer: Large polyp, "saddle" or **"apple core" lesion**

Staging: Helical CT

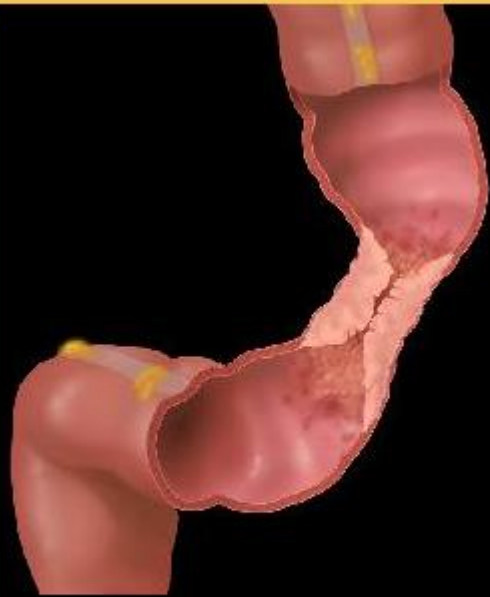
Asymmetric mural thickening ± irregular surface

Pericolonic fat infiltration; spread to adjacent organ

Metastases to mesenteric nodes, peritoneum, liver

Tumor recurrence and surveillance: PET CT

Colon Carcinoma



Graphic shows an "apple core" constricting tumor of the sigmoid colon with circumferential narrowing of the lumen and a nodular tumor surface, the typical appearance of a left-sided cancer. These patients often complain of constipation and rectal bleeding.



Single contrast barium enema shows a classic "apple core" lesion of the sigmoid colon. Note the short segment, irregular, circumferential narrowing of the lumen with destroyed mucosa and nodular "shoulders."



Axial CECT shows a large eccentric mass (white arrow) in the ascending colon with extensive infiltration of pericolic fat and lymphadenopathy (white open).

Rectal Carcinoma



Single contrast BE shows a mass (black arrow) arising from the anterior rectal wall as a filling defect in the barium pool.



Air contrast BE shows a large mass arising from the lateral wall of the rectum.



Axial CECT of extensive lymphadenopathy (white arrow) shows a large mass that fills the rectal lumen and infiltrates the perirectal fat.

Intussusception

Definitions 10

Invagination or **telescoping of proximal segment of bowel (intussusceptum) into lumen of distal segment (intussusciens)** 10

General Features 10

Best diagnostic clue: **Bowel-within-bowel**, 10
"coiled spring" appearance

Location 10

Ileoileal > ileocolic > colocolic 10

Usually small bowel (SB) in adults, 10
ileocolic in children*

10 Radiographic Findings

- 10 Radiography: Air-fluid levels, proximal bowel dilatation, absence of gas in distal collapsed bowel
- 10 Fluoroscopic Findings
- 10 Fluoroscopic guided barium study
 - 10 Retrograde barium study: Convex intracolonic mass with **"claw" sign**
 - Due to trapping of contrast between folds of intussusceptum & intussusciens

Ultrasonographic Findings

Grayscale ultrasound

Transverse US: **"Target," "doughnut,"** or "bull's-eye" sign

Peripheral hypoechoic halo: Edematous wall of intussusciens

Intermediate hyperechoic area: Space between intussusciens and intussusceptum

Internal hypoechoic ring

Longitudinal US: **"Pseudokidney" sign**

Multiple, thin, parallel, hypoechoic and echogenic stripes

Color Doppler: Mesenteric vessels dragged between entering and returning wall of intussusceptum

10

10

10

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CT Findings

10

10

"Target" sign: Earliest stage

10 Outer layer represents intussusciens, inner layer represents intussusceptum

10

Sausage-shaped mass: Layering pattern (later phase)

10 Alternating layers of low-attenuation mesenteric fat, high-attenuation bowel wall

10 Enhancing mesenteric vessels

Intussusception



Graphic shows ileocolic intussusception with a tumor in the bowel wall as the "lead mass." Note the vascular compromise and ischemia.



Radiograph shows a soft tissue prominence over ascending and transverse colon (black arrows) with visible large soft tissue mass (white arrows) surrounded by meniscus of gas.



Air enema (initial image) shows air-filled descending colon with large soft tissue mass (arrows) confirming intussusception in transverse colon.

Intussusception

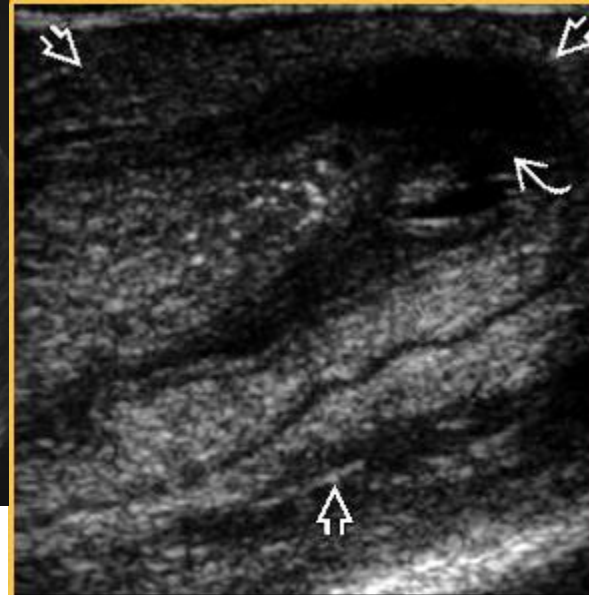
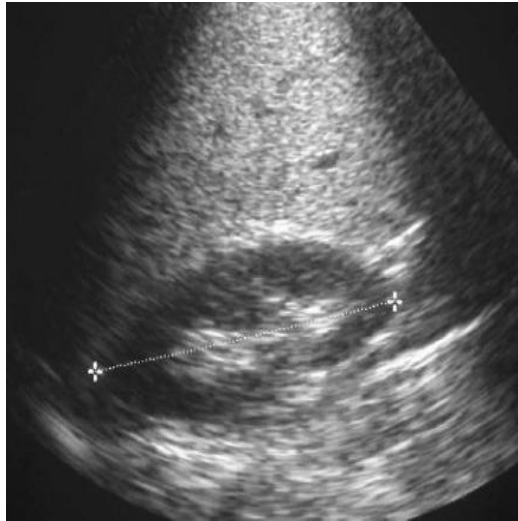
Claw sign Intussusception



Barium enema shows colo-colic intussusception involving transverse colon. Note proximal intussusceptum (white curved) invaginating into distal intussusciens (white open), with classical "claw sign".

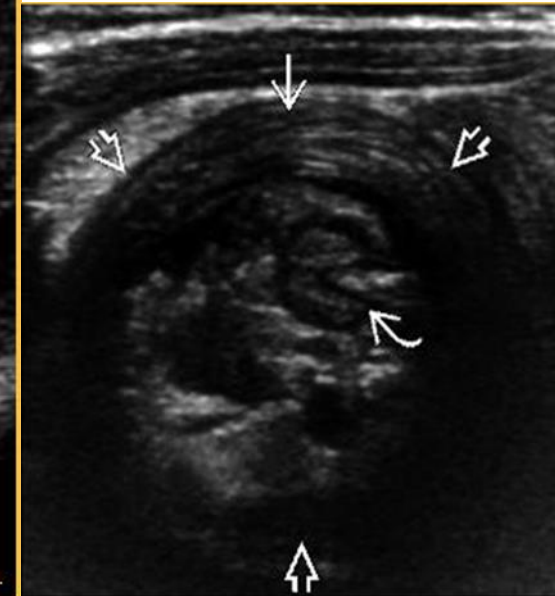
Intussusception

Renal Ultrasound



Longitudinal transabdominal ultrasound shows multilayered appearance of intussusception (white open) giving rise to "pseudokidney" sign. Note minimal fluid trapped between layers (white curved).

Typical, US, Pseudokidney appearance



Transverse transabdominal ultrasound shows classical "target" or "doughnut" sign of intestinal intussusception (white open). Note ring in ring appearance formed by different layers (white arrow) of intestine & central lymph node (white curved) acting as lead point.

Typical, US, Target sign

Colonic Polyps

Definitions

Protruding, space-occupying lesion within colonic lumen.

General Features

Best diagnostic clue: Smooth-surfaced intraluminal small mass on CT colonoscopy or barium enema

Location: Sigmoid (41%)*, Cecum (4%), ascending colon (6%), hepatic flexure (4%), transverse (2%), splenic flexure (8%), descending (20%), rectum (23%)

Morphology

Sessile polyps: Broad base with little or no stalk

Pedunculated polyps: Arise from narrow stalk

Other general features

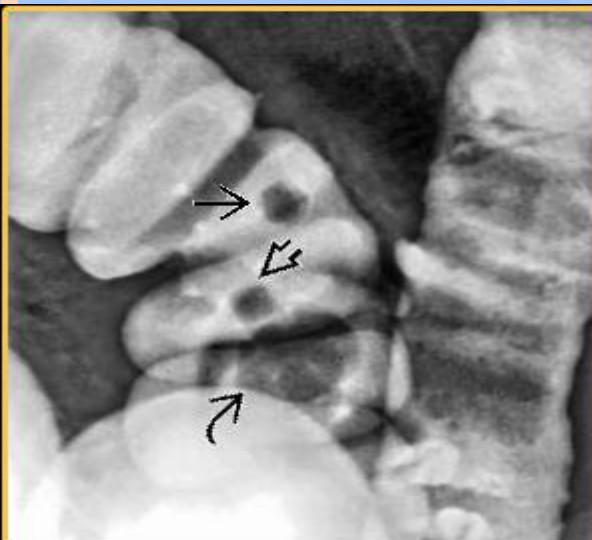
2 types of colon polyps

Neoplastic: Adenomatous (tubular, tubulovillous, and villous)

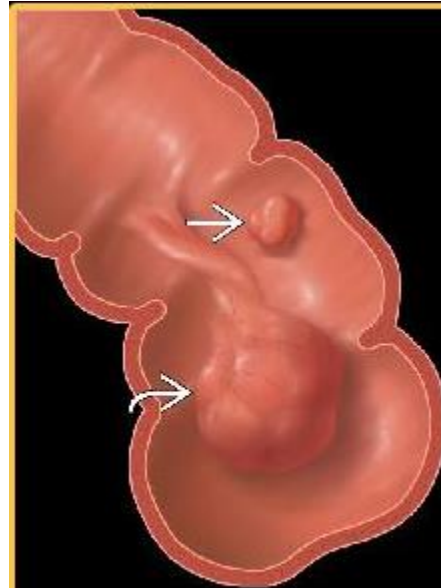
Nonneoplastic: Hyperplastic, hamartomatous, and inflammatory

Best imaging tool: CT colonography (CTC) or air-contrast barium enema

Colonic Polyps



Single contrast barium enema shows a tubulovillous adenoma with a large head (black curved) and a long stalk (black open). A small sessile polyp (black arrow) is also seen.



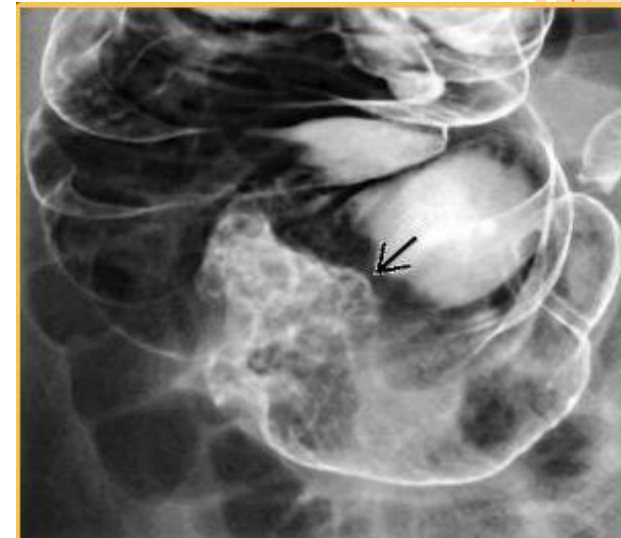
Graphic shows a tubulovillous adenoma on a long stalk (white curved) and a small sessile polyp (white arrow).



Air contrast barium enema shows numerous diverticula (white arrow) and a large pedunculated polyp on a stalk (black arrow) in this patient with tubulovillous adenoma. In a patient with known diverticulosis, it is often much easier to perform and interpret a single contrast rather than an air (double) contrast barium enema.



Air contrast barium enema shows a small sessile tubular adenoma (white arrow). The dome of the "bowler hat" points toward the colonic lumen.



Air contrast barium enema shows a large sessile polyp (black arrow) in the cecum, having the typical appearance of a villous adenoma, with a cauliflower-like surface irregularity.

Acute Calculous Cholecystitis

Definitions

Acute inflammation of gallbladder (GB) secondary to calculus obstructing cystic duct

General Features

Best diagnostic clue

Impacted gallstone in cystic duct

Gallbladder wall thickening

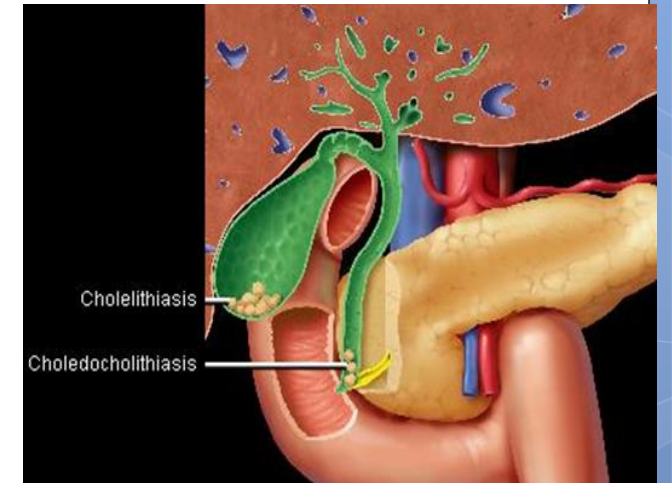
Pericholecystic collection

Positive sonographic Murphy sign

Location: Stone impacted in GB neck or cystic duct

Size: Distended GB (> 5 cm transverse diameter)

Morphology: Distended GB more rounded in shape than normal "pear-shaped" configuration



Grayscale **ultrasound**

Uncomplicated cholecystitis

GB wall lucency "halo sign", sonolucent middle layer (edema)

Positive sonographic Murphy sign

Diffuse GB wall thickening (> 4 mm)

GB hydrops: Distension with AP diameter > 5 cm

Clear pericholecystic fluid

CT Findings

CECT

Uncomplicated cholecystitis

GB wall thickening

Increased mural enhancement

Pericholecystic fat stranding, pericholecystic fluid

Gallstones inside GB neck or cystic duct

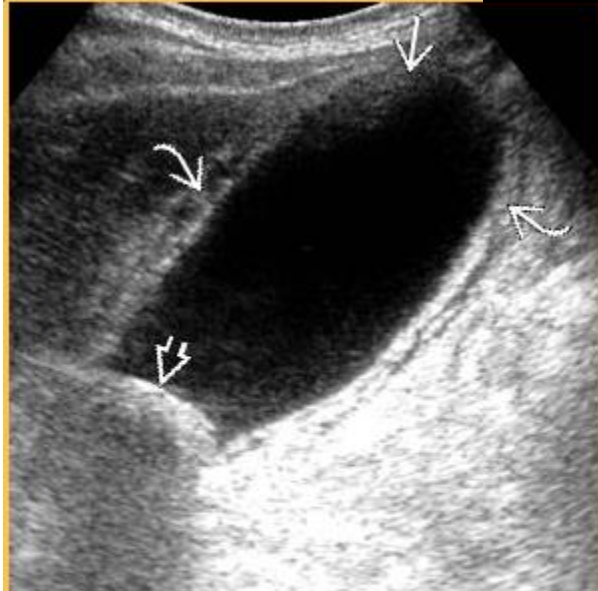
Complicated cholecystitis

Intramural or pericholecystic abscesses leading to asymmetric GB wall thickening

Gas in lumen and/or wall of gallbladder

High attenuation gallbladder hemorrhage

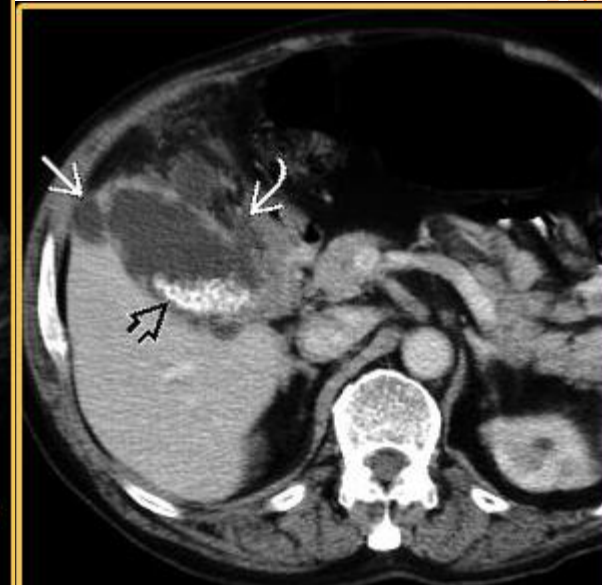
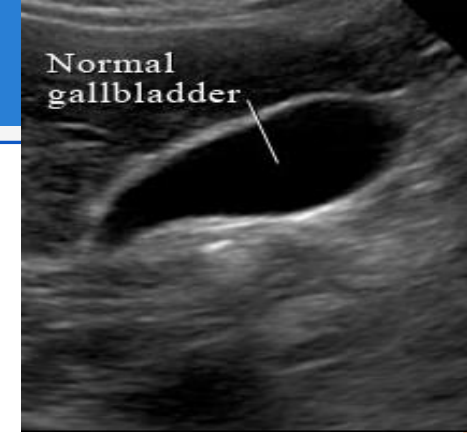
Acute Calculous Cholecystitis



Oblique transabdominal ultrasound shows a distended gallbladder (white arrow), with an impacted gallstone (white open) at the gallbladder neck and diffuse wall thickening (white curved).



Longitudinal ultrasound in a 50-year-old woman with RUQ pain and focal tenderness reveals a large echogenic stone (white curved) with an acoustic shadow (white arrow) and a thickened gallbladder (calipers).



Transverse CECT shows a pericholecystic collection (white arrow) with perigallbladder stranding (white curved) and multiple intraluminal calculi (black open).

Acute Pancreatitis

Definitions

Acute inflammatory process of pancreas with variable involvement of other regional tissues or remote organ systems

General Features

Best diagnostic clue: Enlarged pancreas, fluid collections, obliteration of fat planes

Location: Pancreatic and peripancreatic

Size: Pancreas increased in size (focal or diffuse)

Radiography

Duodenal ileus

Sentinel loop

Mildly dilated, gas-filled segment of small bowel $\pm$ air-fluid levels

CT Findings

Focal or diffuse pancreatic enlargement

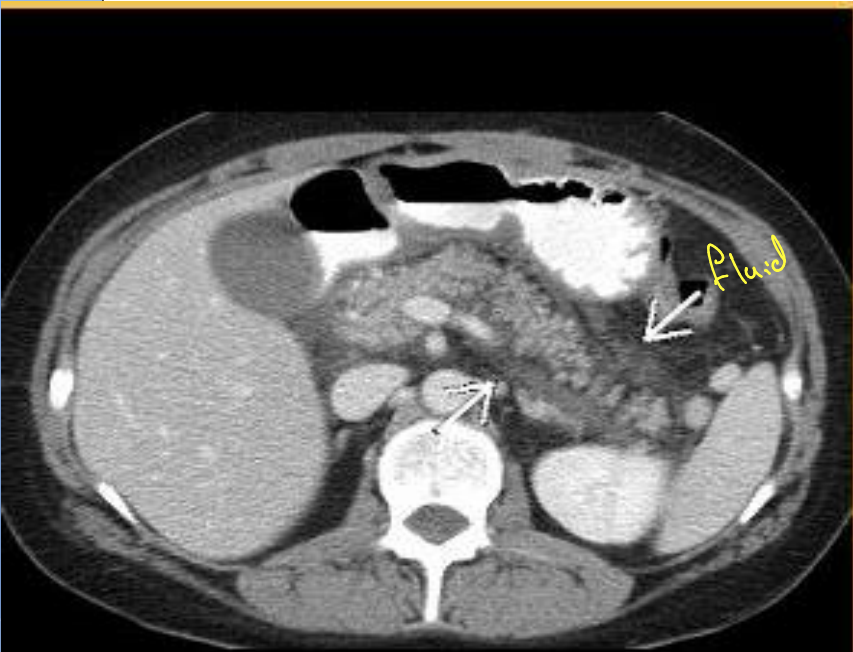
Heterogeneous enhancement with nonenhancing necrotic areas

Rim enhancement of acute fluid collections, abscesses, and pseudocysts

Infiltration of peripancreatic fat; gallstones

Pleural effusions, basilar atelectasis

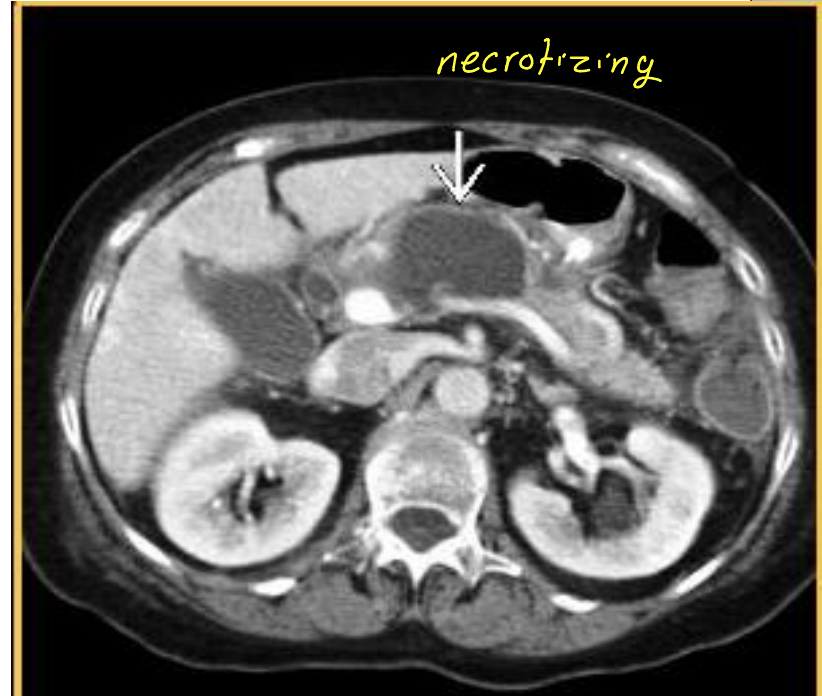
Pancreatitis, Acute



Axial CECT image obtained in a 43-year-old woman with a 2-day history of sharp epigastric pain and a history of alcohol abuse illustrates the typical appearance of uncomplicated pancreatitis. Note the mild pancreatic enlargement, peripancreatic stranding, and edema (white arrow).



Axial CECT of necrotizing pancreatitis following ERCP shows extensive areas of nonenhancement, indicating necrosis (white arrow) of the body and tail of the pancreas.



Axial CECT in a 74-year-old woman reveals necrosis of the mid-pancreas, with no enhancing parenchyma evident in the neck and mid-body region. The pancreatic duct is probably disrupted with an inevitable pseudocyst formation (white arrow).

Edematus, swollen
Complication: pseudocyst

Chronic Pancreatitis

Definitions

Irreversible inflammatory damage to pancreas, usually evident on imaging or functional testing

General Features

Best diagnostic clue: Atrophy of gland, dilated main pancreatic duct (MPD), intraductal calculi

Size: Pancreas usually decreased in size (atrophy)

Pancreatic calcification

Almost diagnostic of chronic pancreatitis

Radiographic Findings

Radiography

Plain abdomen radiograph

Pancreatic calcification

Small, irregular calcifications (local or diffuse)

CT Findings

CECT

Atrophy of body-tail parenchyma

Mass due to chronic pancreatitis: Varied enhancement due to presence or absence of fibrosis

Dilated MPD with ductal calculi

Intra- and peripancreatic pseudocysts

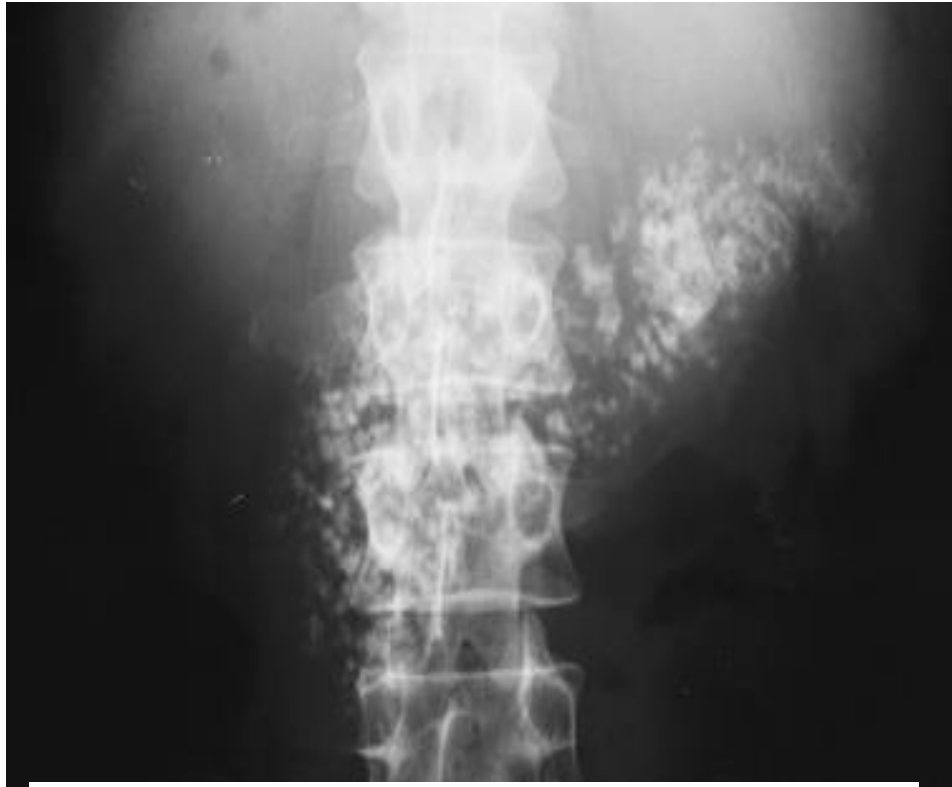
Thickening of peripancreatic fascia (with acute attack)

Splenic vein thrombosis, splenomegaly, varices

May progress to thrombosis of portal vein

Pancreatitis, Chronic

Calcification and atrophy



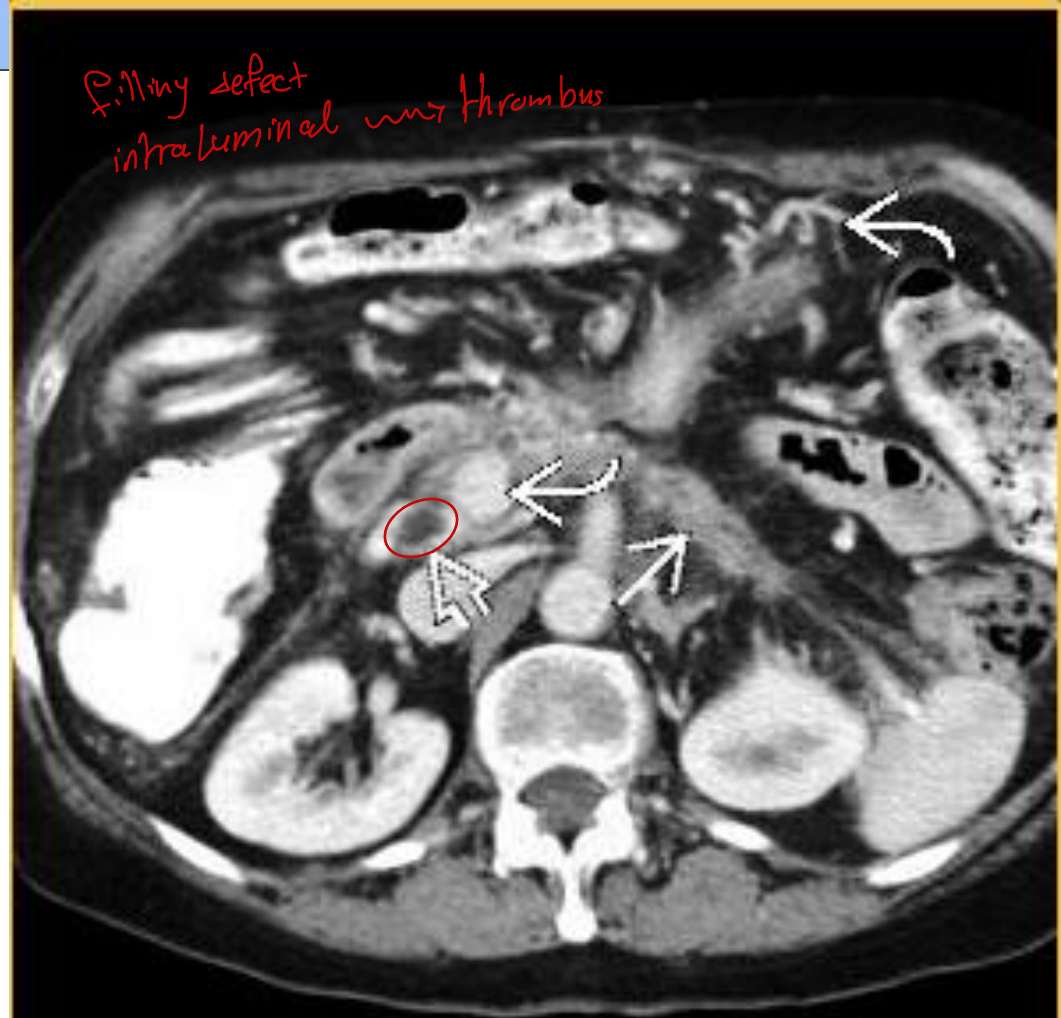
Chronic pancreatitis: calcifications in the pancreas



Axial CECT shows parenchymal atrophy, calcifications, and small pseudocysts.



Axial NECT of a 27-year-old man with familial pancreatitis shows extensive calcification and atrophy of the pancreas (white arrow). Over 90% of patients with chronic calcific pancreatitis have alcohol as the main etiology. There is a genetic predisposition to chronic pancreatitis, however, and some patients have no history of alcohol use or abuse.



Axial CECT in the same patient shows marked atrophy of the pancreas (white arrow), dilation of the distal pancreatic duct (white open), and varices (white curved) within the pancreas and mesentery due to splenic and portal vein thrombosis.

THANK YOU

