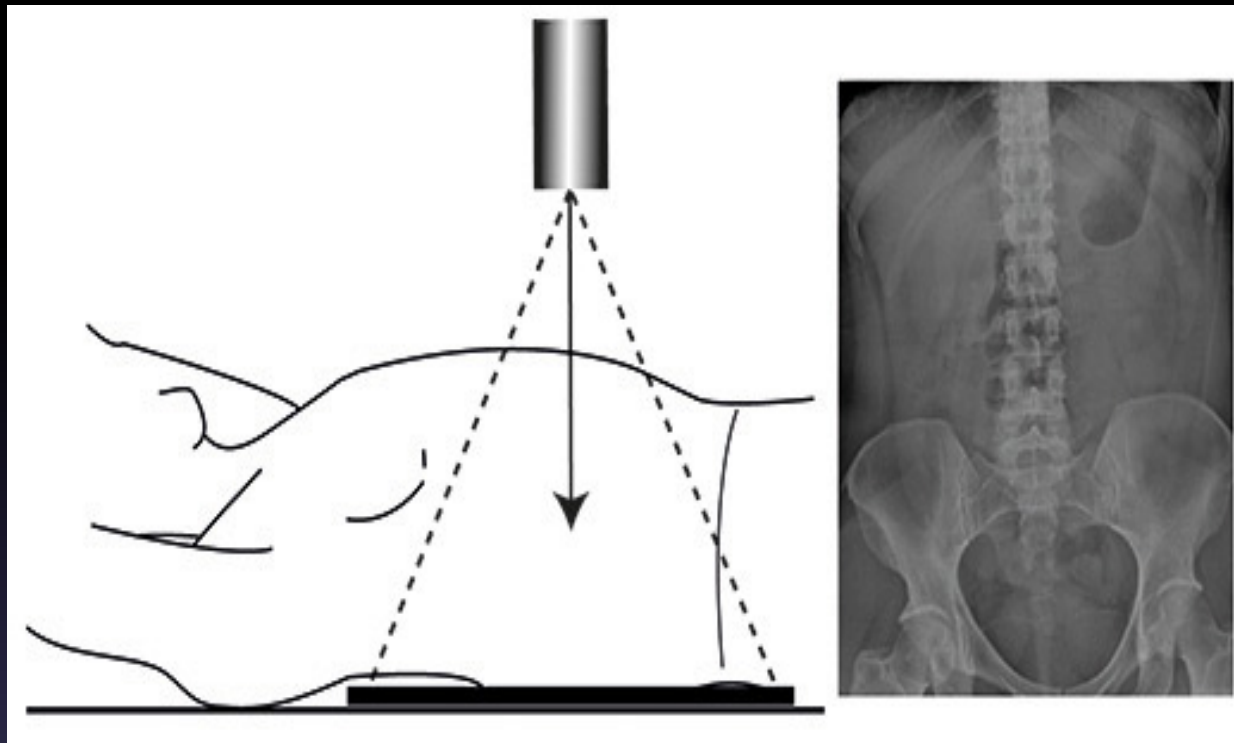




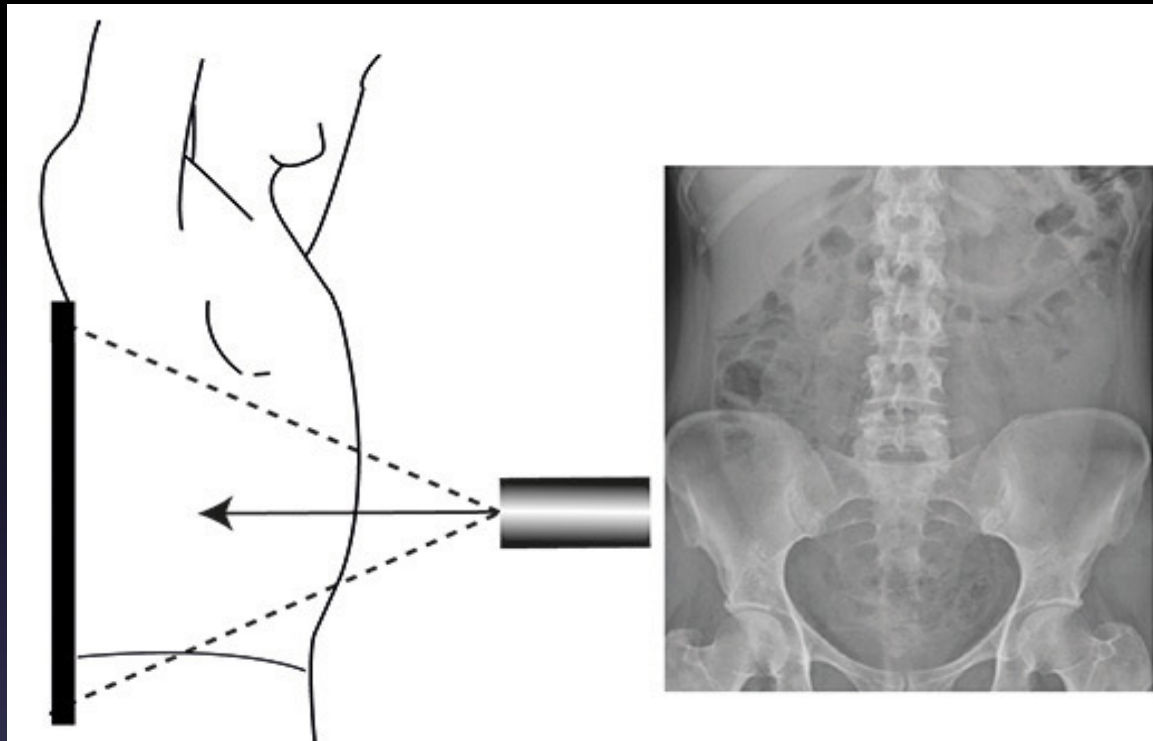
Semeiotica addominale

Dott. Riccardo Cau

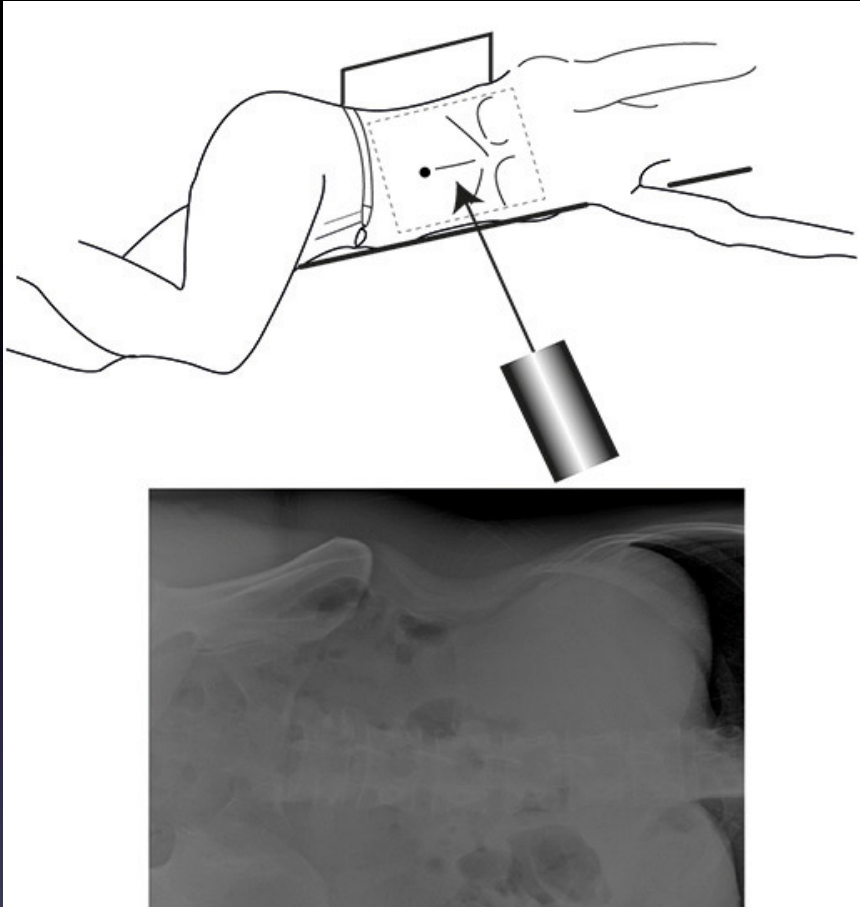
Riccardo.cau@unica.it



- Technique for supine AP (anterior-posterior) image.

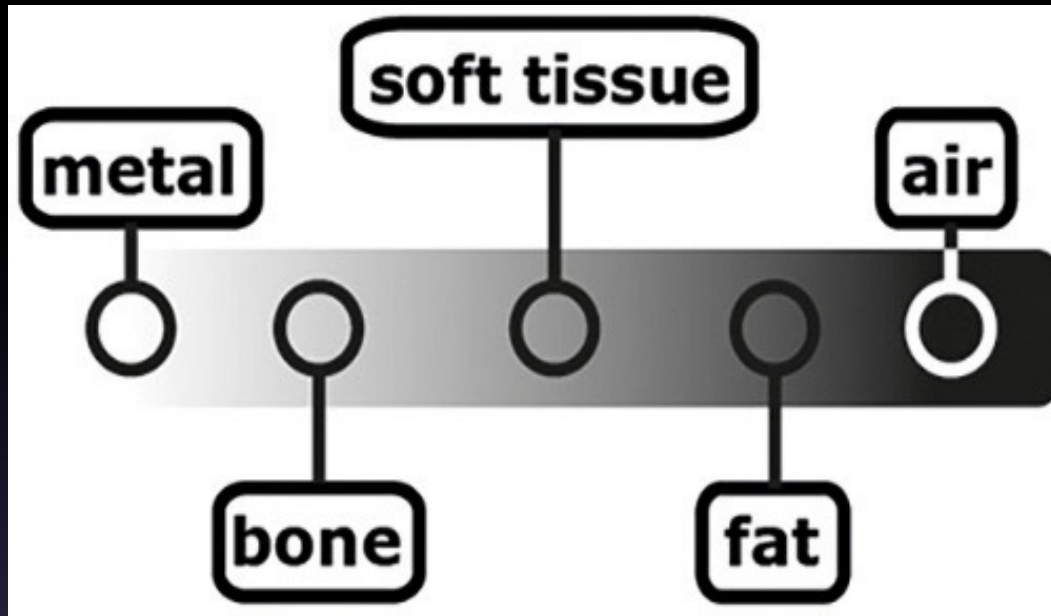


Technique for standing AP (anterior-posterior) image



In each position, the X rays will pass through the body from front to back (anterior-posterior). Basal lung fields up to and including the pubic bone should be imaged.

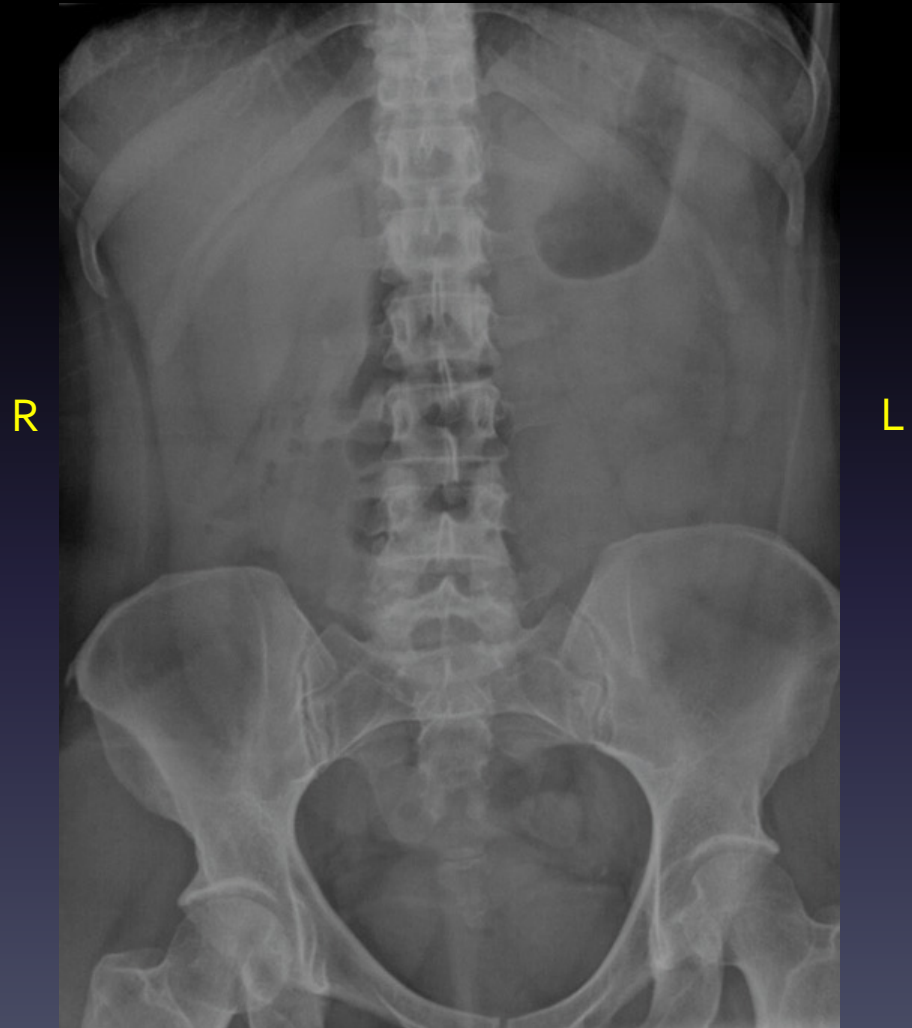
Technique for lateral image lying on the left side



. X-ray densities (= whiteness).

Normal anatomy

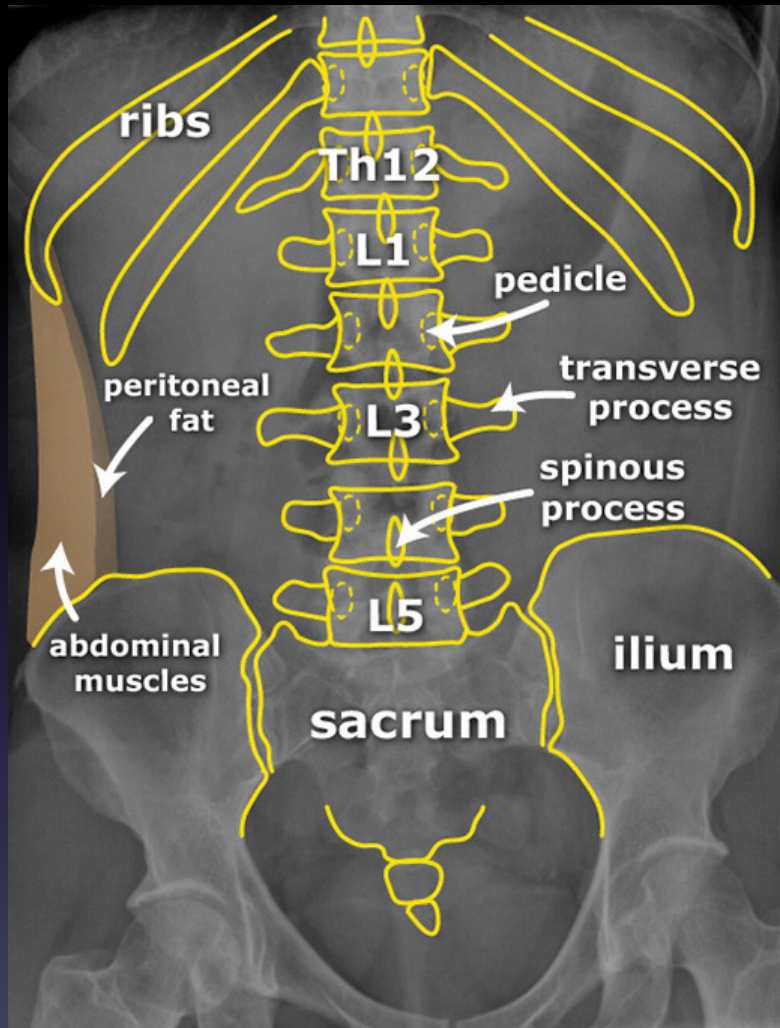
- Examine an AXR as if you are standing in front of the patient; so left is right and vice versa.



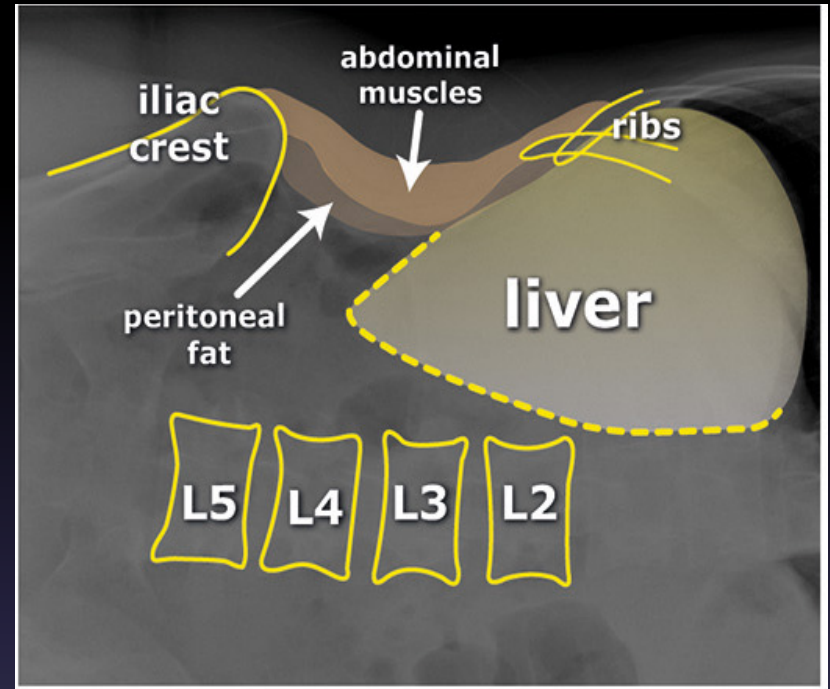
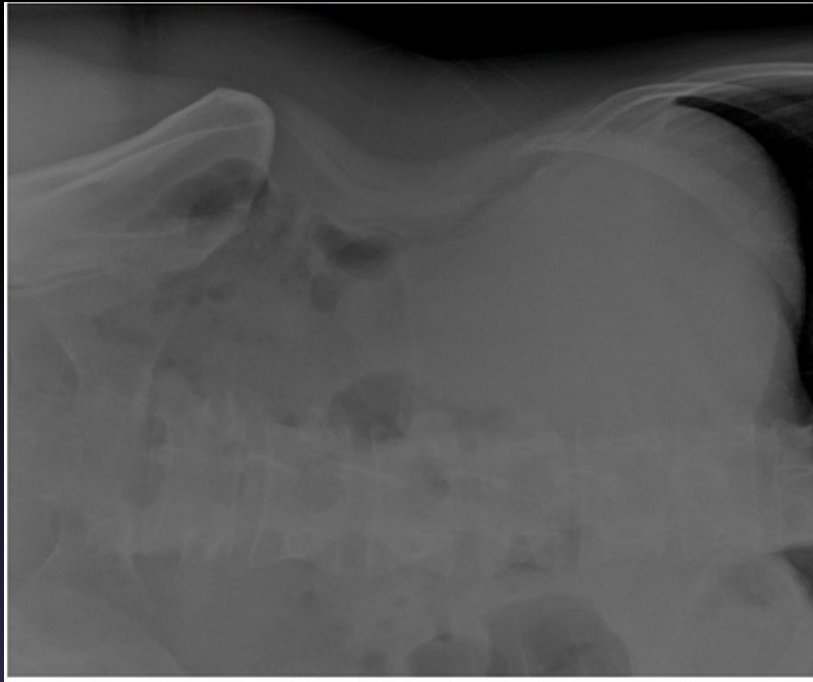
Checklist

The following points may be used as a guide to assess an AXR:

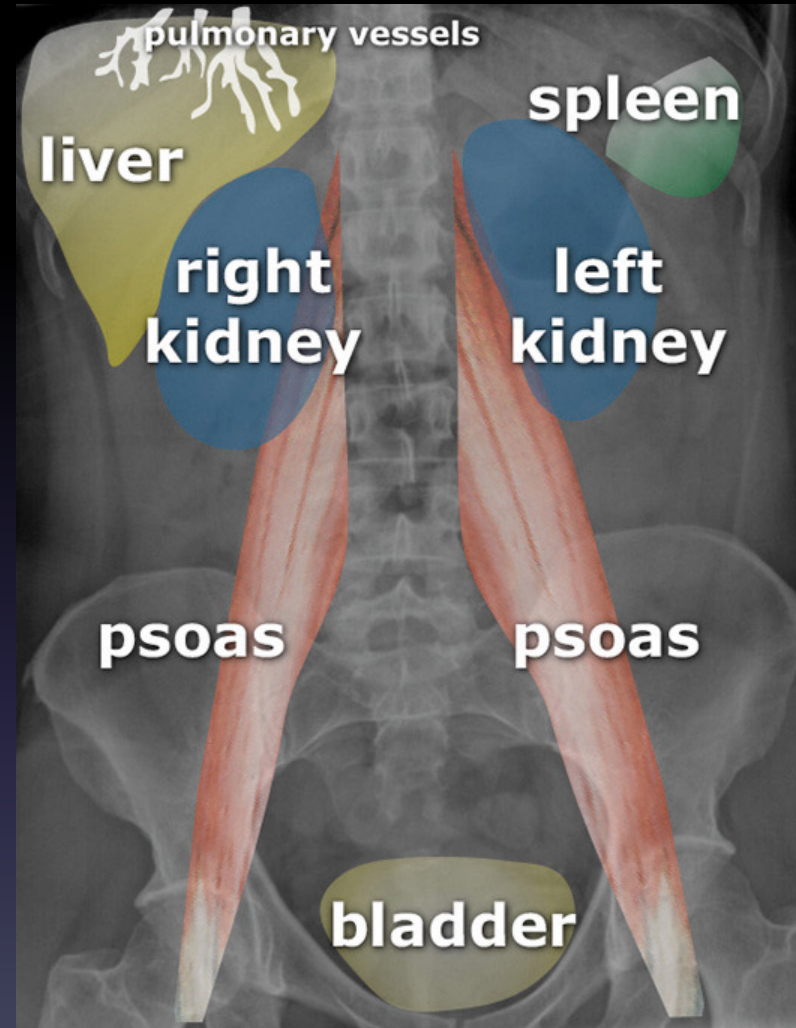
- Technique: is this a standing or supine image?
- Are the psoas muscle contours visible? (If not, caution: pathology)
- Try to trace the liver/kidney/spleen contours.
- Are there calcifications or radio-opaque structures?
- Determine the position of the stomach, small intestinal loops and colonic loops. Is the distribution of intestinal gas normal? Dilated intestinal loops?
- Evidence of free air?
- Examine the skeletal system. Are there fractures, cortex interruptions, ossal lesions?
- Changes versus previous examinations?



Normal
ossal
structures
on a
supine AP
image.



Abdominal musculature and peritoneal fat are easily identified on this image



In a normal AXR, the contours of the psoas muscles are visible. The liver, kidneys, spleen and bladder can in some cases also be identified.

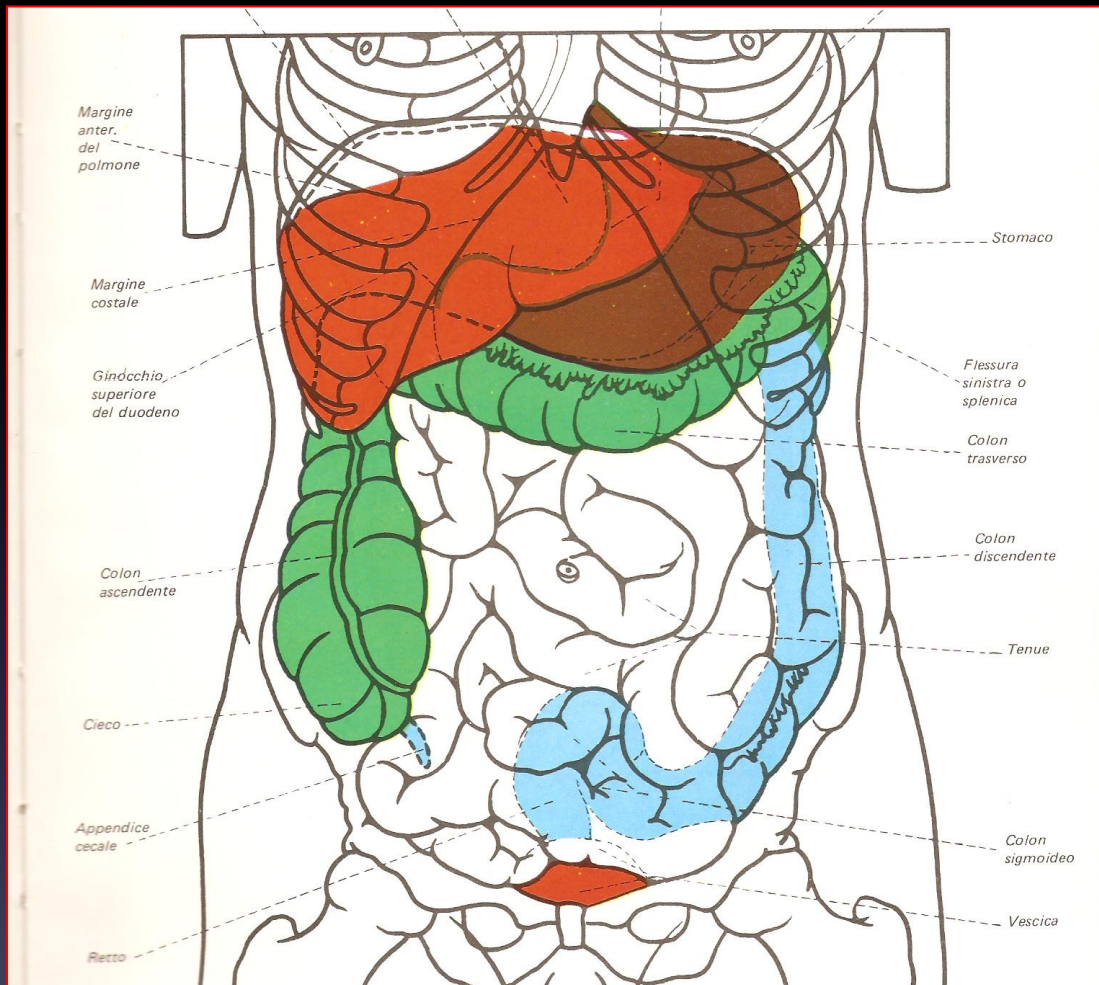
The density (= whiteness) difference at the level of these organs is created by the (retro)peritoneal fat tissue.

Fat is more lucent (= blacker) on X-rays than soft tissues, in this case the abdominal organs (fig. 4/5).



- Unfortunately, the liver/kidney/spleen contours cannot always be traced optimally in practice.
- In most cases this is caused by overprojecting intestinal loops containing air and fecal matter.

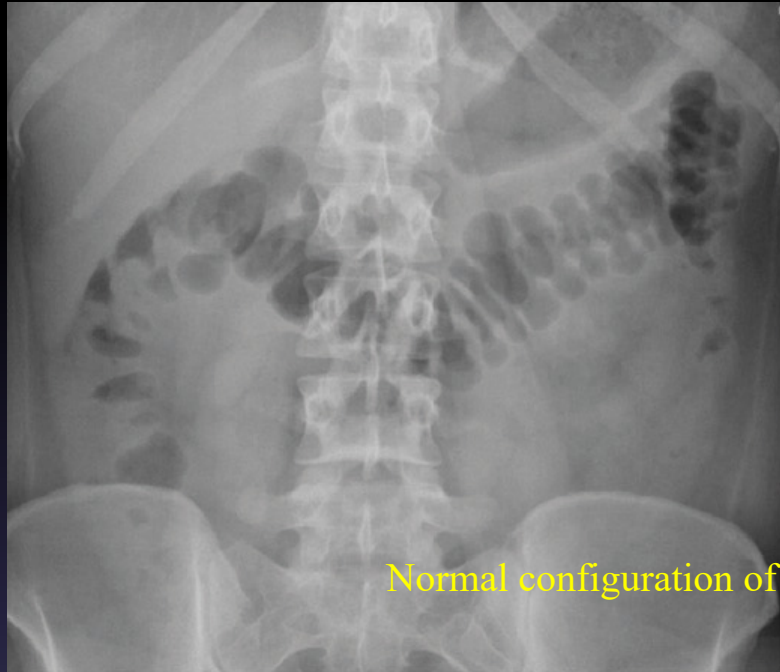
- Because of the difference in X-ray absorption by air and soft tissues, the intestinal structures (intestinal air) can be differentiated from their surroundings.



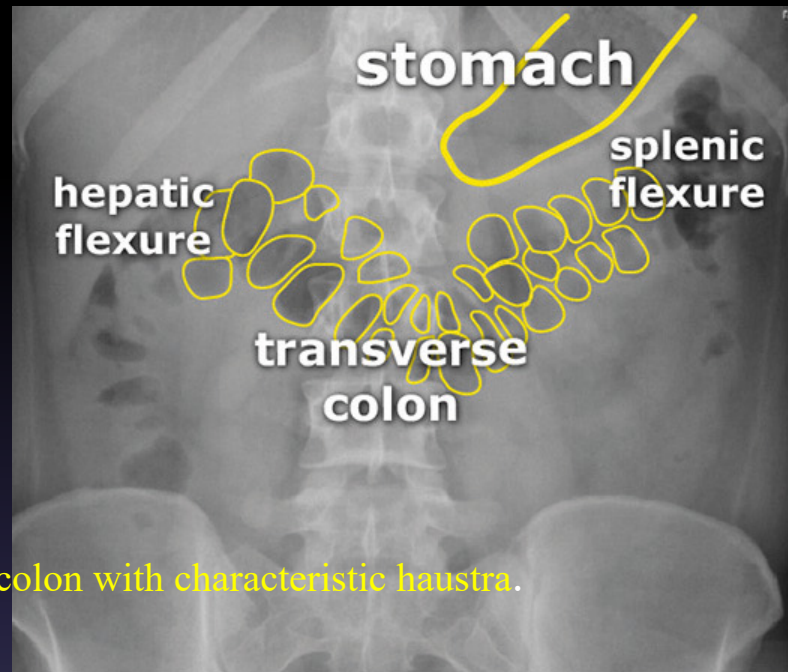
The stomach is in the left upper quadrant and is visible when it is filled with air.

The ascending colon and descending colon are at the right and left side of the abdomen respectively. Both structures are retroperitoneal and have relatively fixed positions.

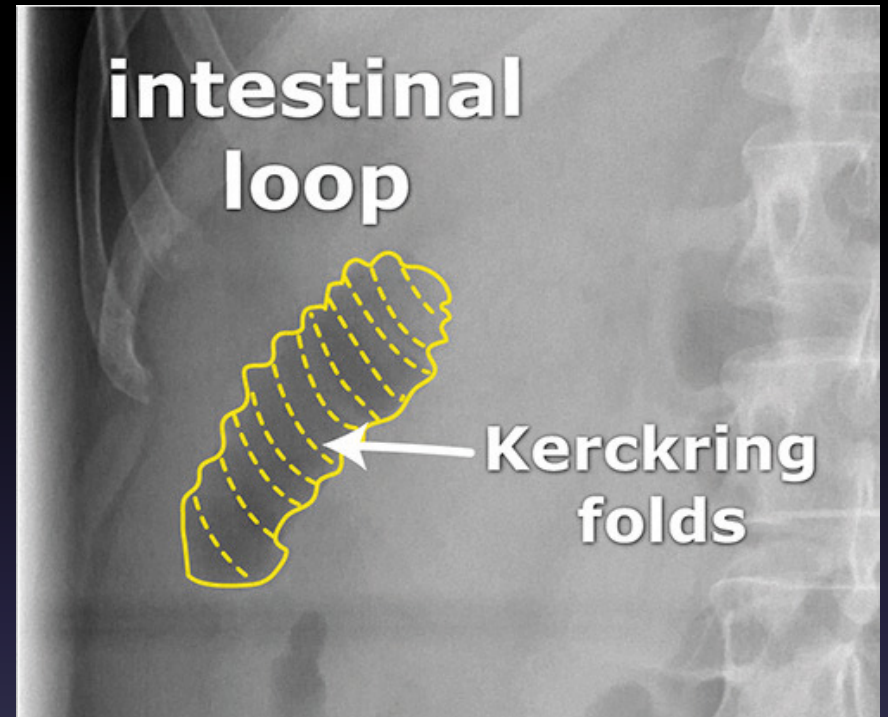
The transverse colon has more variation because of its intraperitoneal position



Normal configuration of the colon with characteristic haustra.



The colon can be recognized by the haustra (has a 'block-shaped' configuration) and the feces



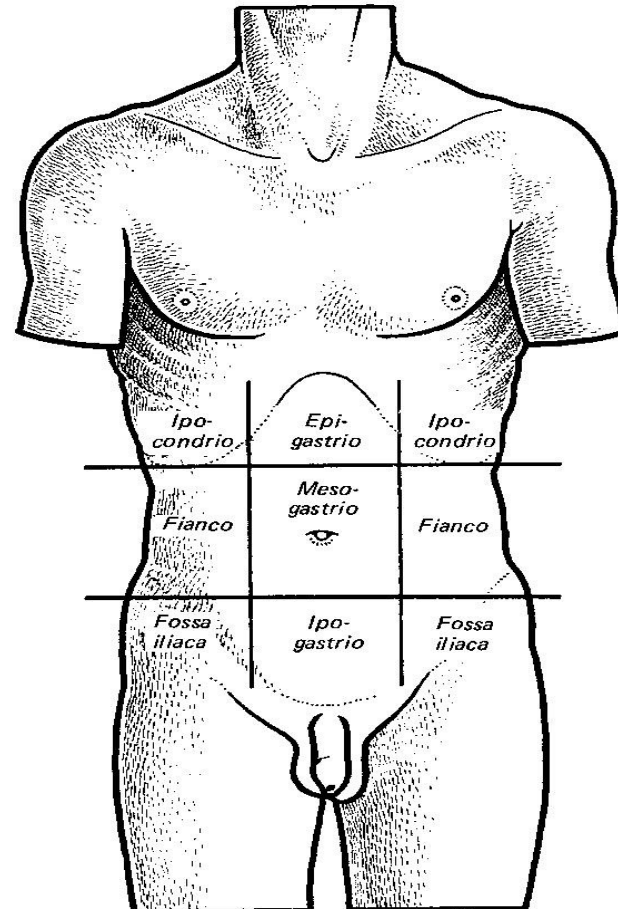
The small intestinal loops are predominantly central in the abdomen and can be recognized by their circular mucosal folds, also known as Kerckring folds / circular folds

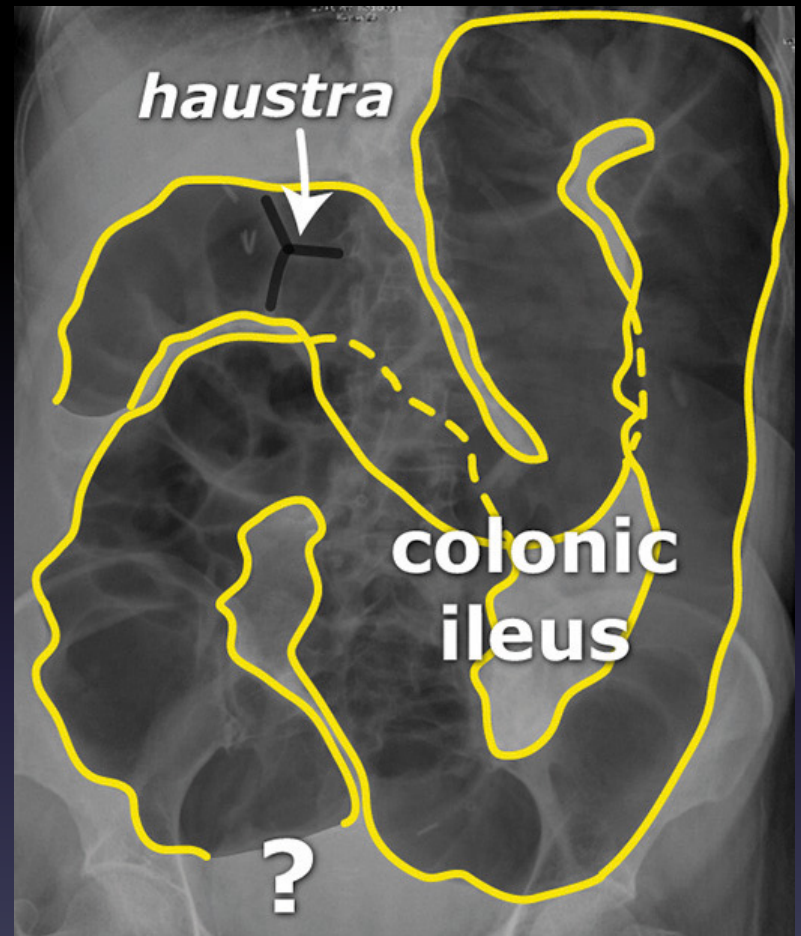
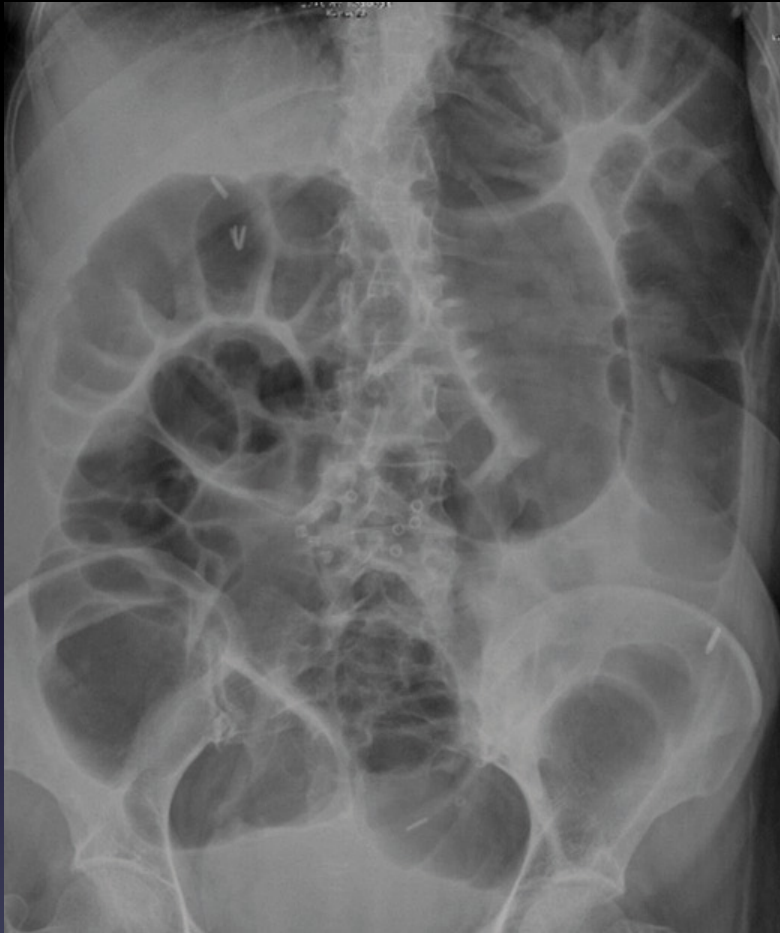


RUSSO LISA F 22 May 1990 10098 RF kV:70 mAs:32.4 ms:01



L: 514 W: 7242 M: 1.0 968.0mGy*cm2 02 Mar 2014 20:24:36 Se:1 Im:1/1





Semeiotica radiologica

Radiotrasparenza

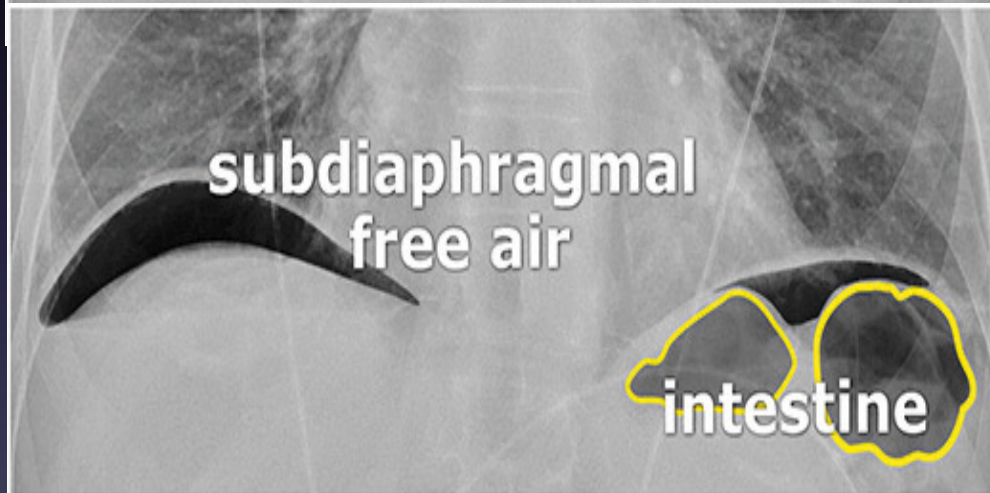
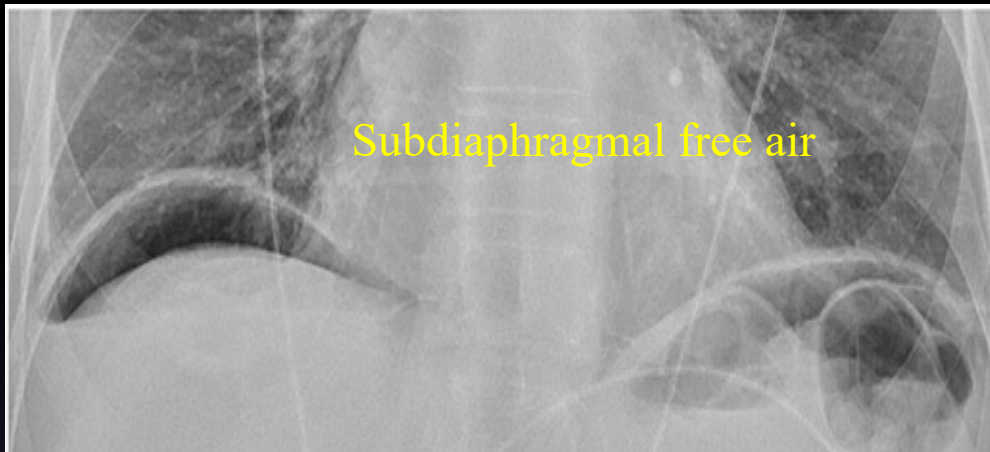
- DISTENSIONE
- LIVELLI
- ARIA LIBERA

Radiopacità

- CALCIFICAZIONI
- ALTRE DENSITA'

Free air

- A standing AXR is the most sensitive for detection of abdominal free air.
- Air always moves to the highest point; in a standing image this is under the diaphragm.
- However, patients in these conditions are frequently immobile or sick, which is why a decubitus image is frequently opted for. A left lateral decubitus image is preferred. In this way the liver is at the cranial side, creating (compared with the air-containing intestines) a better density difference with the free air.

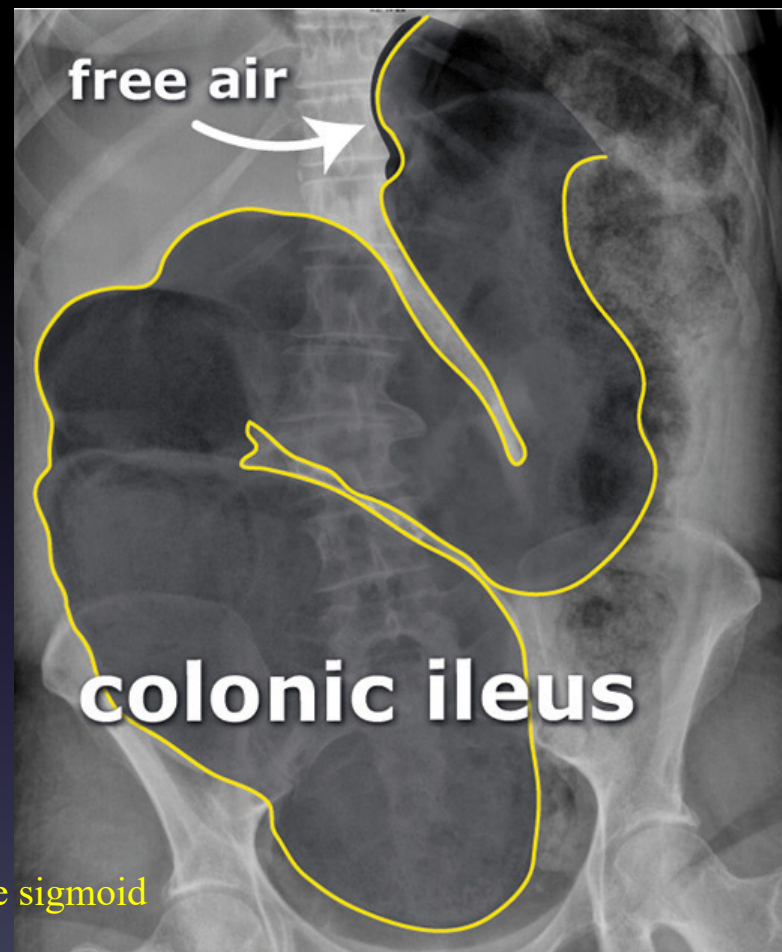


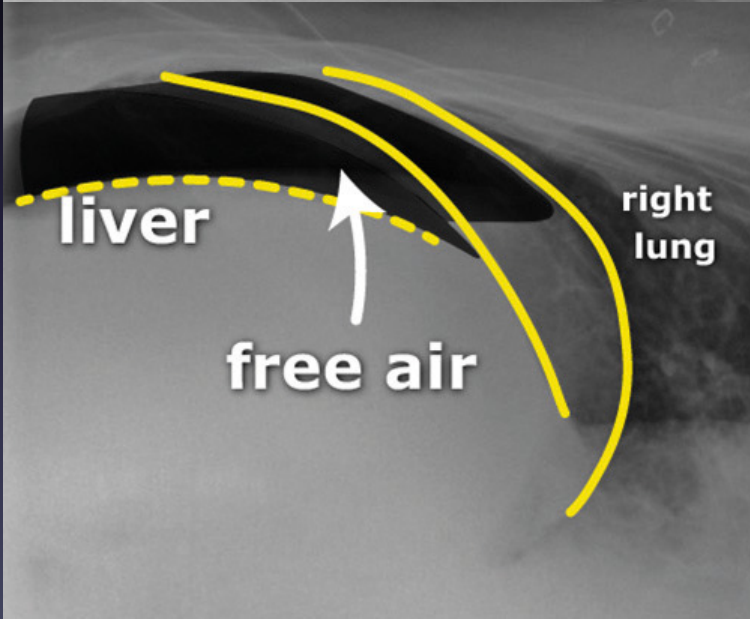


Rigler's sign/double wall sign; when there is a large amount of free air, both the inside and outside of the intestinal wall are visible.



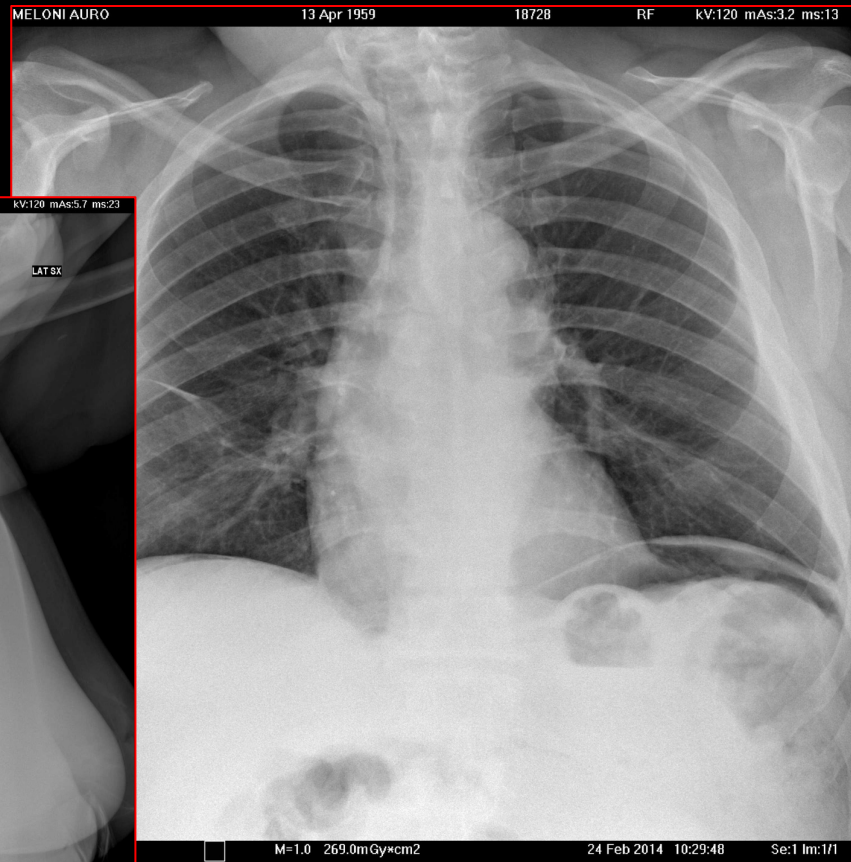
Ileus and free air in perforated diverticulitis in the sigmoid





Left lateral image. Significant amount of free air perihepatic / subdiaphragmatic right.

Aria libera

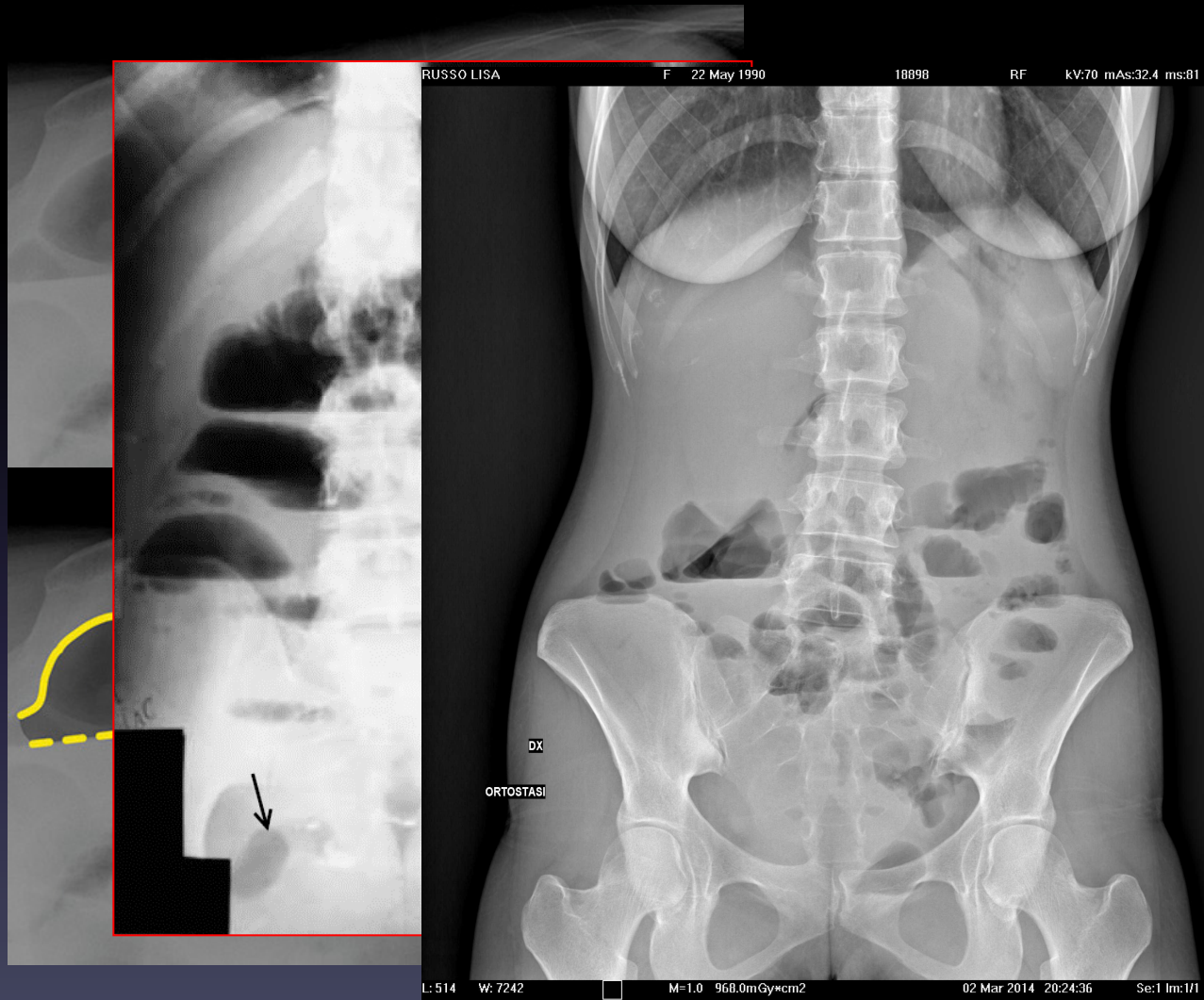




Mimics of free air:

- Gastric air bubble; a round/oval-shaped air configuration under the left diaphragm. Free air is more ring-shaped. On a normal AXR, a thick dense (= white) wall can be seen at the cranial side of the gastric air bubble. As opposed to free air, there is a much thinner border between the lungs and the abdomen.
- Chilaiditi's sign; interposition of intestinal loops between the liver and diaphragm. This may be confused with subdiaphragmatic free air.

Livelli idroaerei



Addome acuto

- Dilatazione gassosa
- Livelli



ILEO ADINAMICO / MECCANICO DIAGNOSTICA RADIOLOGICA

Rx senza mezzo di contrasto
in orto e clinostatismo

Anse del tenue e del colon
uniformemente distese
Presenza di livelli
idro-aerei diffusi



ileo adinamico

Anse distese a monte
dell'ostruzione
Presenza di livelli
idro-aerei a monte
dell'ostruzione



ileo meccanico

ETIOLOGIA ILEO PARALITICO I

CAUSE INTRA ADDOMINALI

INTRAPERITONEALI

Laparotomia (ilio post-operatorio)
Peritonite
Insufficienza vascolare mesenterica

EXTRAPERITONEALI

Emorragia o flogosi retroperitoneali
Pancreatite acuta
Sindromi dolorose gravi (colica renale)

ILEO MECCANICO Eziopatogenesi

•STENOSI

Presenza di un processo infiltrante parietale (tumori, morbo di Crohn)

•OSTRUZIONE

Presenza di un ostacolo endoluminale (tumori vegetanti, corpi estranei, calcoli biliari, fecalomi)



OCCLUSIONI INTESTINALI

OCCLUSIONE MECCANICA - COLON

→TUMORI (75%)

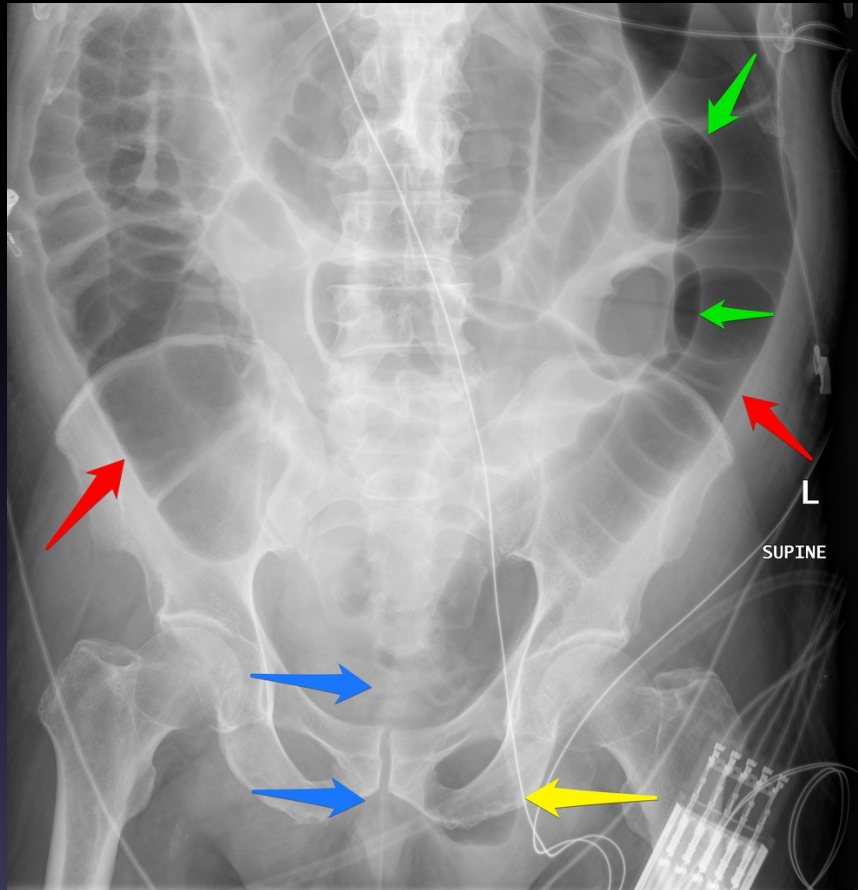
- Diverticolite
- Volvolo
- Ernie
- MIC



Abdominal radiographs are often performed as an initial imaging test in patients with abdominal pain and distension. Bowel dilatation is only visible when the bowel contains gas. The amount of gas within a loop of bowel may significantly underestimate its calibre.

Bowel dilatation can be seen on most modalities to a greater or lesser extent. Normal bowel calibre can be remembered using the 3-6-9 rule:

- small bowel: <3 cm
- large bowel: <6 cm
- caecum/sigmoid: <9 cm



- Yellow arrows = gas projecting over the left inguinal region (always abnormal).
- Green arrows = dilated small bowel loops.
- Red arrows = dilated large bowel loops.
 - Note how the sigmoid colon has a relative abrupt cut-off at the level of the femoral head.
- Blue arrows = absent rectal gas.

INVAGINAZIONE INTESTINALE

Penetrazione di un segmento di intestino mesenteriale (invaginato) in quello immediatamente sottostante (invaginante)

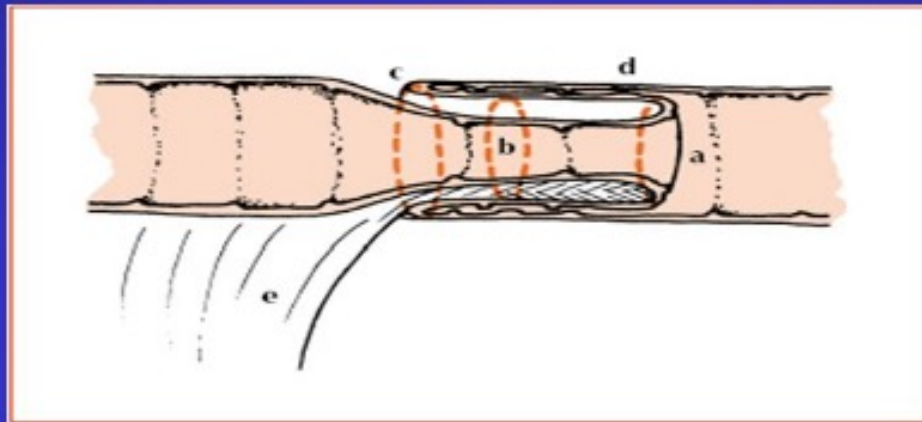
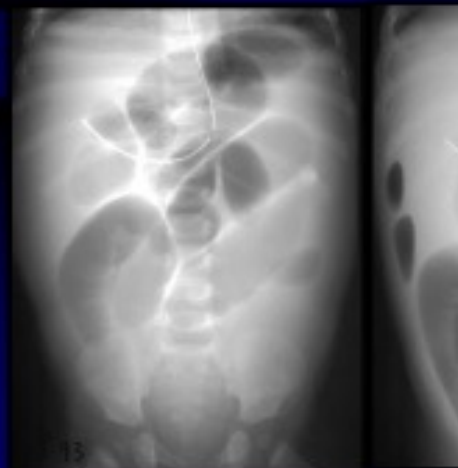


Fig. 11.1. (a) Testa dell'invaginato; (b) invaginato; (c) colletto; (d) invaginante; (e) mesentere.

INVAGI

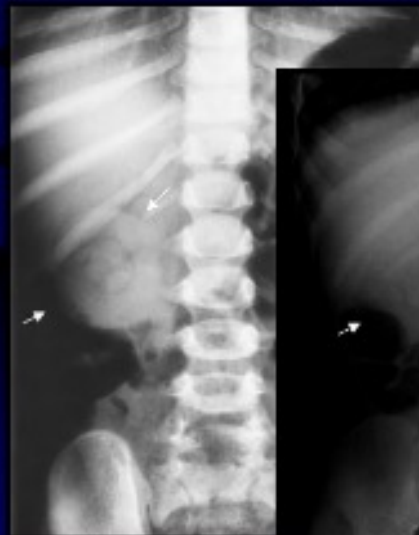
- “meniscus sign”: il gas
delinea con aspetto,
l’apice del segmento
intestinale invaginato



INVAGINAZIONE INTESTINALE

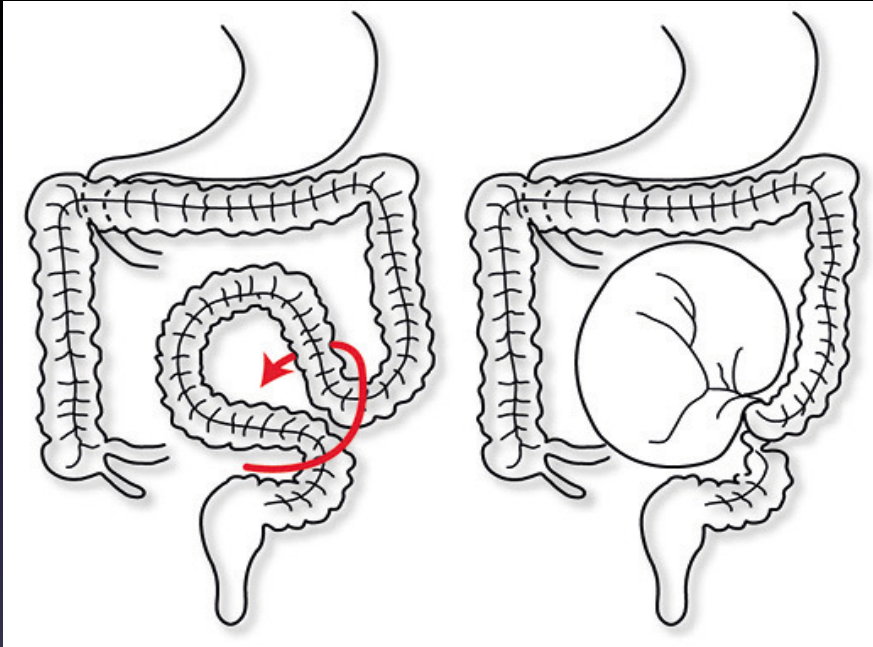
RX DIRETTO ADDOME:

- massa tenuemente radiopaca,
generalm. al QS dx, talora con
riduzione di gas in addome



- “target sign” (“immagine “a bersaglio””): massa
tenuemente rxopaca con aree
concentriche a diversa
opacità per presenza di
grasso mesenterico del
segmento invaginato

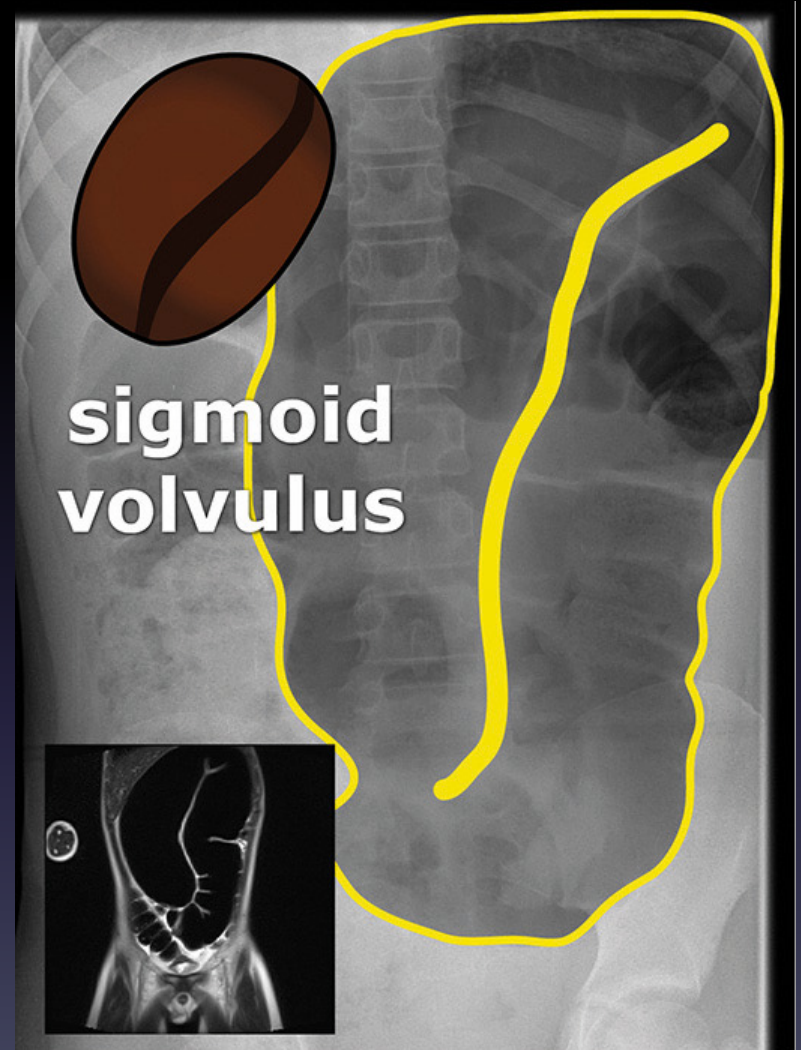
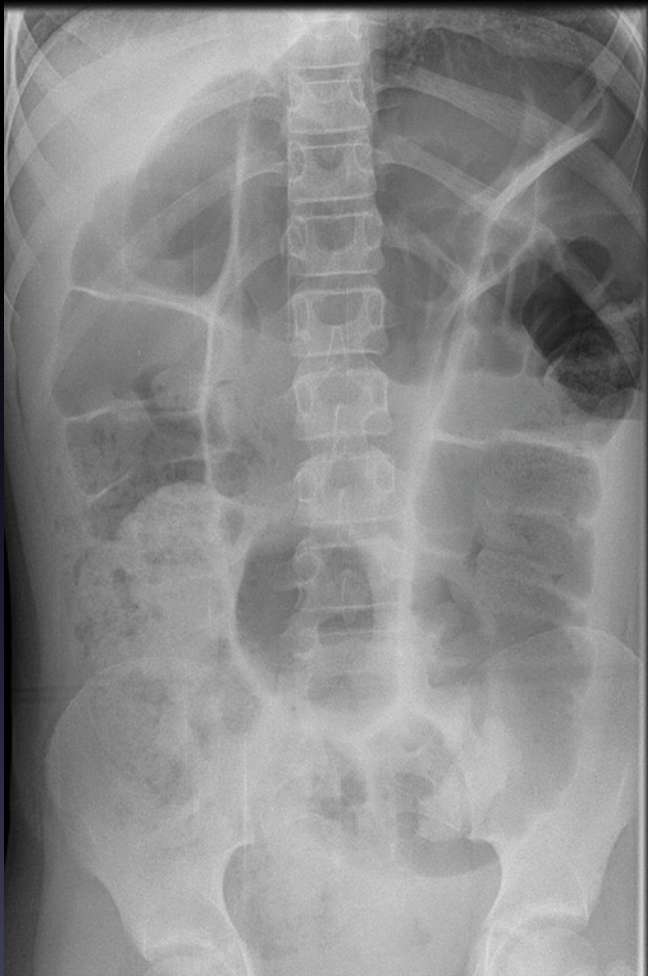
Volvulus



In a sigmoid volvulus, the sigmoid is twisted around its own mesenterial axis. The result is a closed loop

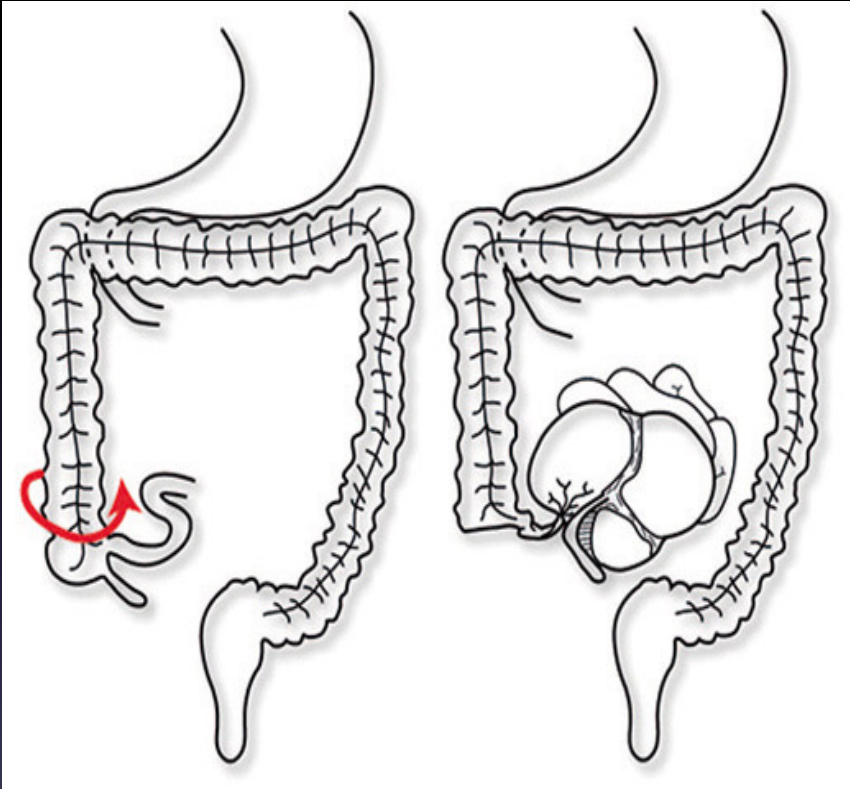
RX: Coffee bean sign

- The coffee bean sign is a classic sign of sigmoid volvulus.
- When the occluded intestinal loops are dilated with air (closed loop), the medial walls will touch and the inner line will create a coffee bean configuration. The lateral walls of the twisted intestinal loops form the outer contours of the coffee bean
- The torsion point is generally located in the pelvis minor. The obstructed sigmoid extends to the left or right upper quadrant and can take up almost the entire abdomen. Absence of air in the rectum supports the diagnosis of sigmoid volvulus.



**sigmoid
volvulus**

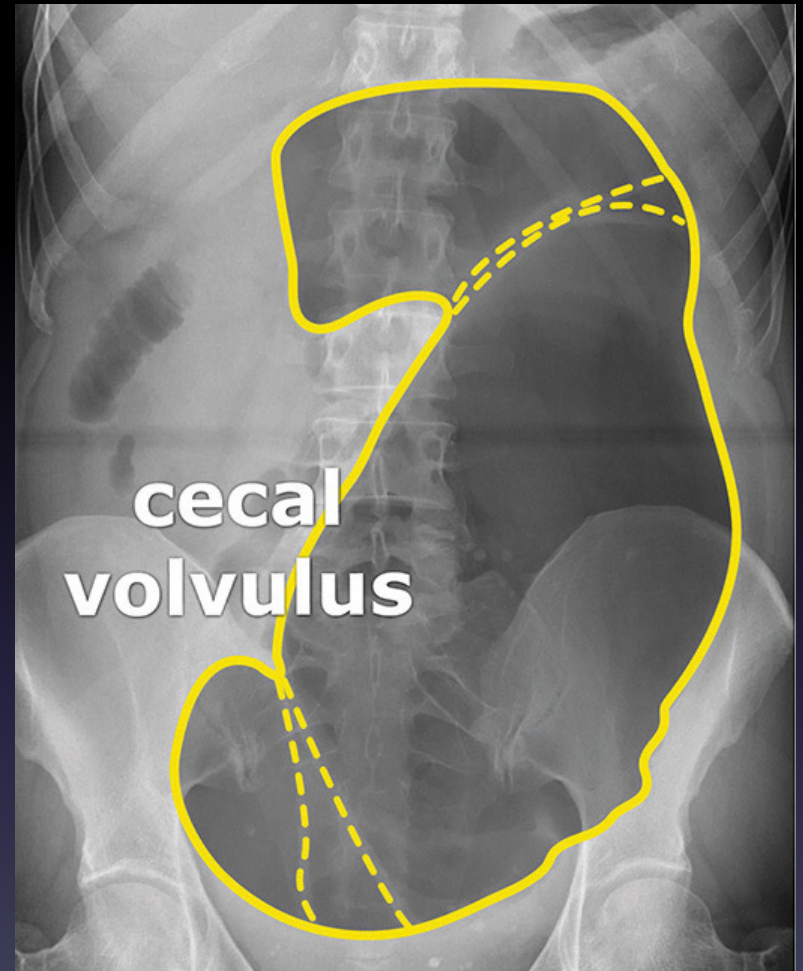
Volvo ciego



Cecal volvulus; the cecum is twisted around its own axis with part of the ascending colon.

Compared to a sigmoid volvulus, the cecal volvulus has a less fixed position, especially when there is marked distension. Depending on the initial position and the length of the (mobile) right colon, the distended cecum may expand in each direction. Classic: basis lower right with expansion towards upper left

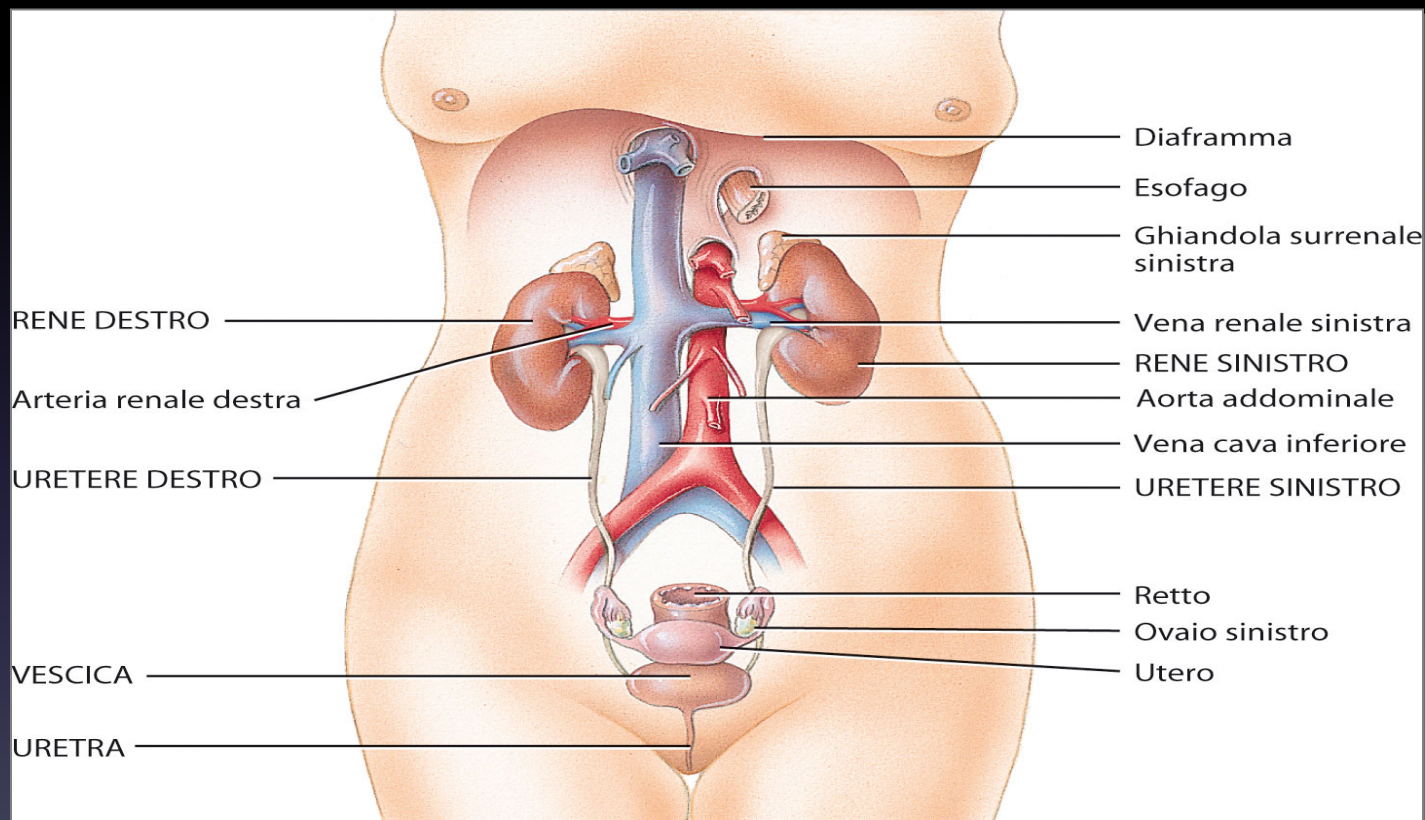
- Cecal volvulus is somewhat less common. The cecum twists (together with part of the ascending colon) around its own axis
- A cecal volvulus is associated with intestinal malrotation. Also the absence or an abnormally long mesenterium of the terminal ileum/cecum/ascending colon may luxate a cecal volvulus. The mesenterium normally keeps the intestinal loops in place. Mesenterial abnormalities may therefore create additional intestinal mobility and increase the risk of torsion.

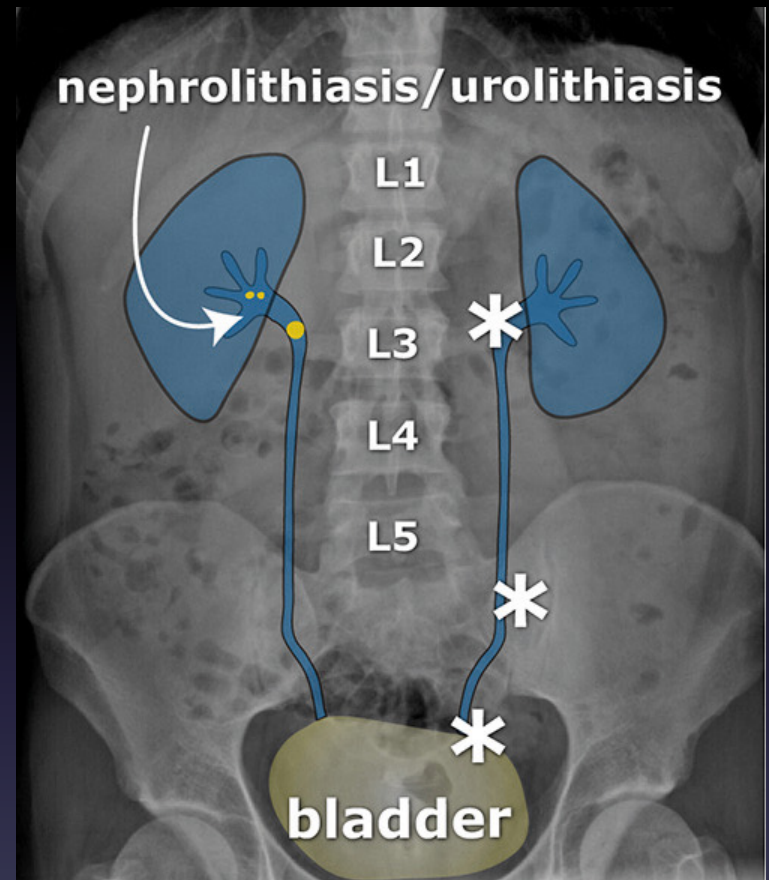


Calcifications

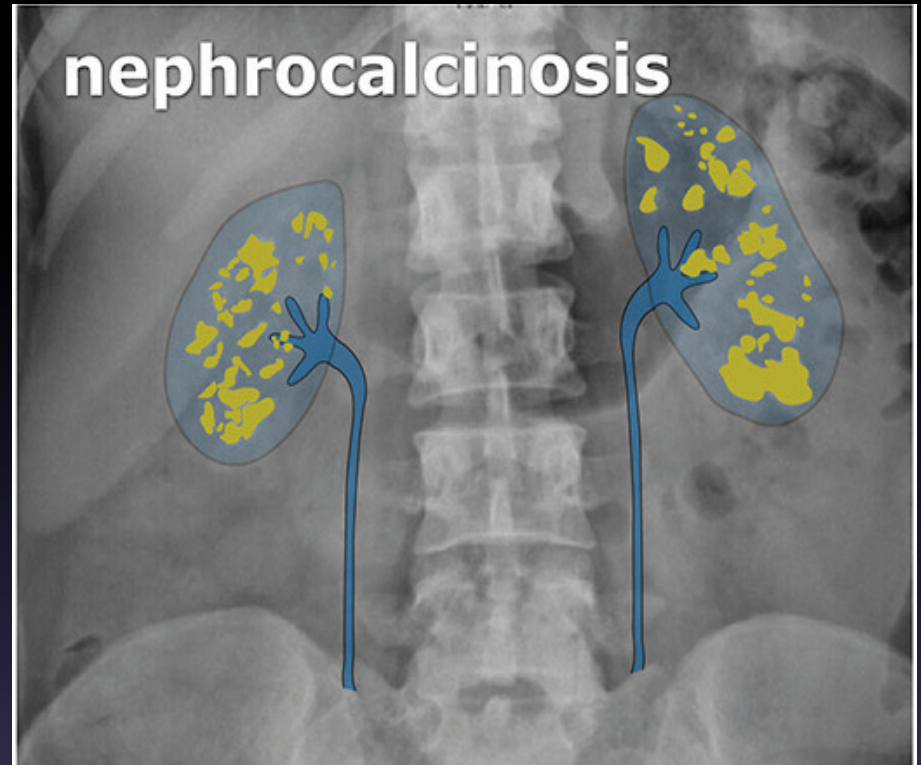
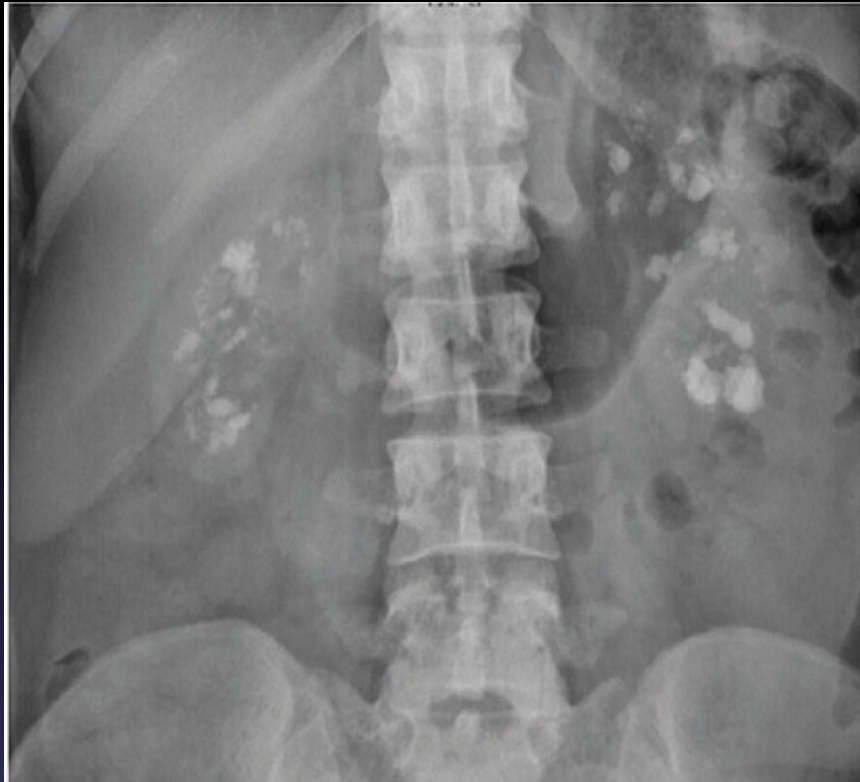
- **Kidneys:**
- Nephrolithiasis/urolithiasis: concrements in the renal collecting system (nephrolithiasis) and the ureters (urolithiasis). Not all concrements are large enough or contain sufficient calcium to be visible on an AXR. About half of the concrements are invisible on X-rays.
Kidney stones are usually small but can sometimes fill an entire renal pelvis (= coral stone/struvite stone).
Most symptomatic ureteral stones are located at the level of the pyeloureteral junction (= transition of kidney-ureter), the iliac vessels and vesicoureteral junction (= transition of ureter-bladder)

Panoramica dell'apparato urinario

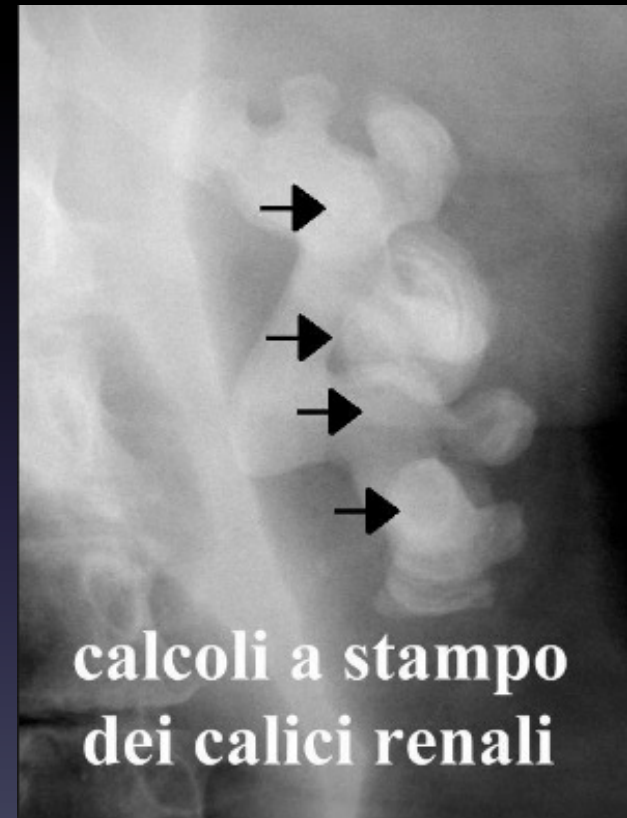




Outline of the ureters. Concrements in the right pyelum/proximal ureter. Predilection sites of symptomatic concretions (*).



Extensive bilateral nephrocalcinosis in a patient with medullary sponge kidneys



**calcoli a stampo
dei calici renali**

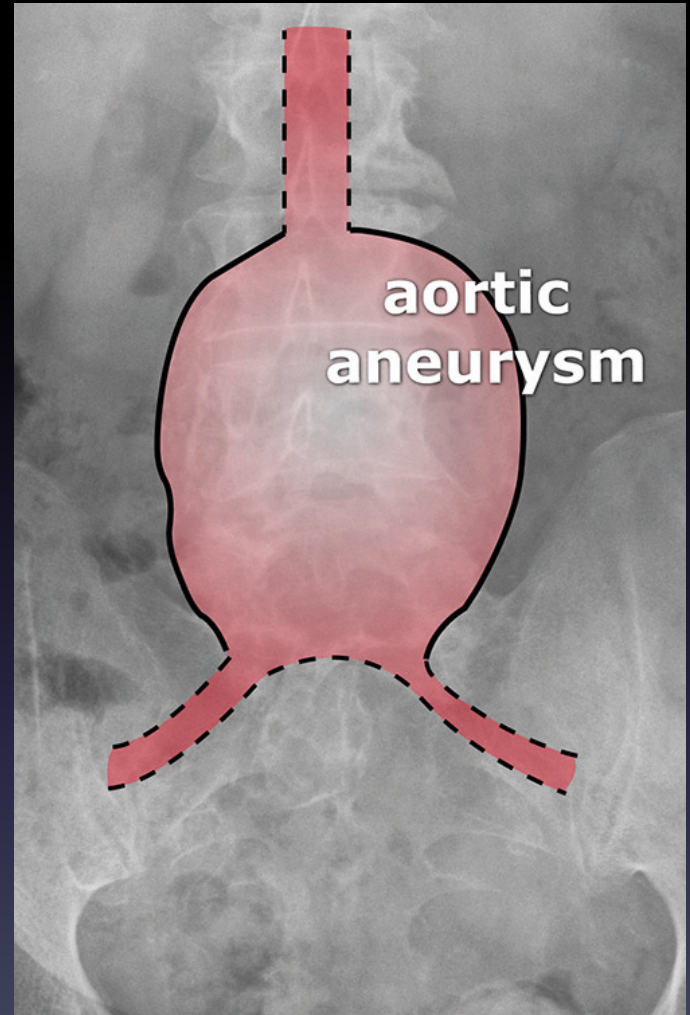
Calcoli della colecisti

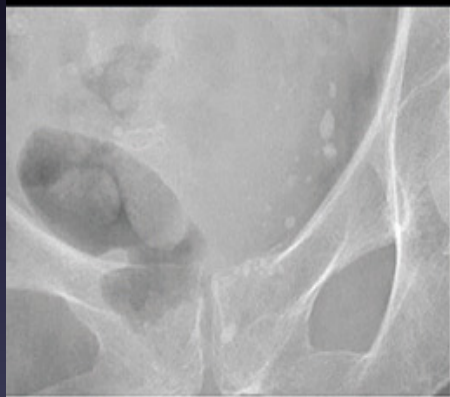
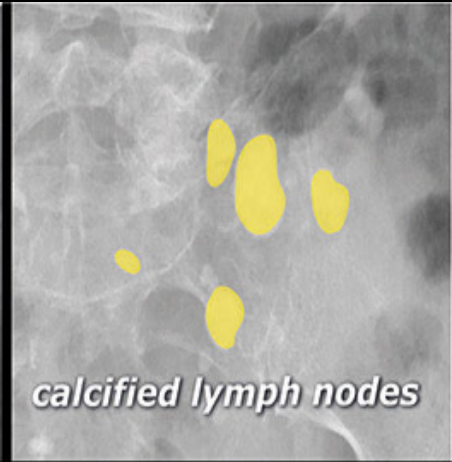
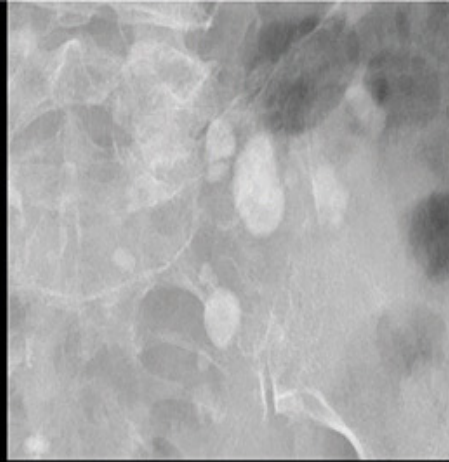


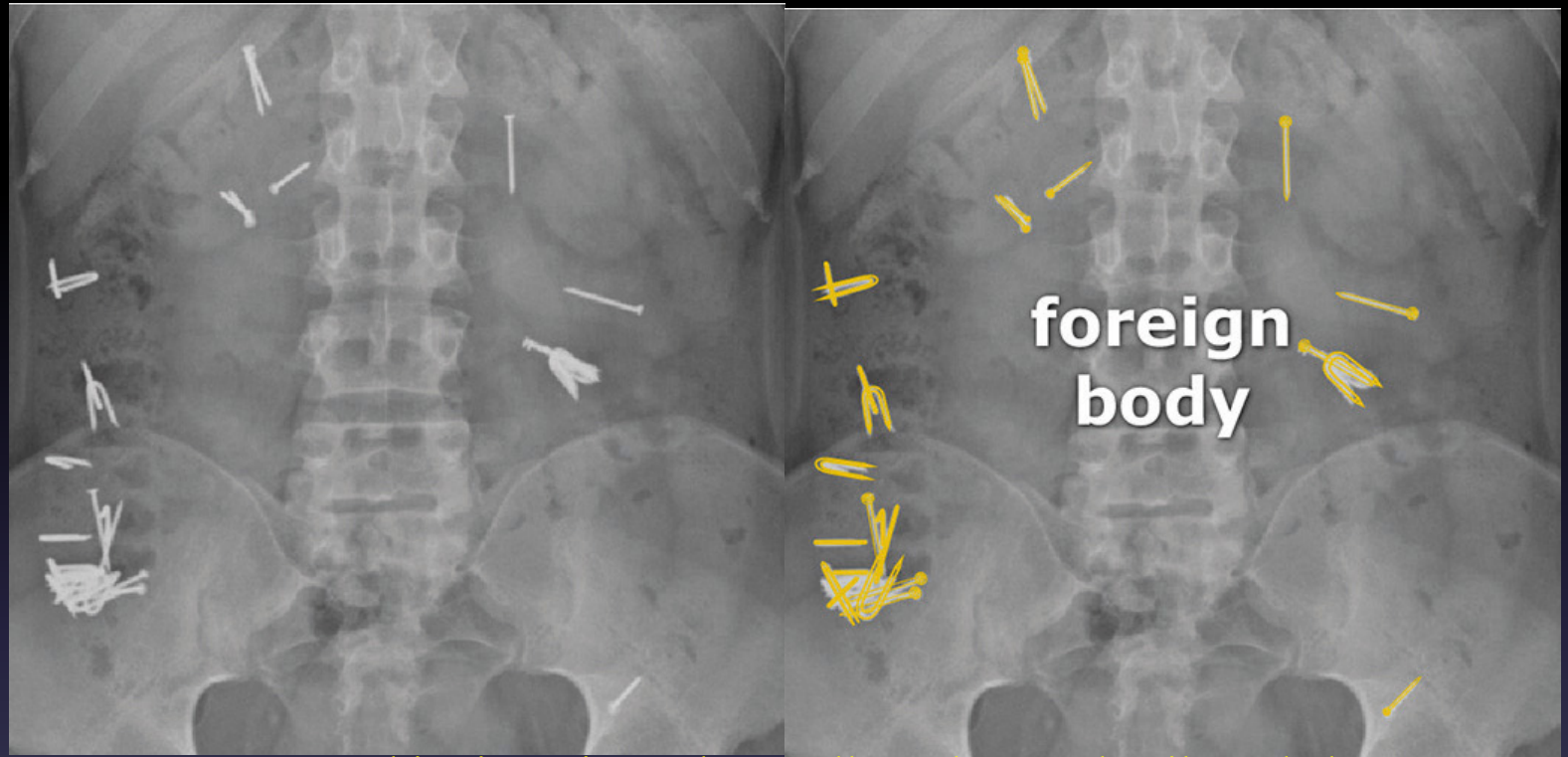
Other calcifications/densities

common calcifications and densities that may be found on an AXR:

- Vascular calcification: particularly vascular calcifications of the lienal or splenic artery (medial of the spleen), aorta and iliac vessels. An unusual finding on an abdominal X-ray is an aortic aneurysm.
- Note: confirmation of an aneurysm is no indication for an AXR.







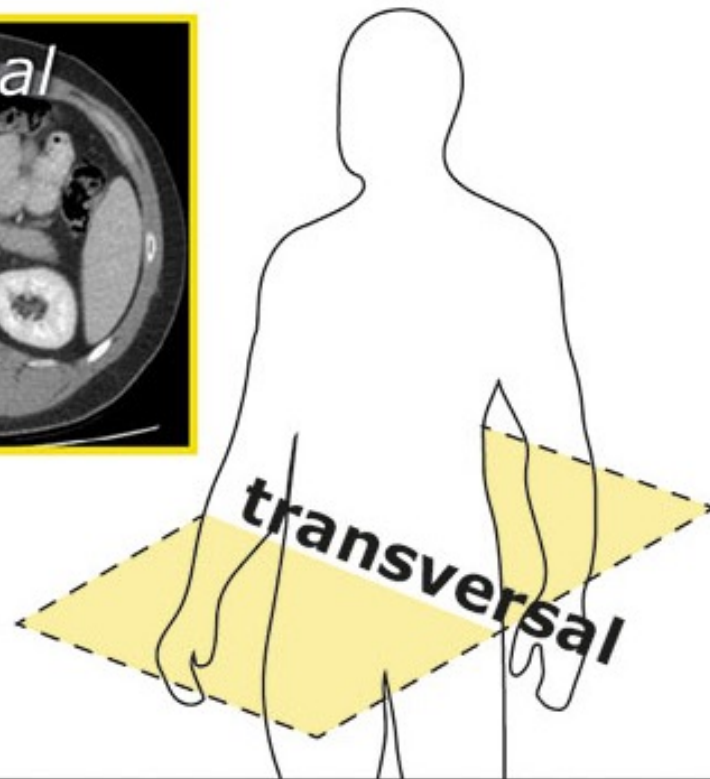
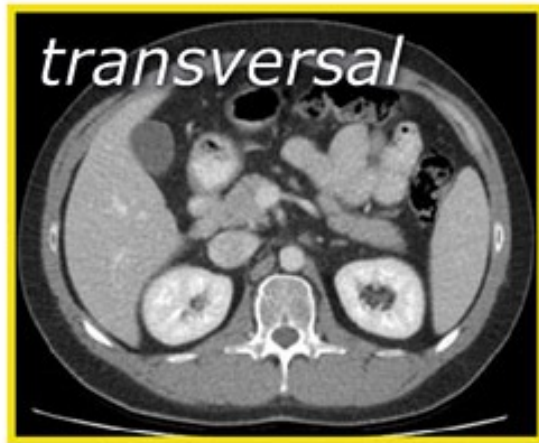
A psychiatric patient who swallowed several nails and clamps.

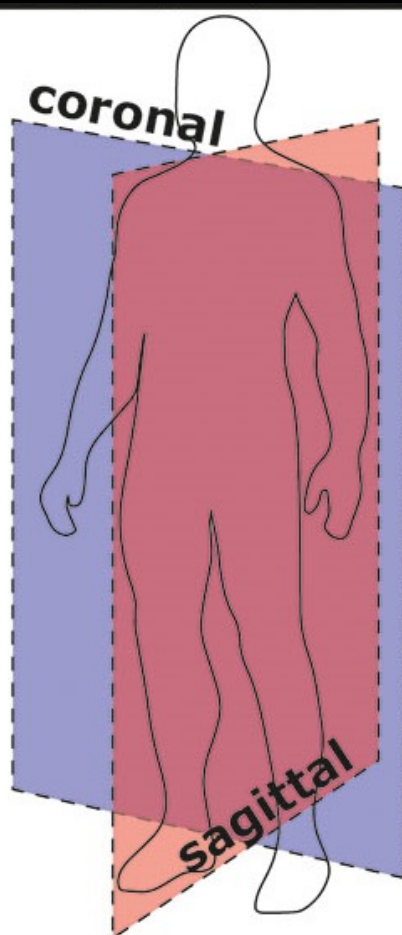
- Foreign body ; only radio-opaque structures are visible on an AXR.

CT abdomen general

Indication/Technique

Abdominal CT scans are generally evaluated in the transversal direction; the patient is seen from the feet upward as it were. The abdomen can also be viewed in the coronal and sagittal directions





UNITA' HOUNSFIELD

- Per poter esprimere in modo relativo le diverse densità dei diversi tessuti e poterle comodamente confrontare tra loro è stato necessario introdurre una scala di unità relative le cosiddette UNITA' HOUNSFIELD (HU)
- La scala ha un range compreso tra +2000 e -2000 e centro (lo 0) che corrisponde alla densità dell'acqua

Hounsfield chose a scale that affects the four basic densities, with the following values:

- Air = -1000
- Fat = -60 to -120
- Water = 0
- Compact bone = +1000

HU

TESSUTO	HU
osso	+1000
Milza	+5
Fegato	+70
Rene	+50
Sangue	+40,50
Encefalo	+25,45
Acqua	0
Grasso	-50,150
aria	-1000

- Per poter rendere utilizzabile in radiologia clinica un'immagine digitale, la visualizzazione di valori HU viene sostituita da una scala di grigi in cui le diverse tonalità di grigio corrispondono alle differenti densità
- Per convenzione la scala di grigi è orientata in modo che valori più **positivi di HU corrispondano a livelli di grigio-chiaro o bianco** mentre valori più negativi a valori di grigio-scuro nero
- Ovviamente questo concetto è relativo in quanto la scala di grigi può essere modificata cambiandone l'ampiezza (WW) e il centro (WL)



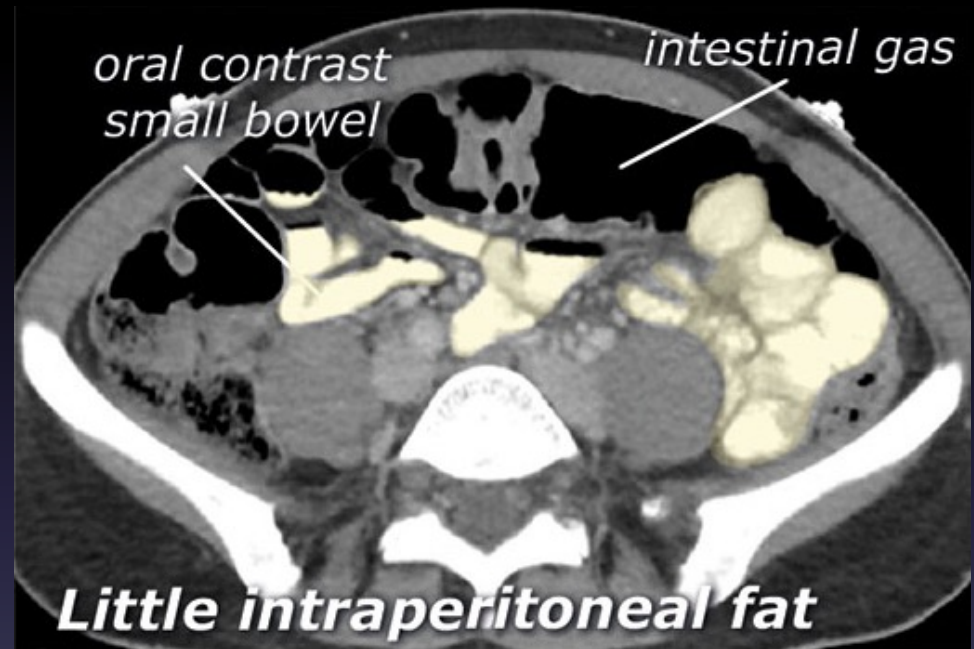
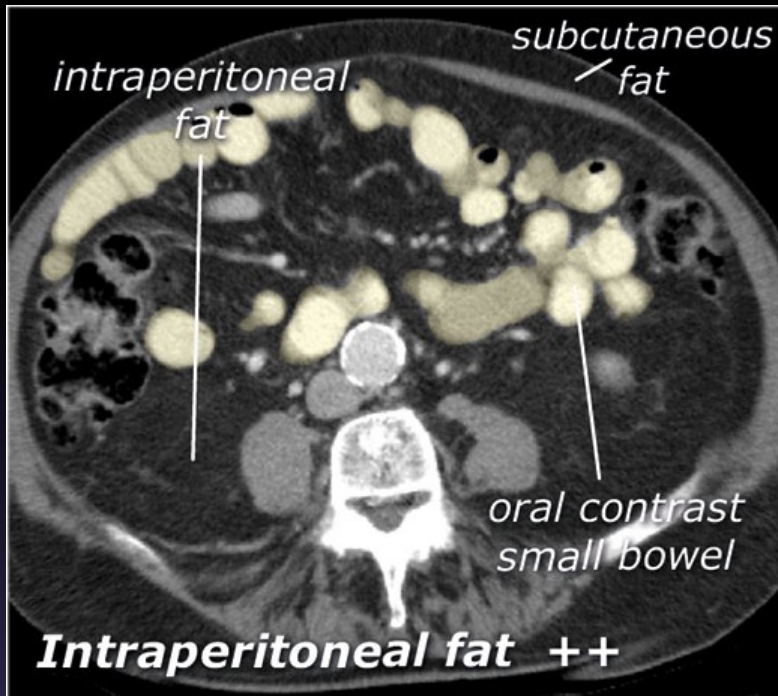
Ipo/isodenso	iperdenso: bianco
<ul style="list-style-type: none">• Liquidi nero=ipo• Aria nero=ipo• Grasso nero=ipo• Tessuti grigio= iso	<ul style="list-style-type: none">• Sangue• Mezzo di contrasto• Calcificazioni• Osso

CT SCAN PRE-CONTRAST

- Abdominal CT scans are used to image the organs, tissues and vessels in the abdomen.
- The indication for this examination is very important and is used to decide whether the examination is performed with oral, rectal or intravenous contrast agent.
- Additionally, when performing a CT scan with intravenous contrast agent, the phase(s) in which the scan is made is also relevant.

Oral contrast agent

- Depending on the indication, patients drink a predetermined volume of oral contrast agent prior to the examination
- This may be a positive contrast agent (diluted iodinated contrast agent, 'white'/dense) or negative contrast agent (including water, 'dark'/hypodense). The contrast agent is in the small intestine during the examination, allowing it to be effectively identified and distinguished from other organs and tissues
- Oral contrast agents are particularly valuable in patients with limited intraperitoneal fat



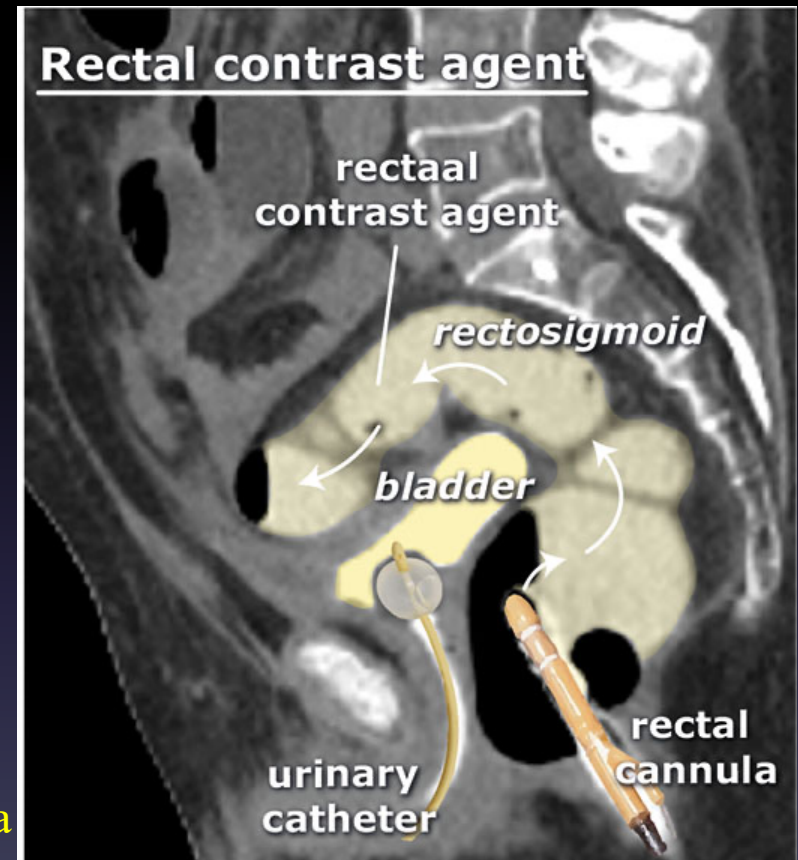
Positive oral contrast agent (= diluted iodinated contrast agent) in two different patients; one with much intraperitoneal fat and one with little intraperitoneal fat

Rectal contrast agent

- Depending on the indication, contrast agent is administered rectally immediately before the examination.
- this may be a positive or negative contrast agent. One of the primary indications for administering rectal contrast agent is to demonstrate a leak, e.g. in the event of an abnormality following recent intestinal surgery where the distal colon was sutured. The contrast agent then passes through the intestinal lumen. Another example of an indication for administering rectal contrast agent is to demonstrate the presence of a fistula. In the event of a rectovesical fistula, contrast agent will enter the urinary bladder through the fistula. Another example is to demonstrate abscesses in the pelvis minor located between the intestines.



Rectal contrast agent, administered through a rectal cannula. Note: the dense bladder content was caused by intravenous contrast agent which has now been excreted

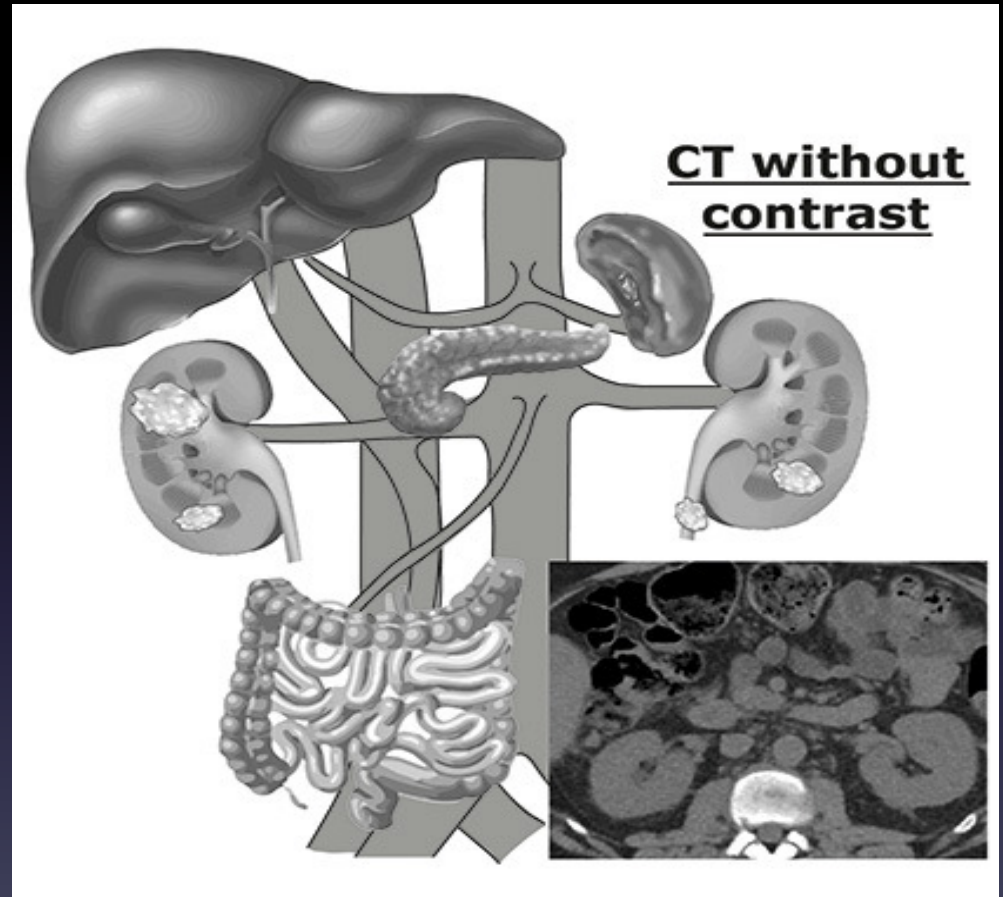


Intravenous contrast agent

- Firstly, the administration of intravenous (IV) contrast agent allows for effective evaluation of the arteries and veins. The administered contrast agent is transported to the heart through a vein in an arm or leg and is then pumped around through arteries and veins.
- Additionally, enhancements (blood supply, perfusion) of the abdominal organs can be evaluated. At fixed time intervals after administration the contrast agent, mixing with the blood, will arrive at various sites in the body, which can then be scanned. Scan phases include the arterial, portal venous, nephrogenic and excretion phases

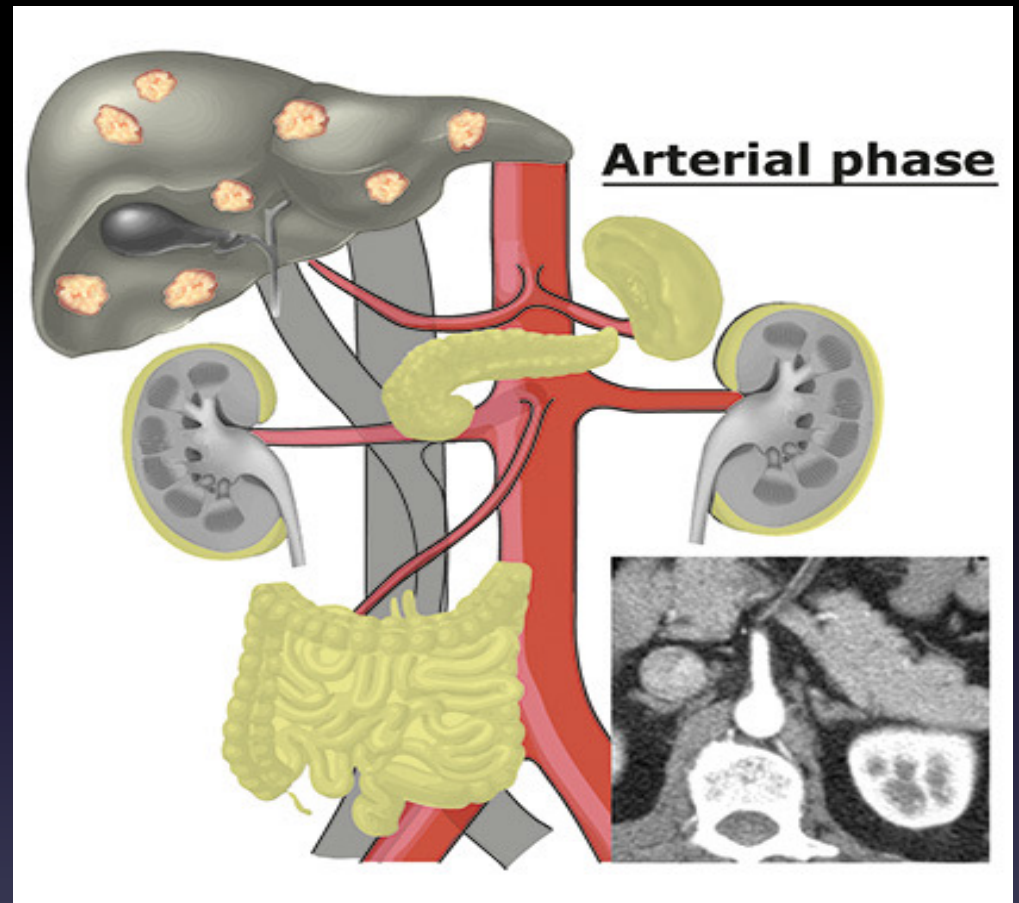
CT without contrast

- This scan is made without the administration of IV contrast agent. A primary indication for abdominal scans without contrast agent is the detection of renal or ureteral stones.



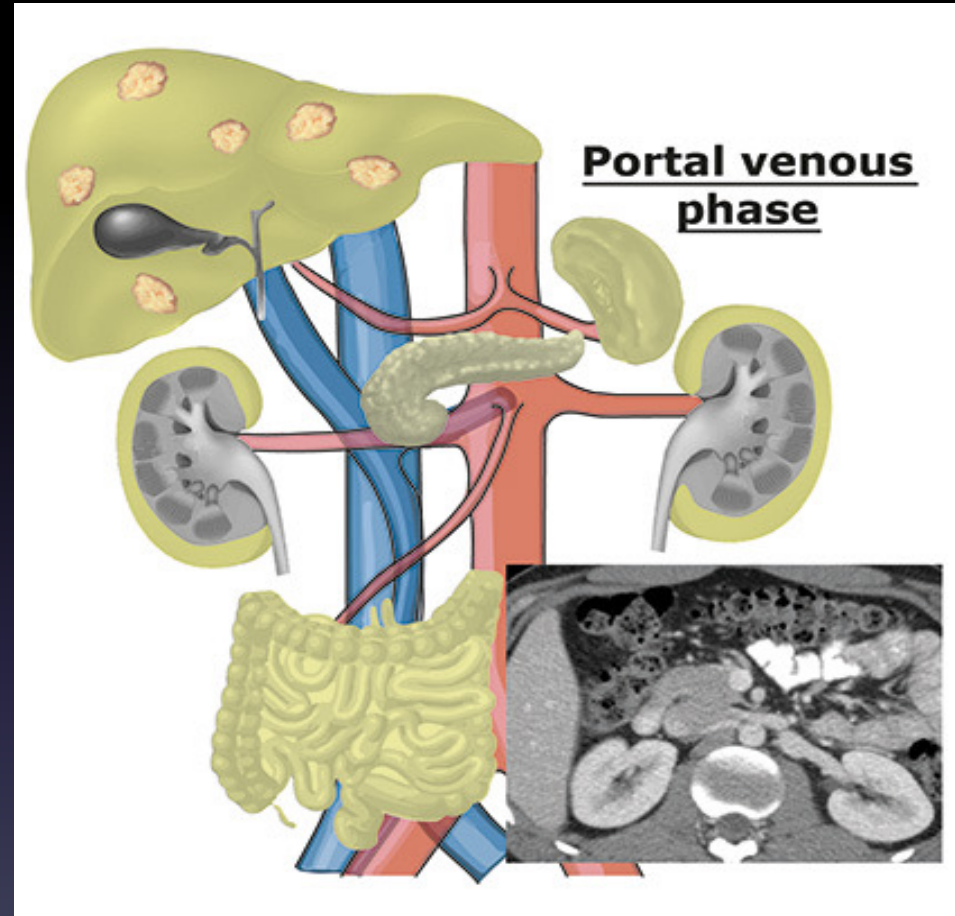
Arterial

- This scan is made about **20-30 seconds** after the administration of IV contrast agent. The contrast agent is still in the arteries and some organs are starting to absorb the agent. This scan phase is particularly suited for **evaluating arteries and detecting hypervascular abnormalities**, e.g. hypervascular metastases in the liver

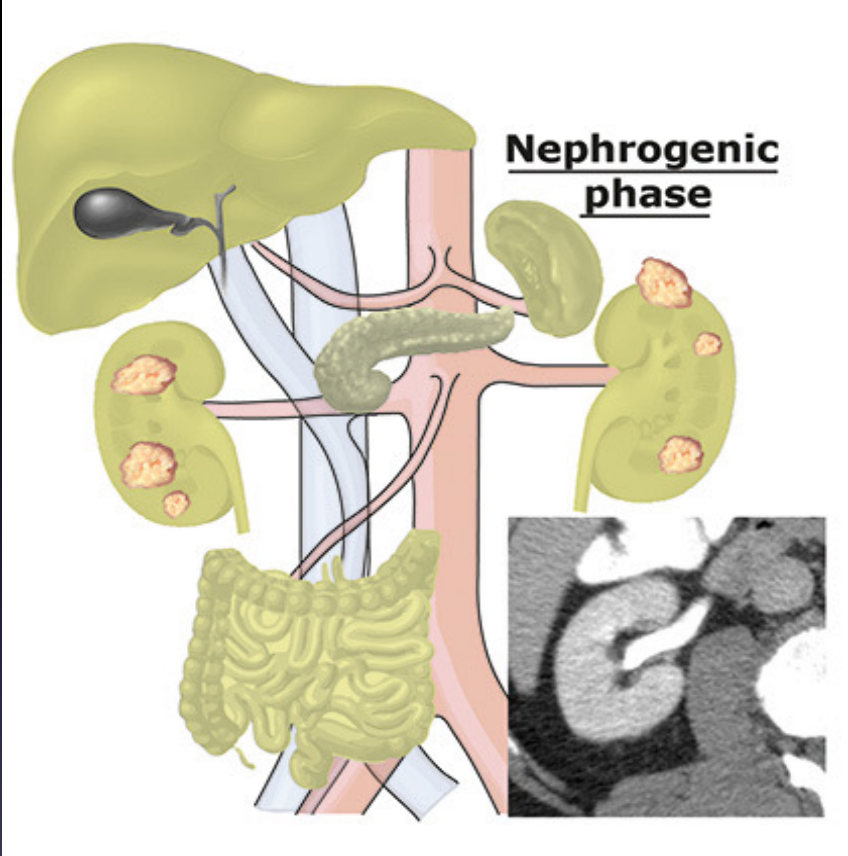


Portal venous

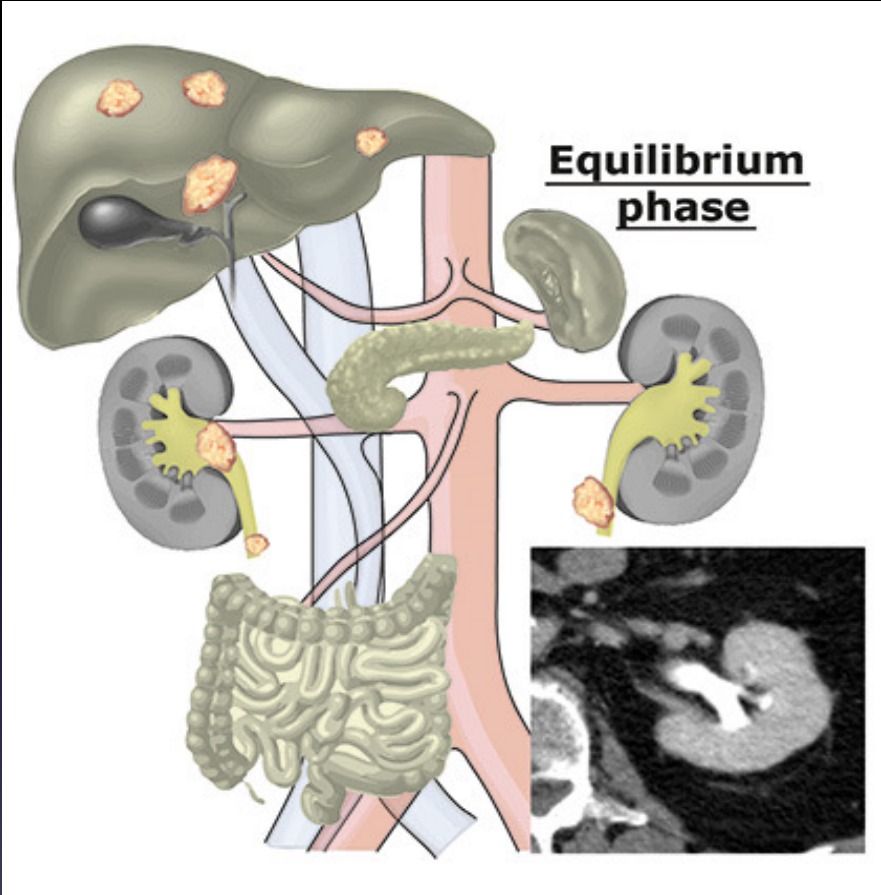
- This scan is made about **60-80 seconds** after the administration of IV contrast agent. This is the most commonly used scan phase. In this phase, the contrast agent is for the most part in the veins. The abdominal organs have absorbed the contrast agent and are 'enhanced'. This scan phase is generally used to screen for abdominal abnormalities and detect hypovascular liver metastases



- **Nephrogenic**
- This scan is made about **80-100 seconds** after the administration of IV contrast agent. In this phase, both the renal cortex and medulla are homogeneously enhanced. This allows for effective evaluation of the renal parenchyma. This phase is used in particular to evaluate kidney tumors.



- **Equilibrium/delayed**
- This scan is made about **6-10 minutes** after the administration of IV contrast agent. This phase is also termed the washout or delayed phase. The contrast agent has passed through all the organs and is being excreted by the kidneys. This phase is used frequently to evaluate the **urinary tract**. In addition, this phase can help characterize liver lesions or detect bile duct tumors.



Phase	Time	Indications
No contrast	-	<i>Kidney/ureteral stones, arterial calcifications</i>
Arterial	<i>20 - 30 sec</i>	<i>Abdominal bleeding, aortic aneurysm, arterial stenosis/occlusions, hypervascular liver metastases, pancreas tumors</i>
Portal venous	<i>60 - 80 sec</i>	<i>Screening, hypovascular liver metastases, abscess formation, venous thrombosis</i>
Nephrogenic	<i>80 - 100 sec</i>	<i>Kidney tumors, kidney trauma</i>
Equilibrium /delayed	<i>6 - 10 min</i>	<i>Ureteral obstruction or leaks, characterization of liver tumors</i>

Various scan phases with their corresponding scan times (= time after administration of intravenous contrast agent) and primary indications.

- Many patients require **multiphase scans**, e.g. in abdominal trauma or in liver, pancreas and kidney tumors.

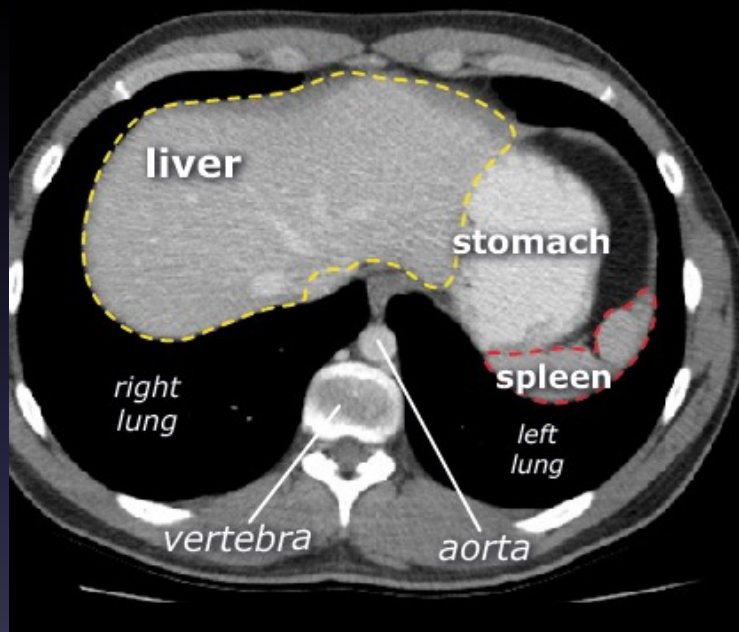
Abdominal CTs generally have multiple slice thicknesses. The slice thickness is commonly shown in the top left corner of the screen, under the patient data.

When starting a standard evaluation of an abdominal CT, a slice thickness of **5 mm** is recommended. The **1-mm** slices are recommended for more detailed analysis of abnormalities or small structures

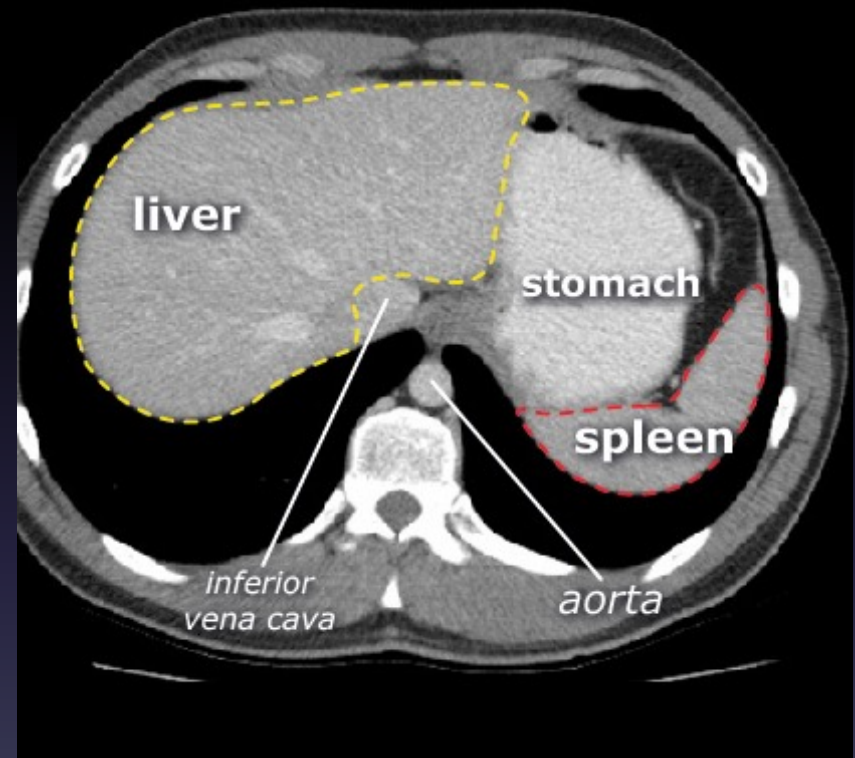
Normal anatomy

Normal abdominal CT

Normal abdominal CT



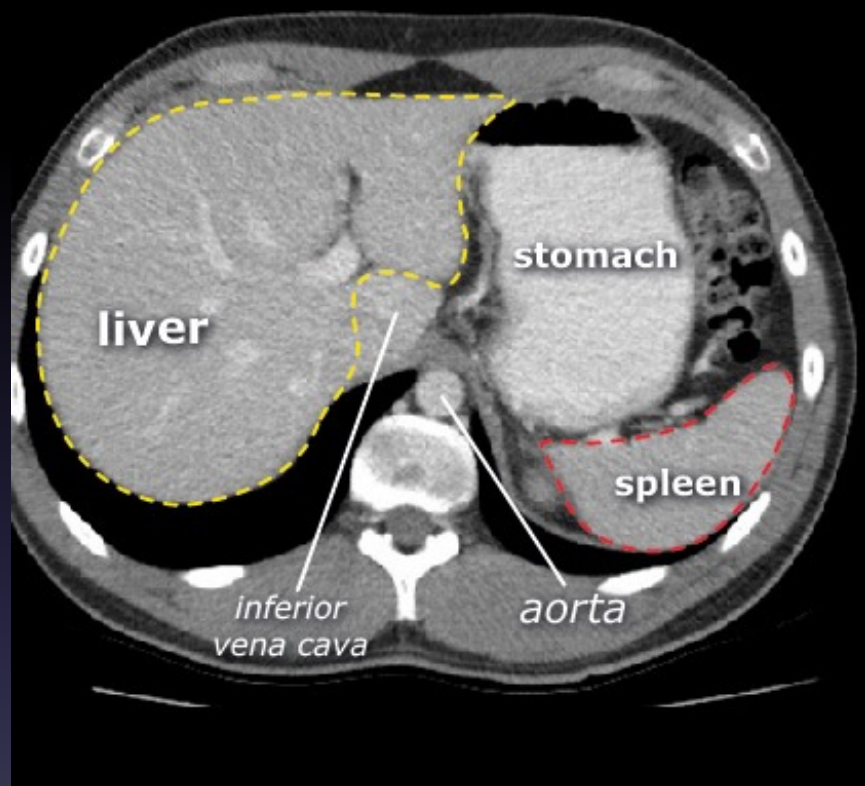
Normal abdominal CT



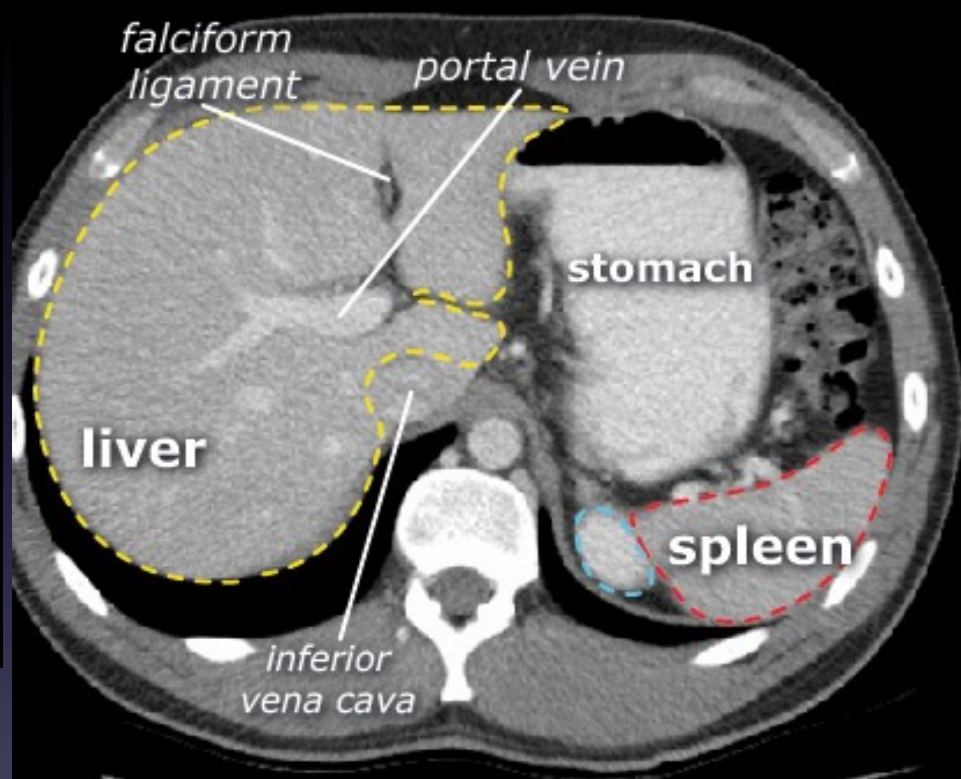
Fase portale

- Portal venous phase: the parenchyma of the liver/spleen/pancreas is homogeneously enhanced.
- Intra-abdominal fat has the density of fat (HU -50 to -100) similar to normal subcutaneous fat. If not, there may be ascites or fatty infiltration

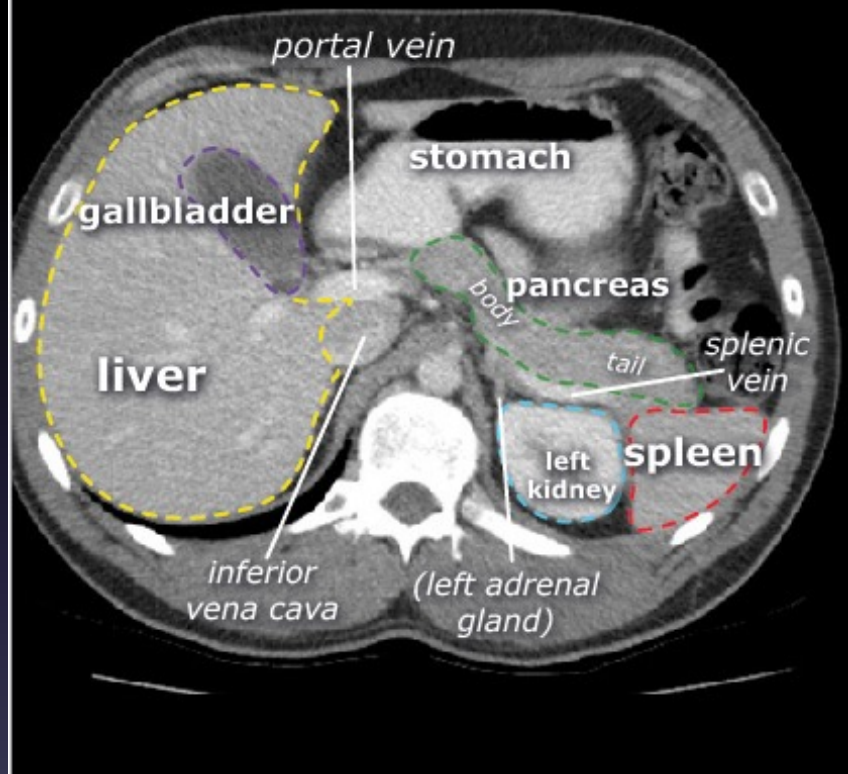
Normal abdominal CT



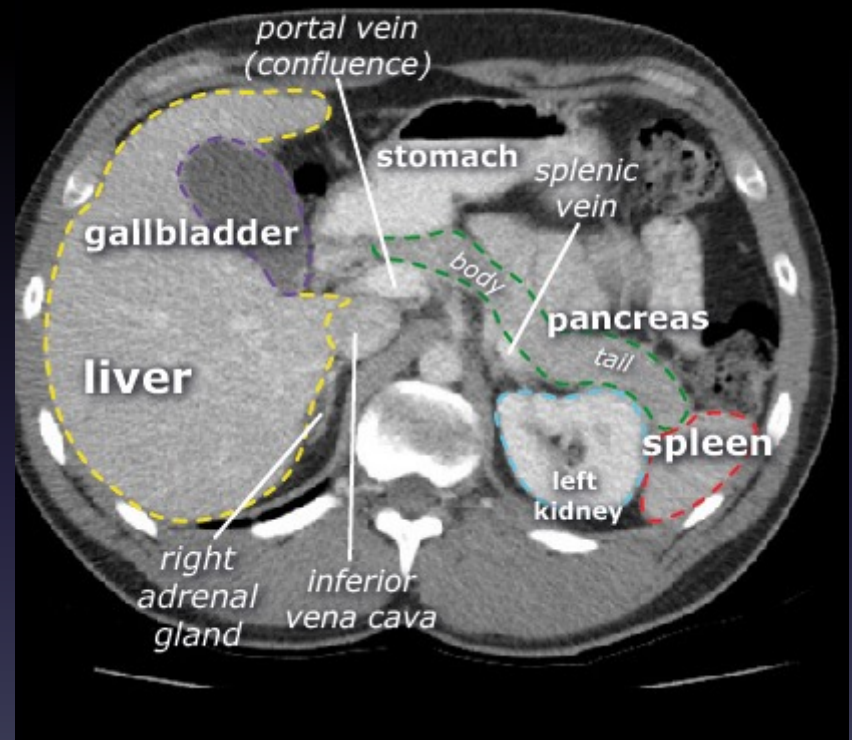
Normal abdominal CT



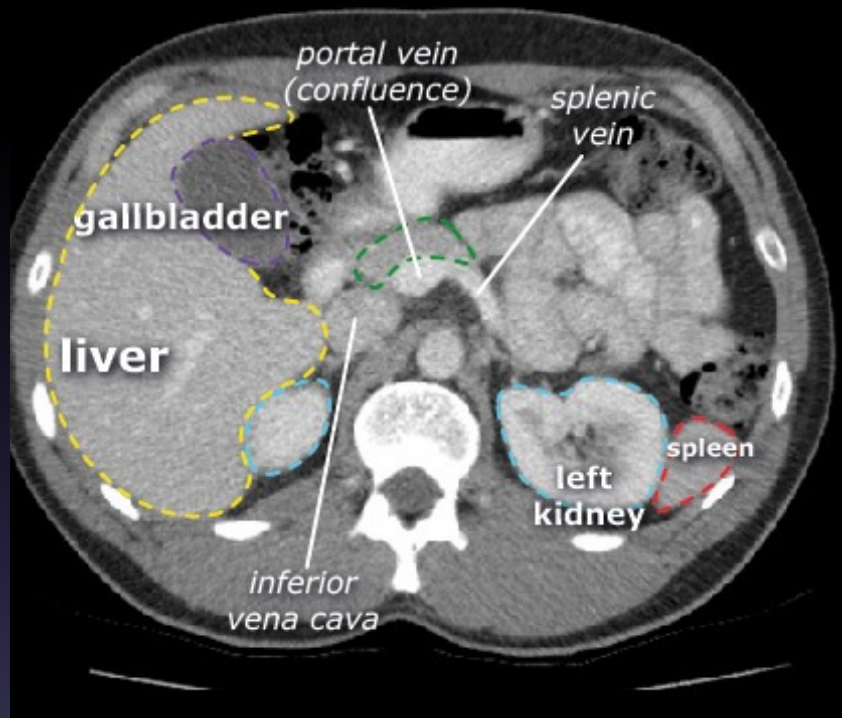
Normal abdominal CT



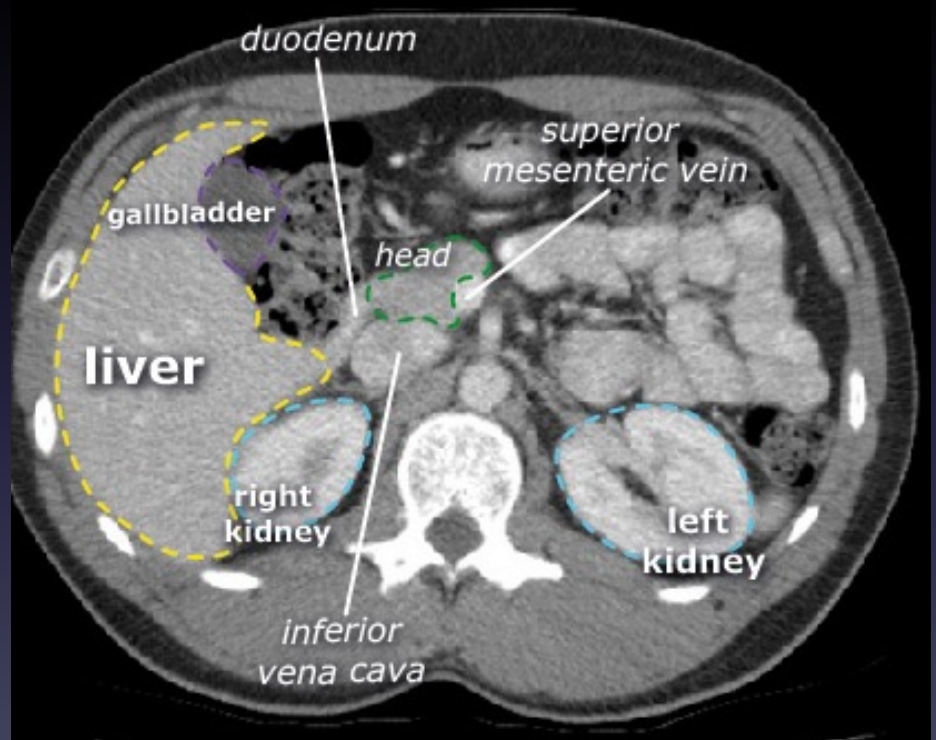
Normal abdominal CT



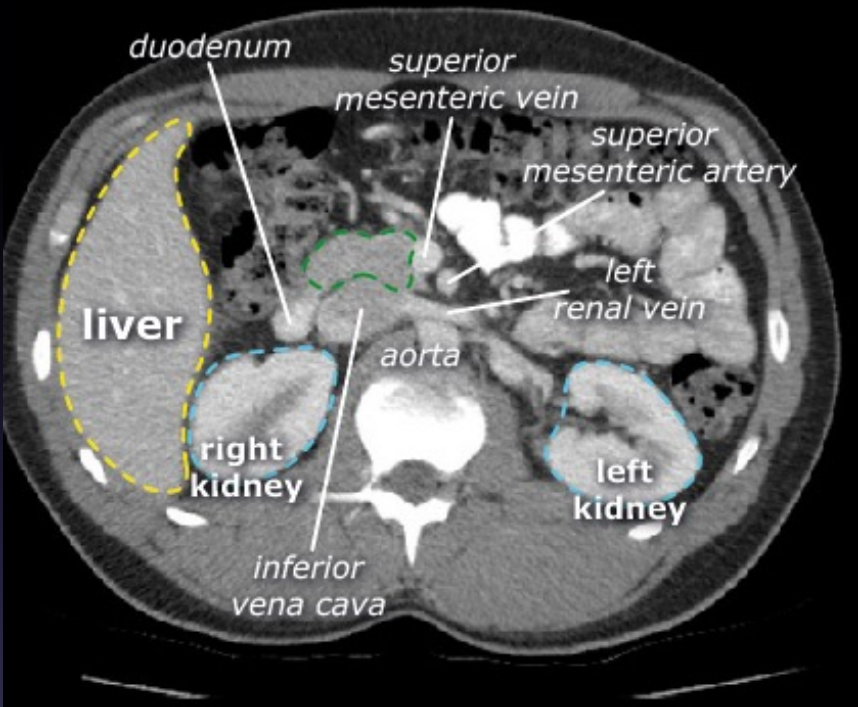
Normal abdominal CT



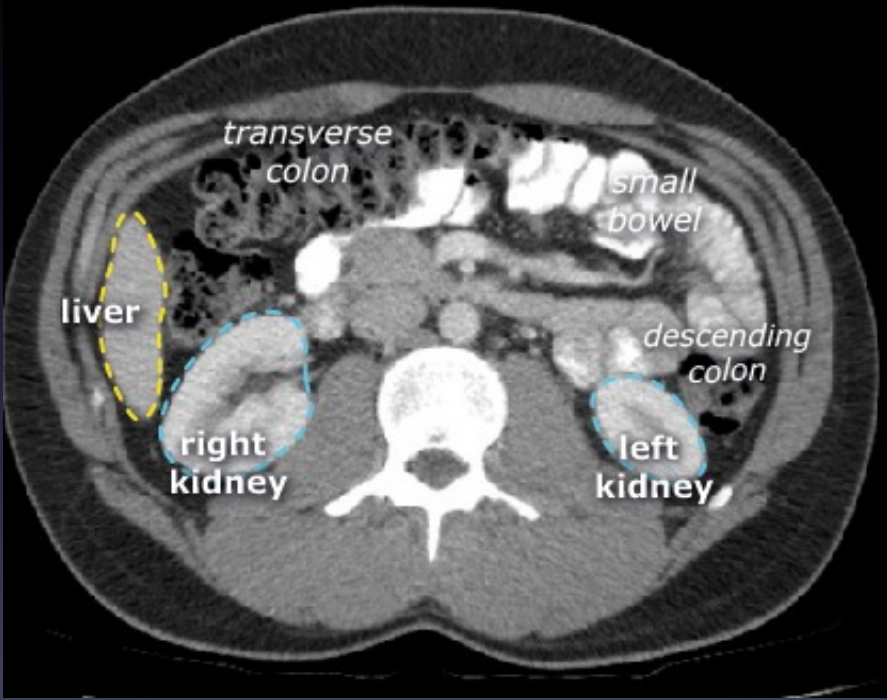
Normal abdominal CT



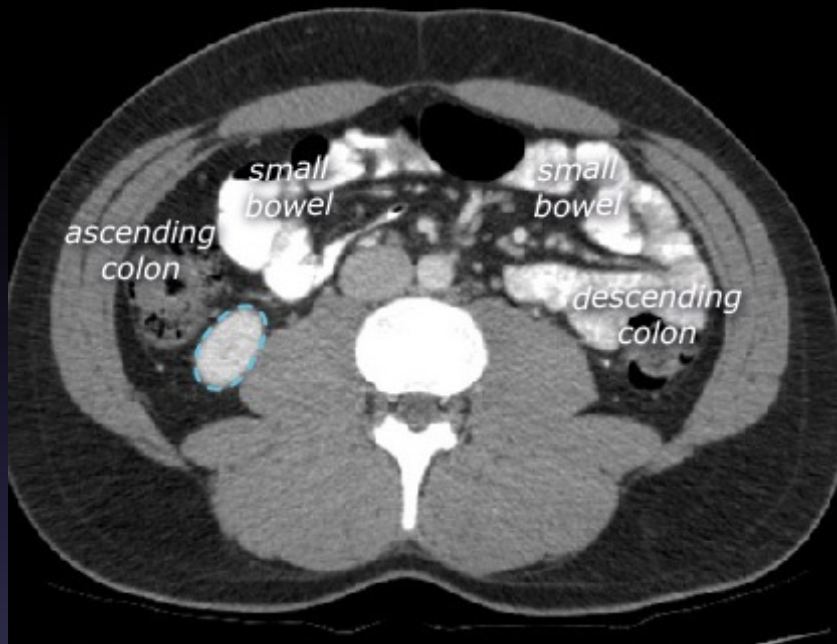
Normal abdominal CT



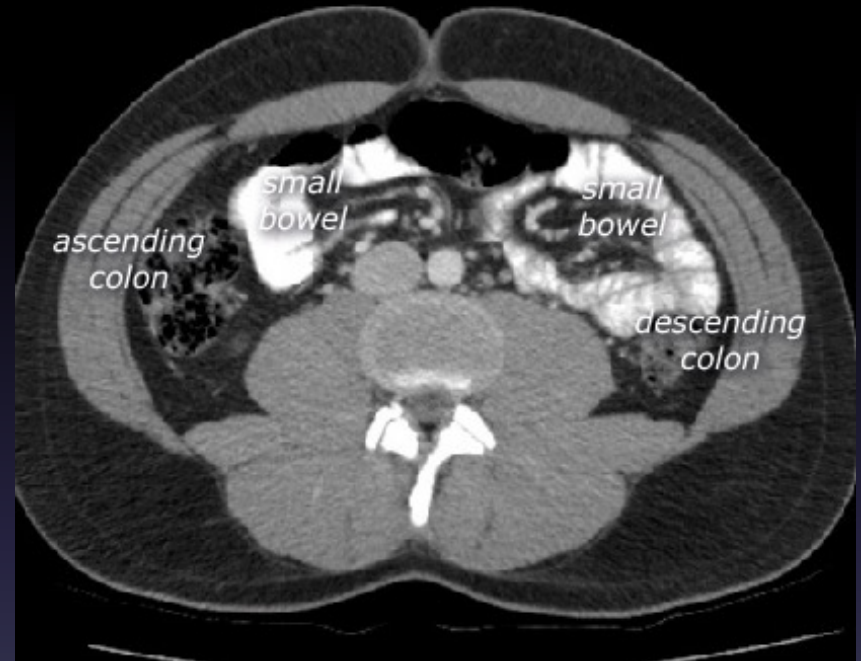
Normal abdominal CT



Normal abdominal CT



Normal abdominal CT



Normal anatomy of the abdomen, scanned in the portal venous phase. The patient drank positive oral contrast agent (the contrast is in the small intestines). The colon is for the most part filled with granular feces

- **History**
- Before evaluating an abdominal CT, you should first carefully study the case history. The patient's medical history is always important. See if previous abdominal CTs have been made, which you could use for comparison. It would be a waste of your time to focus on abnormalities which have been analyzed before. Additionally, the patient's general history and clinical status are important when evaluating an abdominal CT, think of (recent) abdominal surgery, radiotherapy, fever/elevated infection parameters.

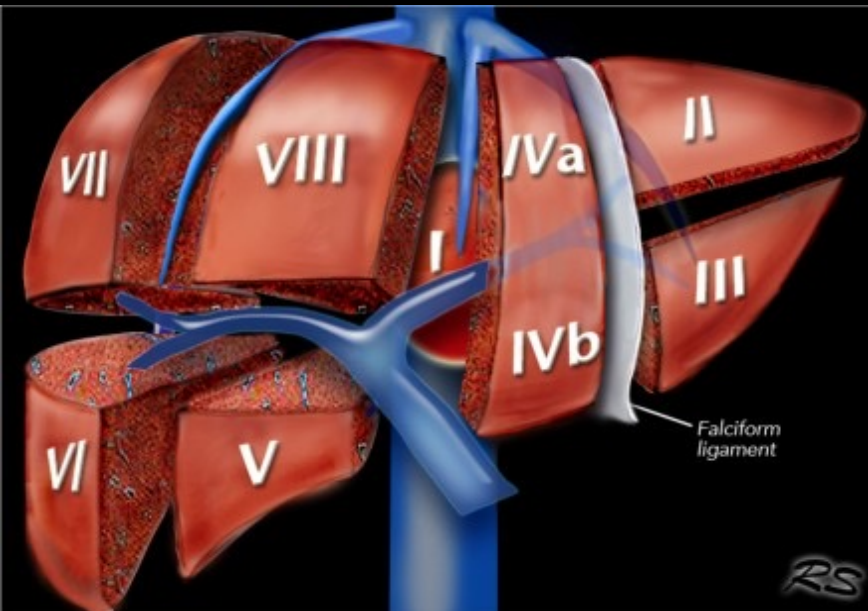
Quality of the examination

- On the basis of the indication and question, a specific scan protocol has been selected. First see if the examination was successful and if the question can be answered. Example: liver metastases are generally invisible on an abdominal CT without contrast agent.

Method

- It is recommended to follow a structured method when evaluating a CT. This forces you to examine all organs and reduces the risk of missing anything. Some people prefer to first answer the question and then examine the other organs; others follow a fixed order of organs.

LIVER



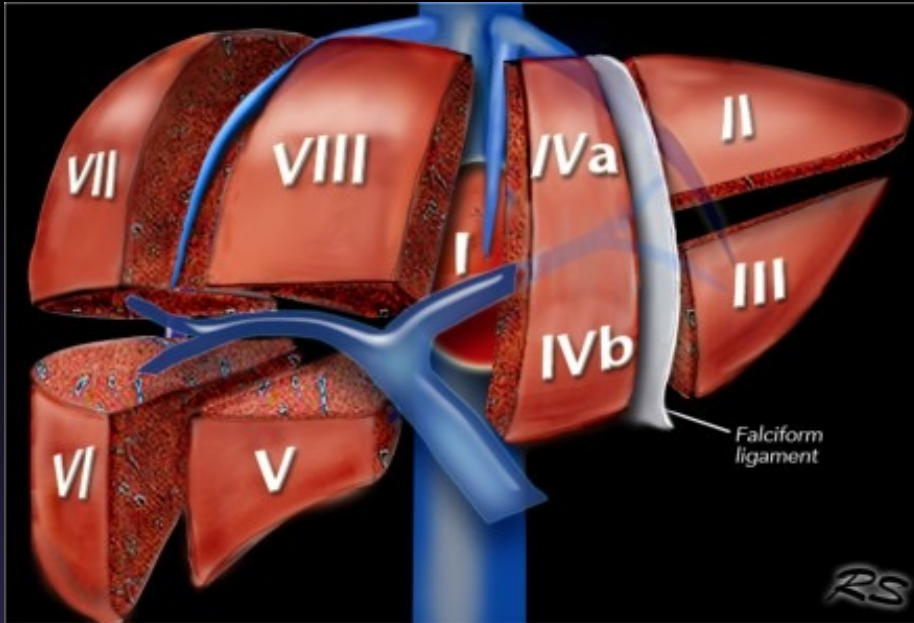
- The anatomy of the liver can be described using two different aspects: morphological anatomy and functional anatomy.

The traditional morphological anatomy is based on the external appearance of the liver and does not show the internal features of vessels and biliary ducts branching, which are of obvious importance in hepatic surgery.

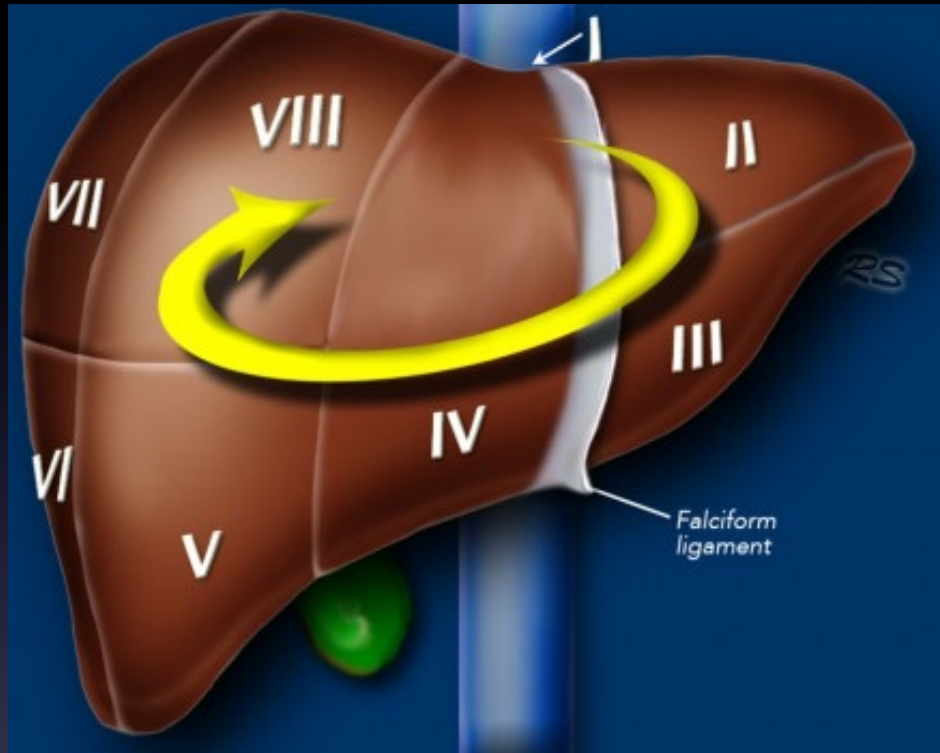
TOPOGRAPHIC ANATOMY

- A normal liver enhances homogeneously. The liver receives about 80% of its blood through the portal vein (= nutrient-rich blood from the intestines). The remaining 20% is supplied by the hepatic artery.

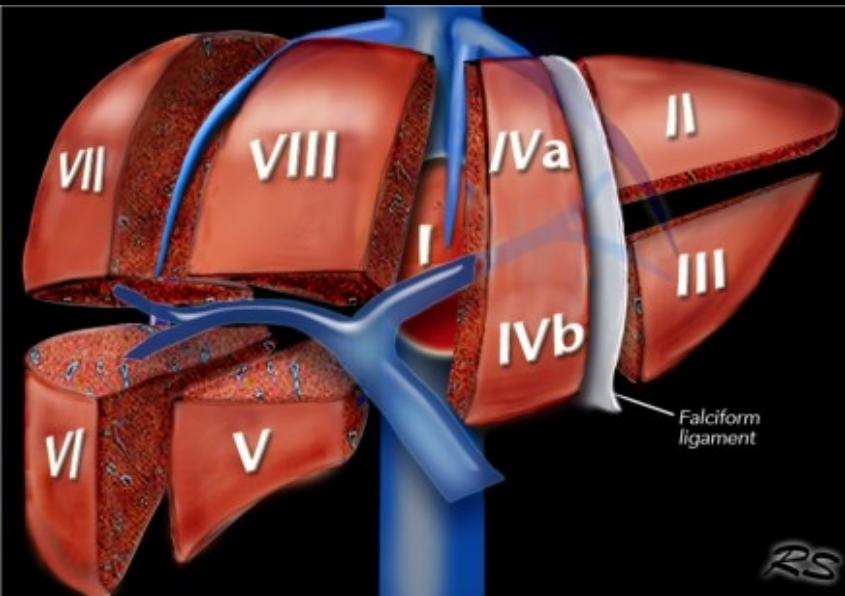
If focal liver pathology is present, it is important to document its location. This may be crucial to any surgical options. Using the **Couinaud classification**, the liver is subdivided into eight individually functioning segments. Each segment has its own afferent hepatic artery and portal vein, and efferent hepatic vein and efferent bile ducts



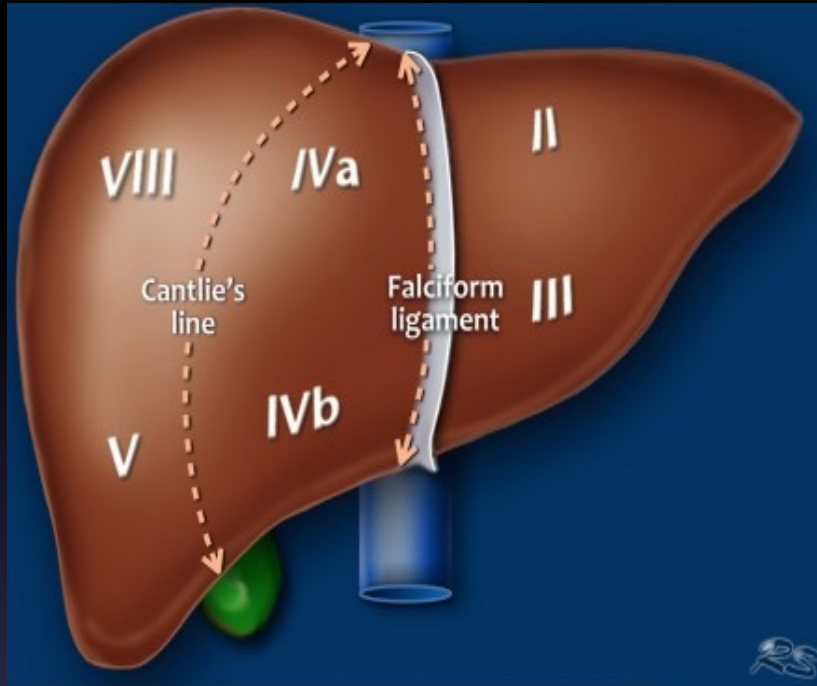
- The French surgeon and anatomist Claude Couinaud was the first to divide the liver into eight functionally independent segments allowing resection of segments without damaging other segments



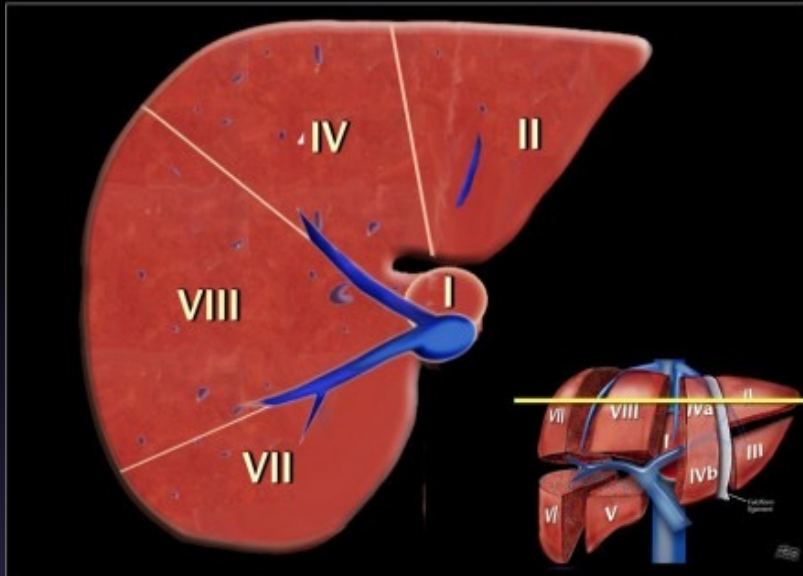
- **Segments numbering**
- There are eight liver segments.
Segment IV is sometimes divided into segment IVa and IVb according to Bismuth.
The numbering of the segments is in a clockwise manner.
Segment I (the caudate lobe) is located posteriorly.
It is not visible on a frontal view



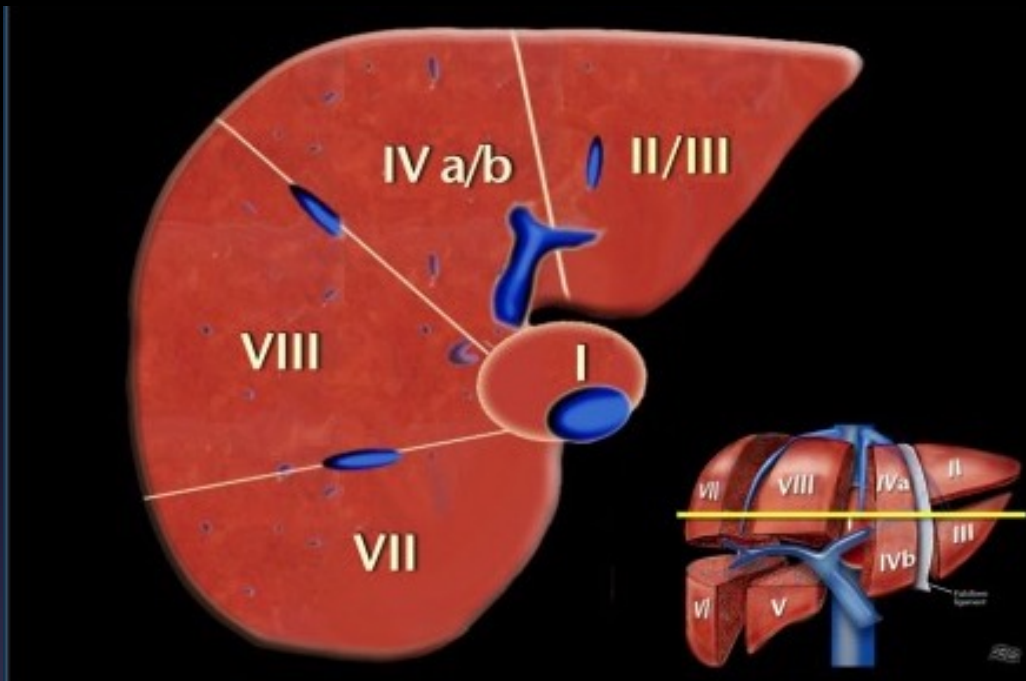
- **Right hepatic vein** divides the right lobe into anterior and posterior segments.
Middle hepatic vein divides the liver into right and left lobes (or right and left hemiliver). This plane runs from the inferior vena cava to the gallbladder fossa.



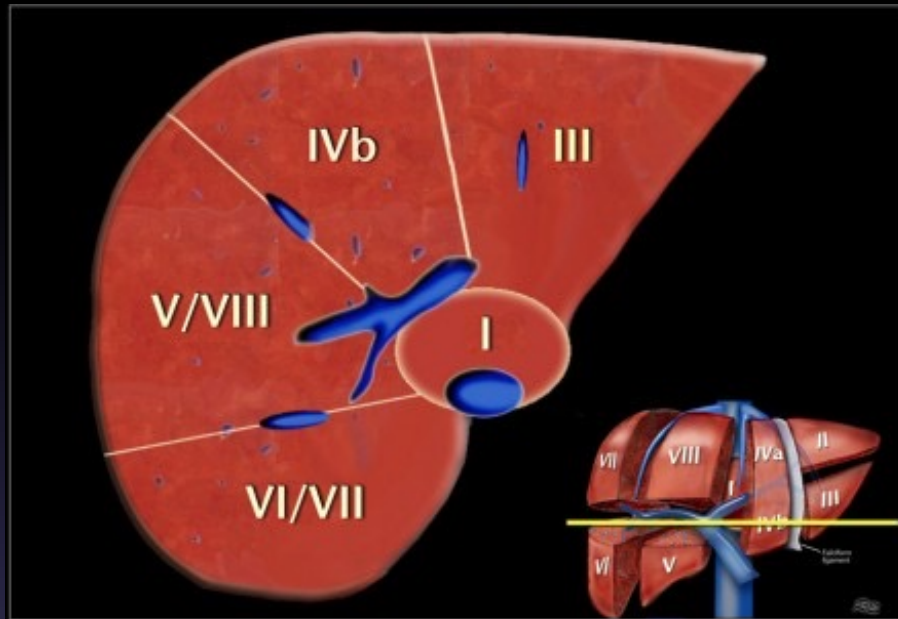
- **The Falciform ligament** divides the left lobe into a medial- segment IV and a lateral part - segment II and III.
- **The portal vein** divides the liver into upper and lower segments.
The left and right portal veins branch superiorly and inferiorly to project into the center of each segment.



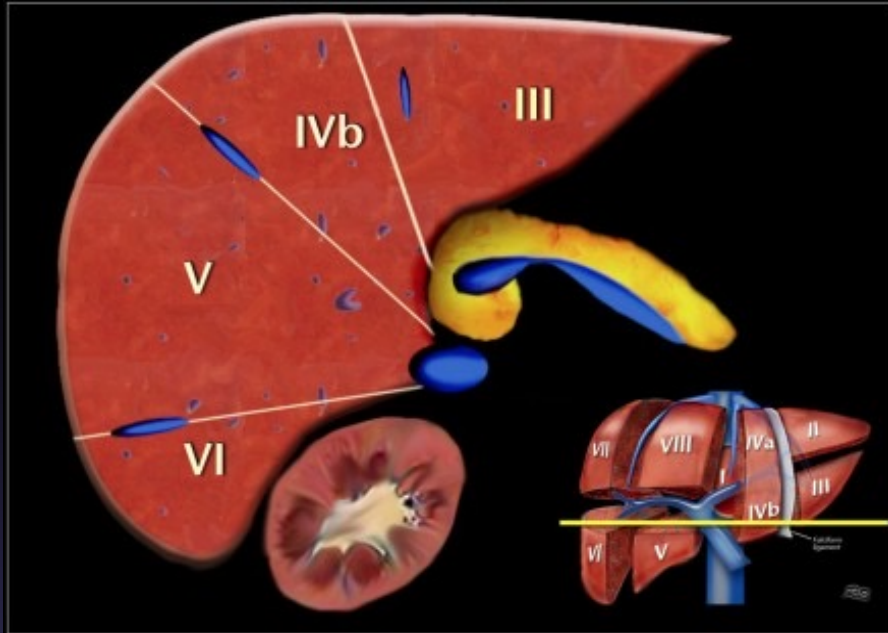
- **Transverse anatomy**
- This figure is a transverse image through the superior liver segments, that are divided by the right and middle hepatic veins and the falciform ligament.



- This is a transverse image at the level of the left portal vein. At this level the left portal vein divides the left lobe into the superior segments (II and IVa) and the inferior segments (III and IVb). The left portal vein is at a higher level than the right portal vein.



- This image is at the level of the right portal vein.
At this level the right portal vein divides the right lobe of the liver into superior segments (VII and VIII) and the inferior segments (V and VI).
The level of the right portal vein is inferior to the level of the left portal vein.



- At the level of the splenic vein, which is below the level of the right portal vein, only the inferior segments are visible

- **Caudate lobe**

- The caudate lobe or segment I is located posteriorly.

The caudate lobe is anatomically different from other lobes in that it often has direct connections to the IVC through hepatic veins, that are separate from the main hepatic veins.

The caudate lobe may be supplied by both right and left branches of the portal vein.

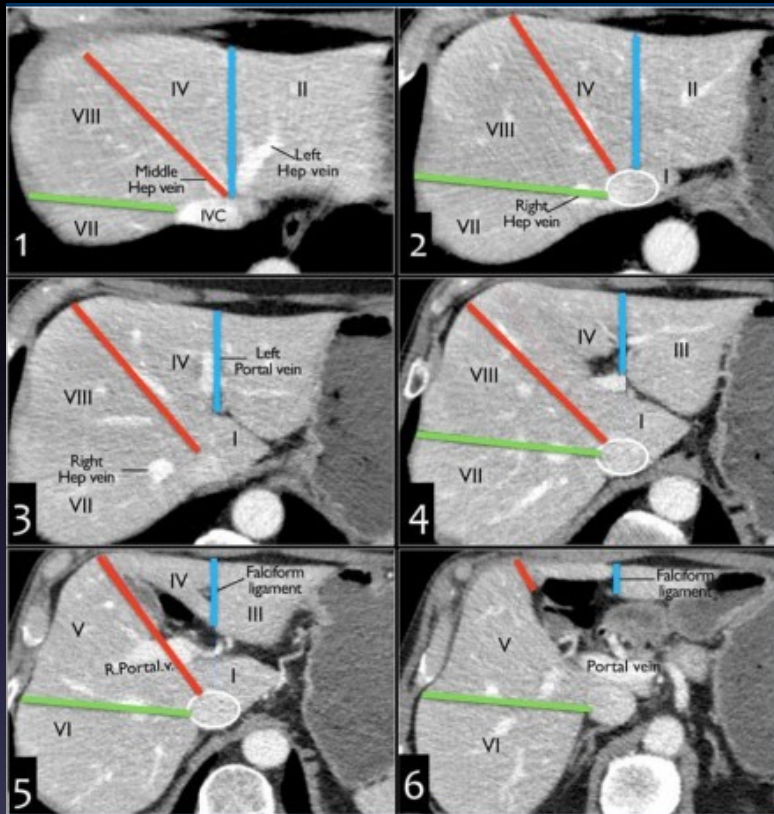
LIVER: CT role

- The conspicuity of a liver lesion depends on the attenuation difference between the lesion and the normal liver.

On a non enhanced CT-scan (NECT) liver tumors usually are not visible, because the inherent contrast between tumor tissue and the surrounding liver parenchyma is too low.

Only a minority of tumors contain calcifications, cystic components, fat or hemorrhage and will be detected on a NECT

How to separate liver segments on cross sectional imaging



- **Left lobe: lateral(II/III) vs medial segment (IVA/B)**
Extrapolate a line along the falciform ligament superiorly to the confluence of the left and middle hepatic veins at the IVC (blue line).
- **Left vs Right lobe: IVA/B vs V/VIII**
Extrapolate a line from the gallbladder fossa superiorly along the middle hepatic vein to the IVC (red line).
- **Right lobe: anterior (V/VIII) vs posterior segment (VI/VII)**
Extrapolate a line along the right hepatic vein from the IVC inferiorly to the lateral liver margin (green line).

Focal abnormalities

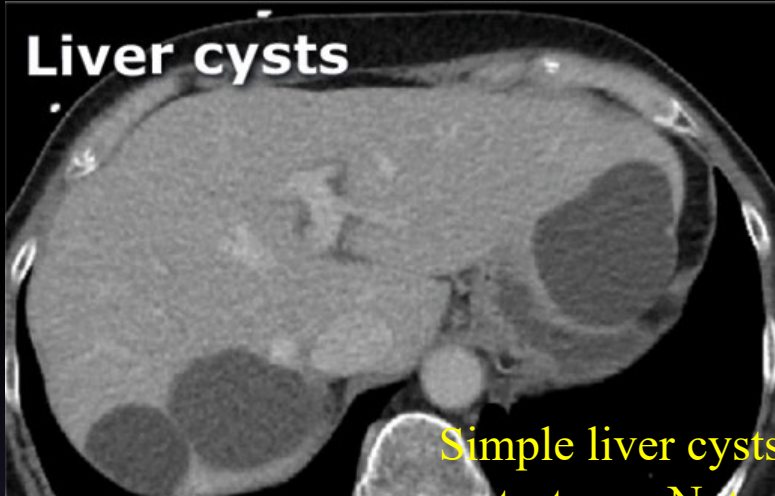
- As mentioned previously, multiple-phase abdominal CT is performed when a liver lesion is suspected in order to evaluate the enhancement pattern of the lesion. Lesion morphology often presents clues for diagnosis. In order to arrive at a sure diagnosis, however, additional examination is usually required, mostly in the form of a liver MRI.

Most common benign liver lesions

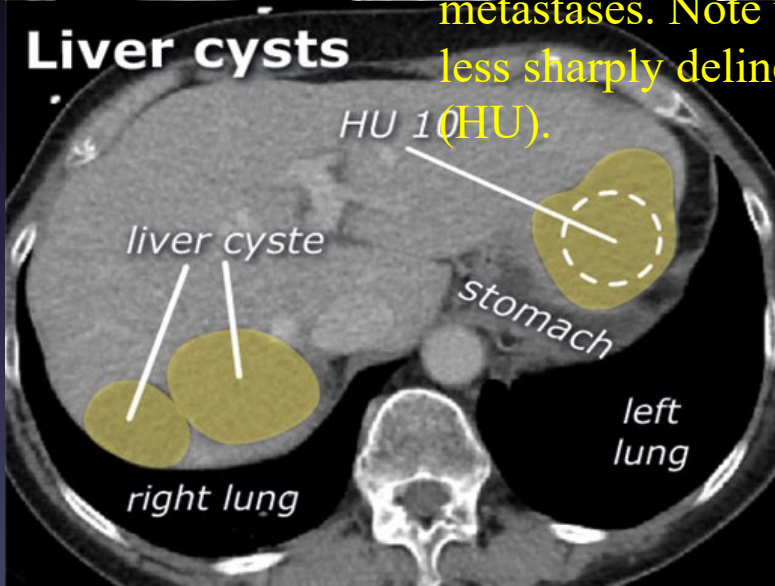
- Cyst

Cysts are very common abnormalities in the liver. A liver cyst may vary in size from a few millimeters up to more than 10 cm. Cysts are sharply delineated with a low density (HU < 10). Cysts do not enhance

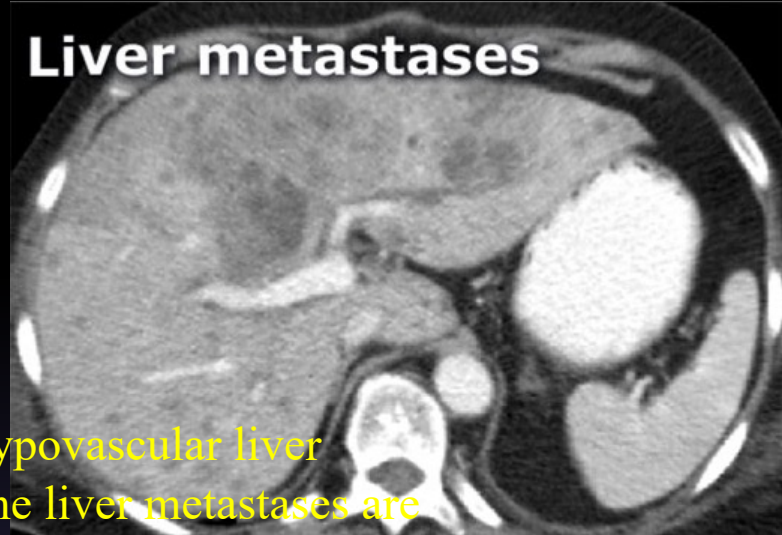
Liver cysts



Liver cysts



Liver metastases



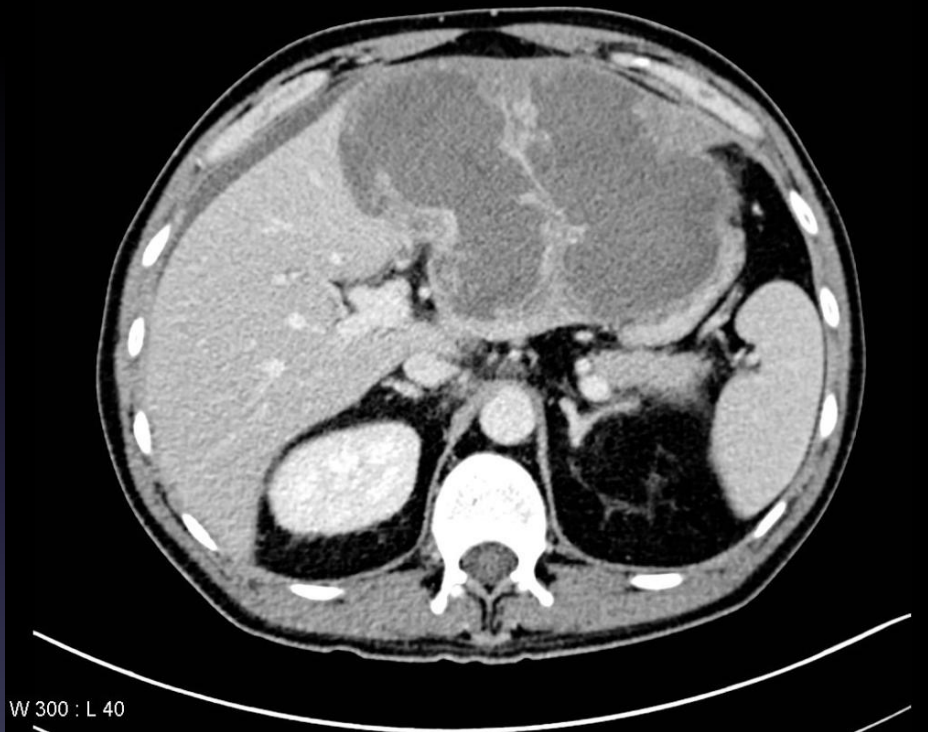
Liver metastases



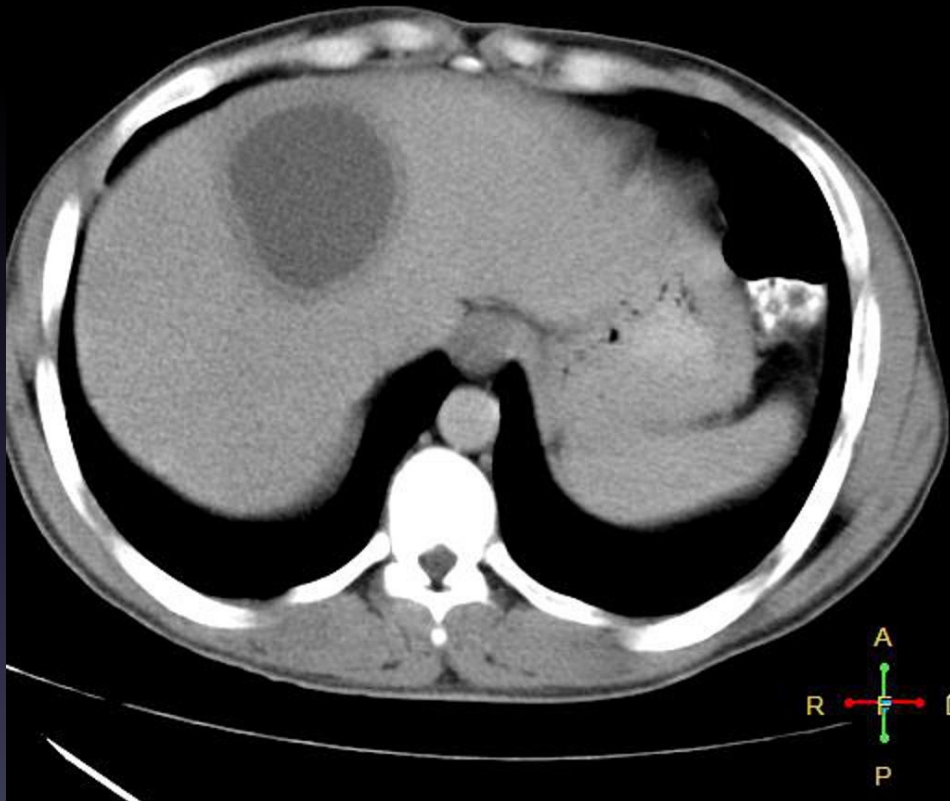
Simple liver cysts vs hypovascular liver metastases. Note that the liver metastases are less sharply delineated and have higher density (HU).

- Abscess

Abscesses in the liver are usually a complication of an intestinal infection. The bacteria migrate to the liver through the venous system. Patients with a liver abscess are sick, have a fever and elevated infection parameters in the blood. The abscess is usually a cluster of jaggedly delineated hypodensities. The abscess rim may enhance (note: rim enhancement is commonly absent).



- Large, multiseptated lesion, occupying most of the left hepatic lobe. It shows irregular and thick peripheral as well as septal enhancement. Surrounded by inflammatory stranding and perihepatic free fluid.



- Solitary cystic liver lesion with low attenuation center and peripheral thick enhancing wall.
- CT Findings are consistent with amebic liver abscess.

- Hemangioma

Hemangiomas are common abnormalities in the liver. A hemangioma can be up to 10 cm in size. Hemangiomas are sharply delineated with a specific enhancement pattern. The arterial phase reveals peripheral, nodular, discontinuous enhancement and the portal venous phase reveals progressive filling. Characteristic of hemangiomas is that the enhancement in each phase corresponds with the 'blood pool'

haemangioma



Focal nodular hyperplasia

H) is

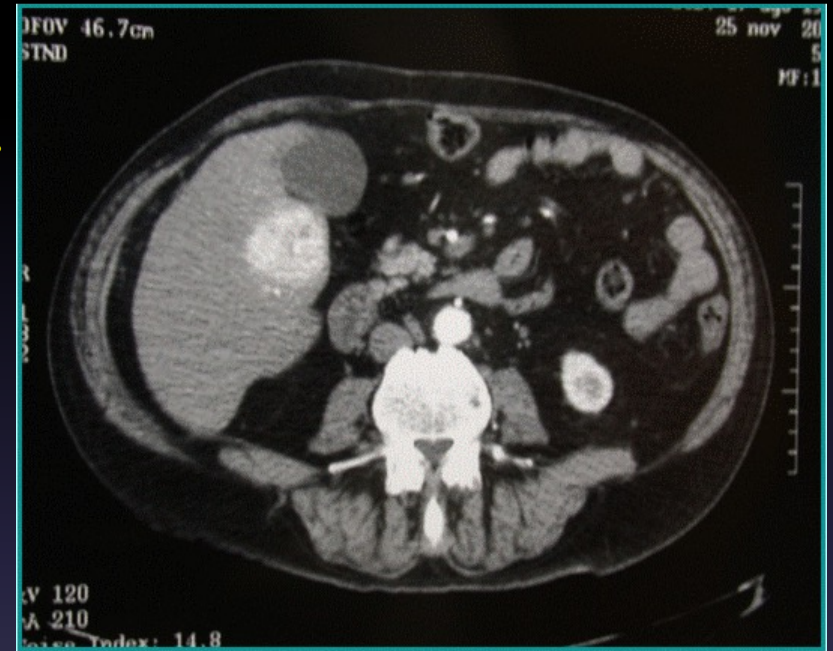
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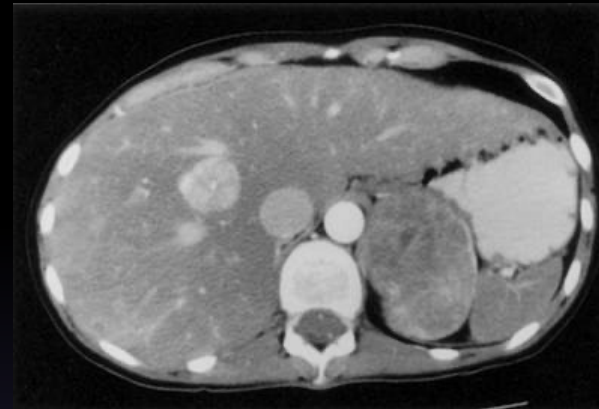
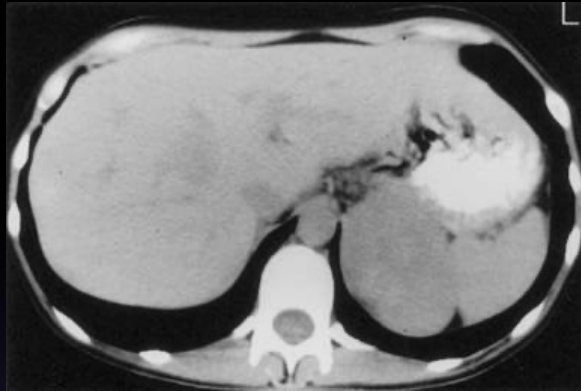
scar (table 2). In most FNHs, the fibrous central scar enhances in the equilibrium/delayed phase.



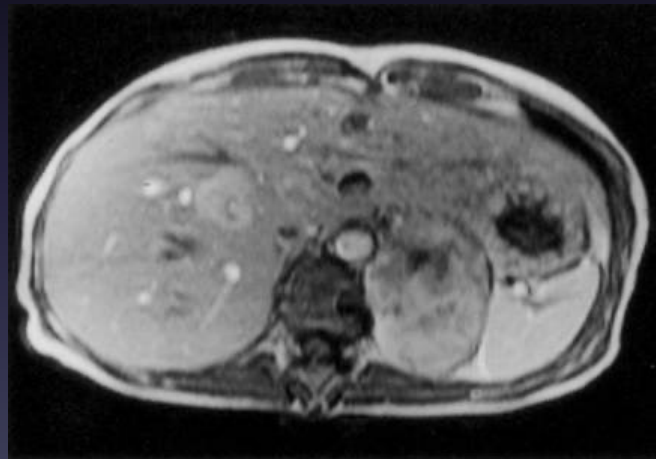
(pseudo)capsule in the equilibrium/delayed phase.


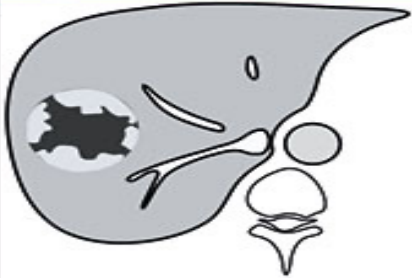
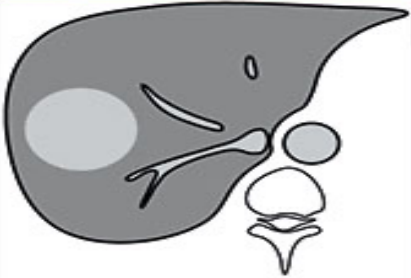
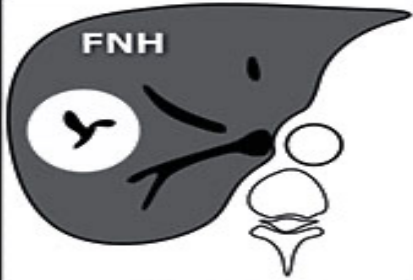
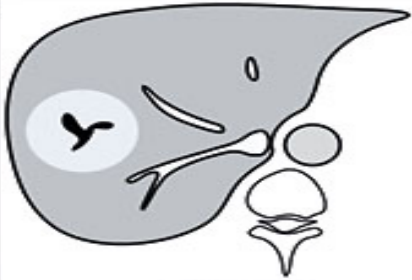
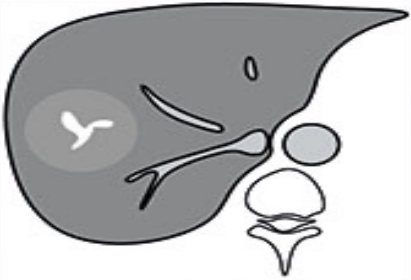
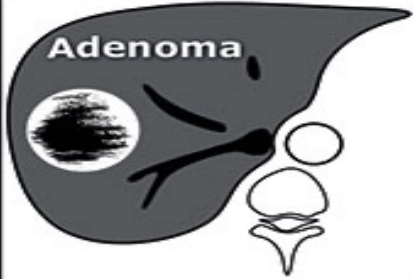
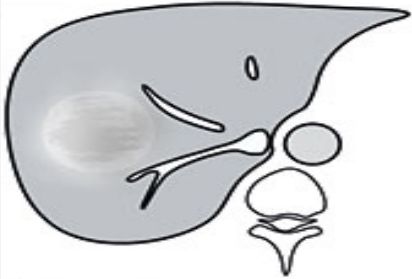
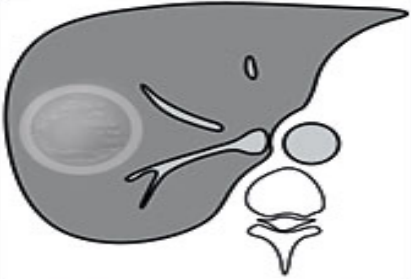
ADENOMA

- Quasi esclusivamente in donne con contraccettivi
- **Anatomia patologica:** cordoni di epatociti con lievi alterazioni nucleari senza vere atipie, non contiene duttuli biliari, coinvolge diramazioni terminali di rami portalì e vene sovraepatiche
- **Complicanze:** emorragia, emoperitoneo da rottura, trasformazione maligna
- Aspetto simile all'FNH, struttura non omogenea per la presenza di complicanze, area fredda alla scintigrafia con Tc solfuro colloidale



ADENOMA

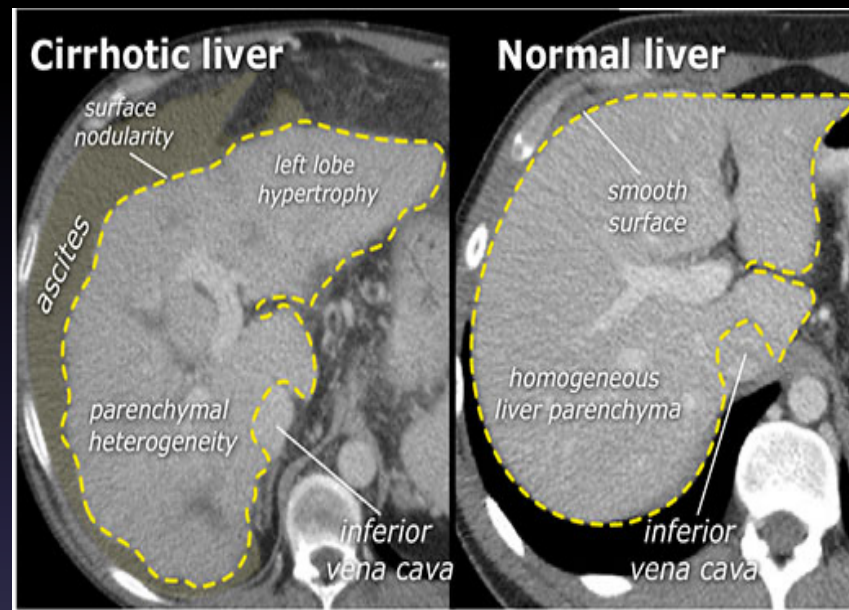
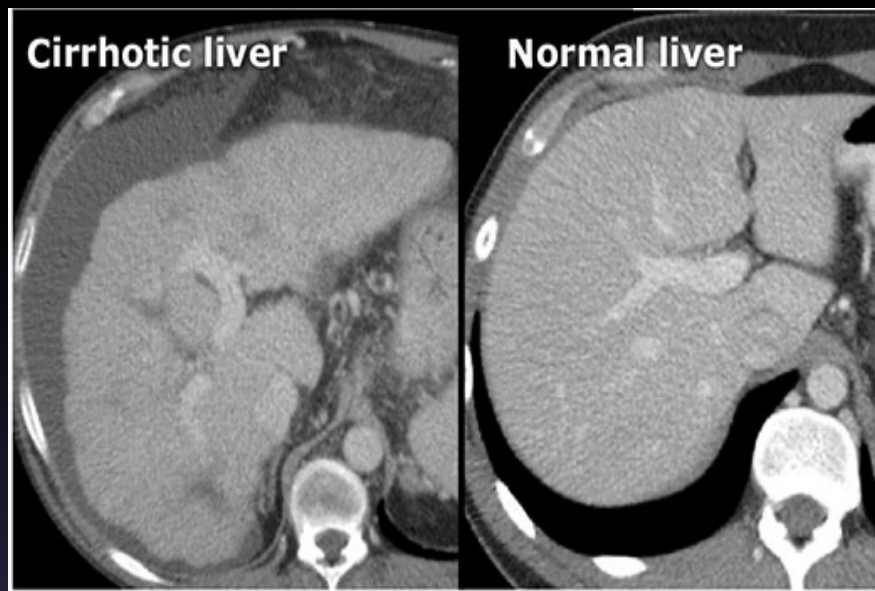


Arterial (20 -30 sec)	Portal venous (60 - 80 sec)	Delayed (6 - 10 min)
Hemangioma 		
FNH 		
Adenoma 		

Enhancement pattern of the most common benign liver lesions.

Chronic hepatopathy

- Liver cirrhosis is the result of chronic liver disease, causing irreversible damage to the liver tissue. The liver is **small** and proportions have changed; the left liver lobe and **segment 1** are **hypertrophic**, and the right liver lobe is atrophic. The liver tissue and surface has a **nodular aspect**. Liver cirrhosis may increase the pressure in the hepatic vessels, giving rise to '**portal hypertension**'. Signs of portal hypertension include collateral formation, splenomegaly and ascites.

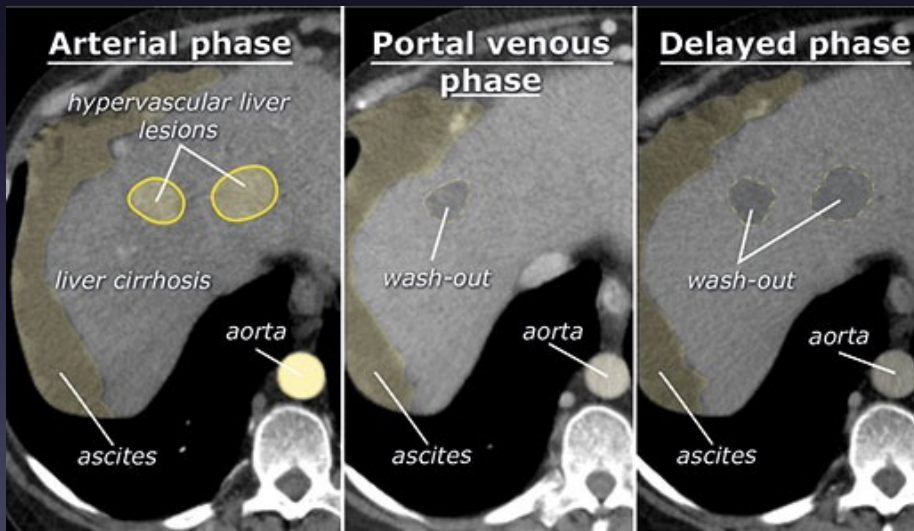
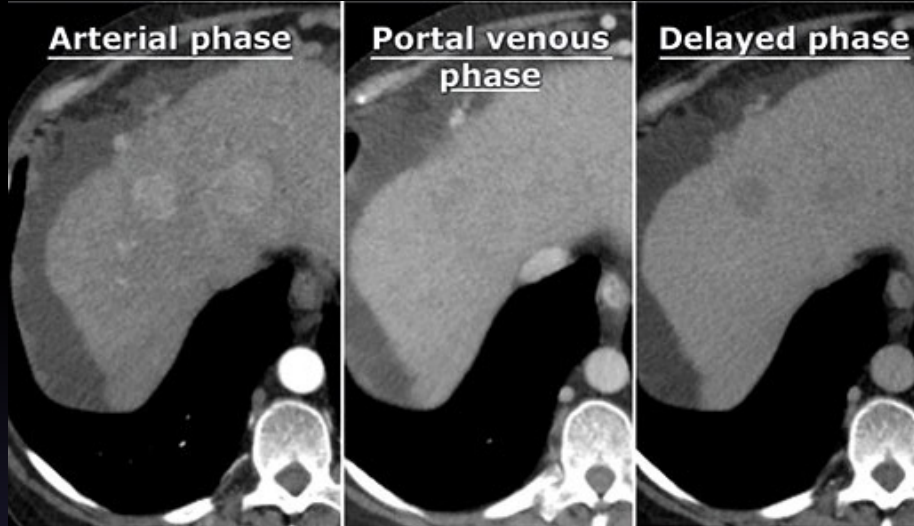


Scanned in the portal venous phase. Cirrhotic liver vs a normal liver.



- This CT-image is of a patient with liver cirrhosis with extreme atrophy of the right lobe, normal volume of the left lobe and hypertrophy of the caudate lobe.

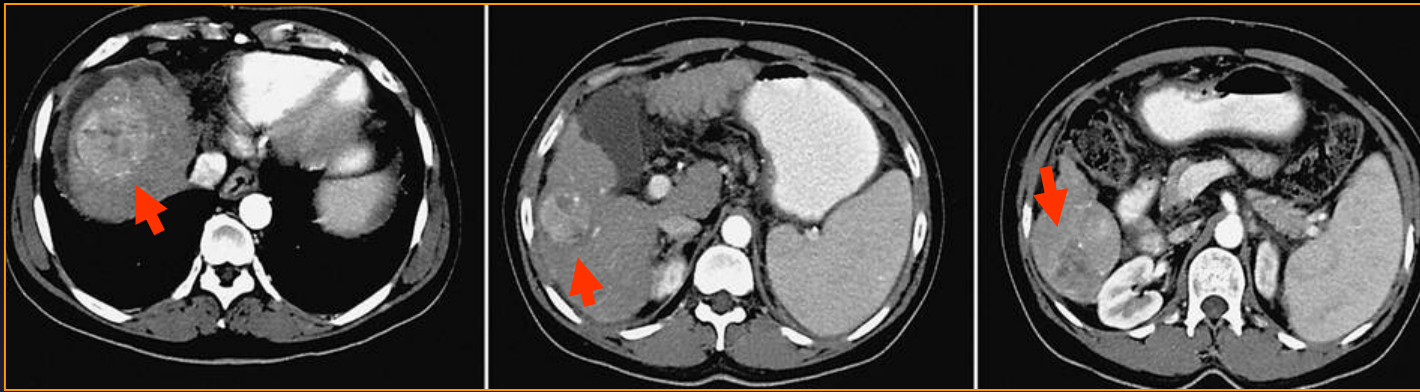
Due to a different blood supply the caudate lobe is spared from the disease process and hypertrophied to compensate for the loss of normal liverparenchyma



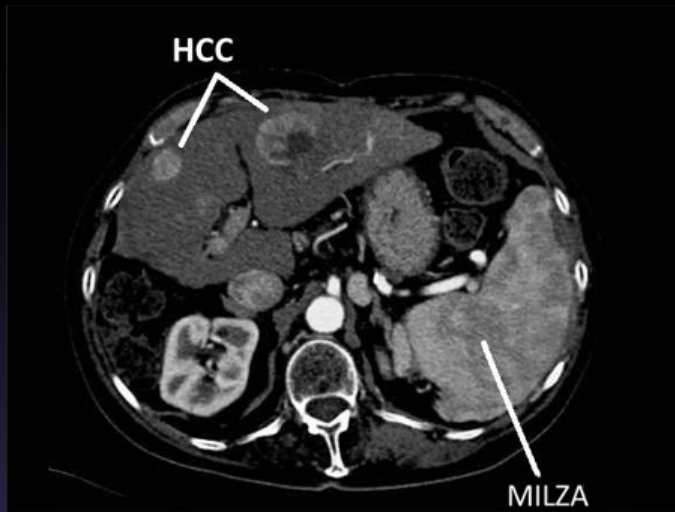
Liver cirrhosis with ascites. Two hypervascular enhancing liver lesions in the arterial phase. Both lesions reveal washout in the portal venous & equilibrium/delayed phases (= hypodense as compared to other liver parenchyma), consistent with HCC.

- Hepatocellular cell carcinoma

Hepatocellular cell carcinoma (HCC) is a malignant tumor arising from hepatocytes. HCC is strongly associated with chronic liver diseases such as hepatitis B and C and liver cirrhosis. HCC is more prevalent in non-Western countries than Western countries. HCC is an infiltrative tumor that may proliferate into the veins. Characteristic of HCC is the marked arterial enhancement and the rapid washout of contrast agent in the portal venous and equilibrium/delayed phases



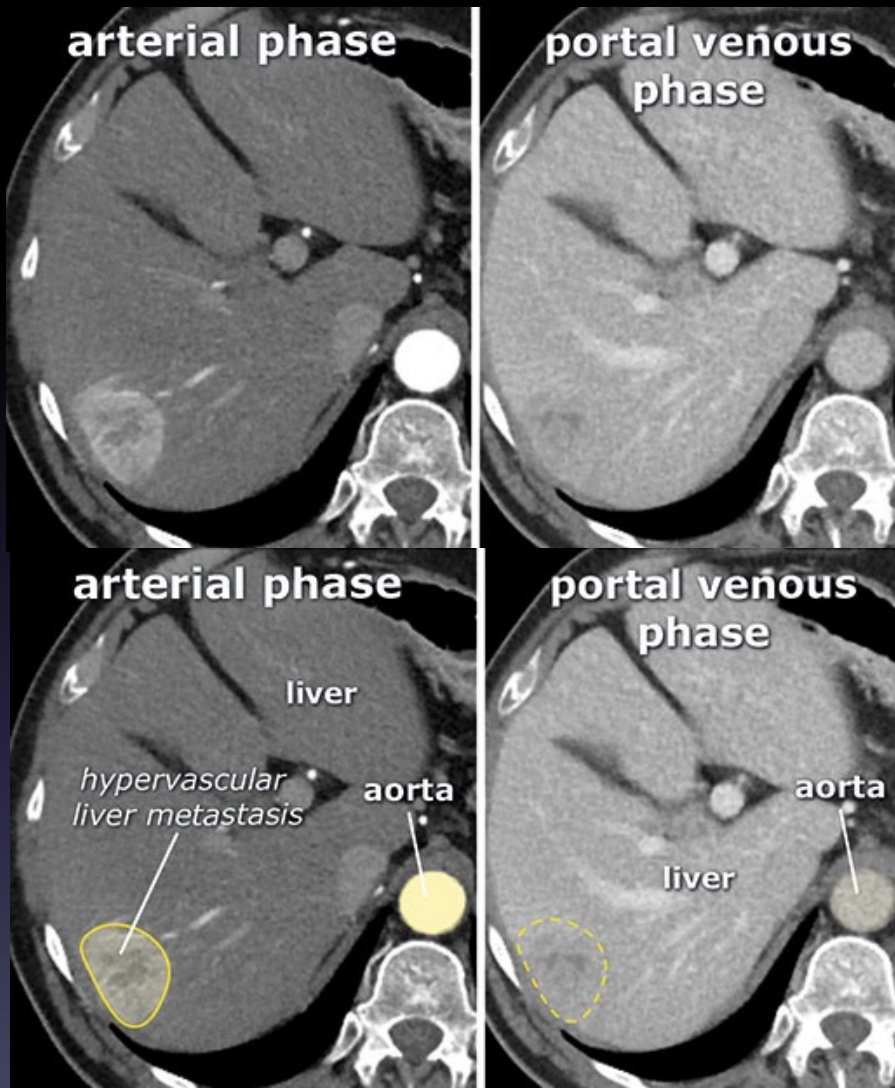
TC: epatocarcinoma multifocale



Most common malignant liver lesions

- Metastasis

Logically, metastases develop in people with a malignancy, but the primary malignancy may not be known yet. Metastases are vaguely delineated. There are both **hypovascular and hypervascular** liver metastases (table 6). It is important to realize that hypervascular metastases may be very difficult or impossible to see on a scan in the portal venous phase



Hypervascular liver metastasis in a patient with a history of renal cell carcinoma. Note it is difficult to see the metastasis in the portal venous phase.

It is therefore important to know beforehand whether a patient is known (or suspected) to have a tumor giving rise to hypervascular metastases. It can then be decided to scan in the arterial phase also.

Hypervascular metastases

Melanoma

Thyroid carcinoma

Mammary carcinoma

Hepatocellular carcinoma (HCC)

Renal cell carcinoma (RCC)

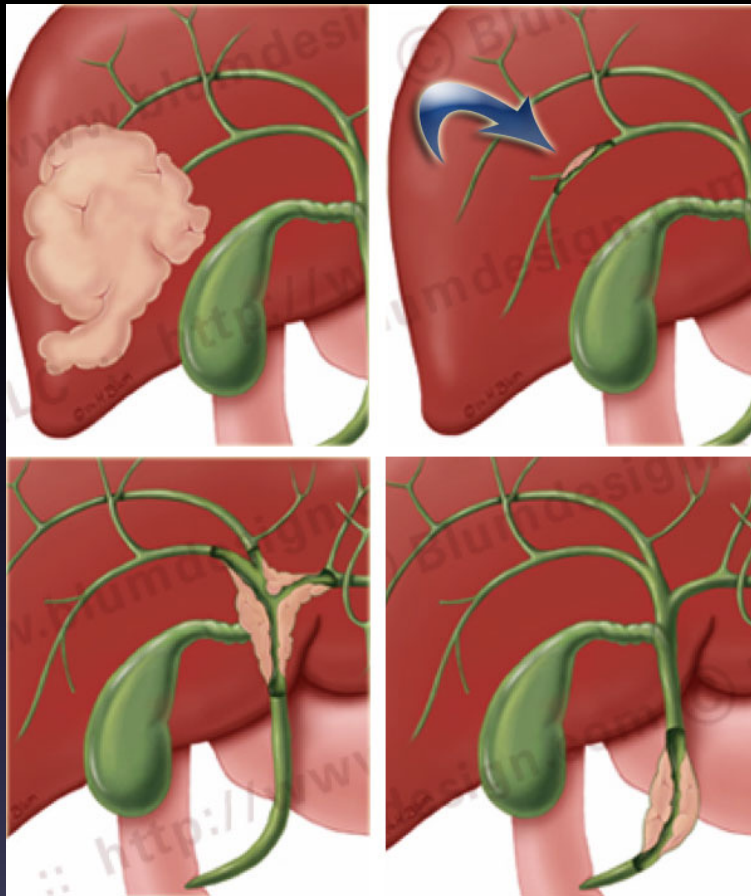
Neuroendocrine tumor (NET)

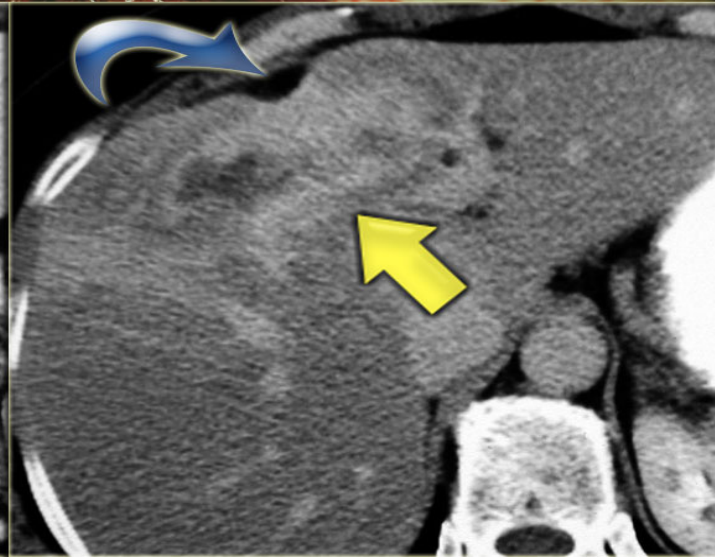
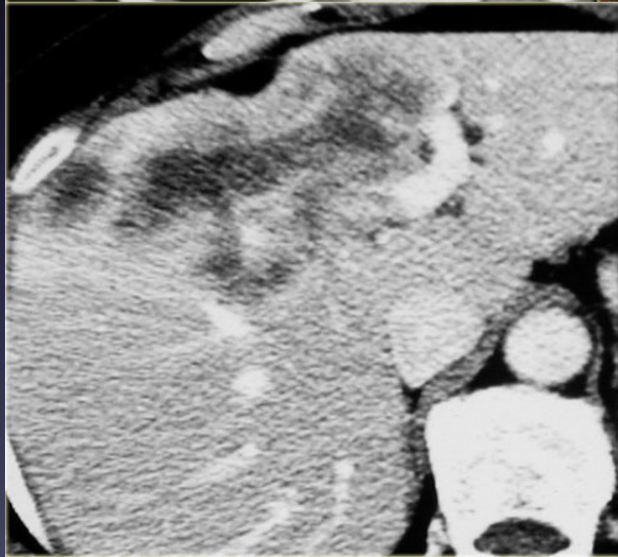
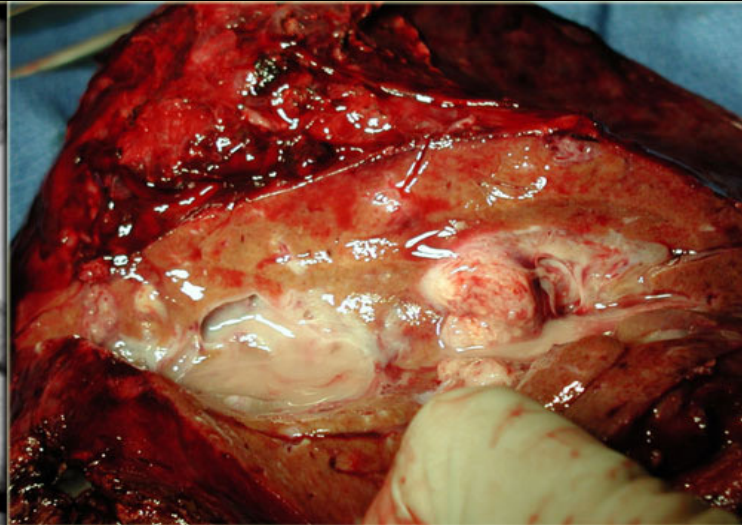
Leiomyosarcoma

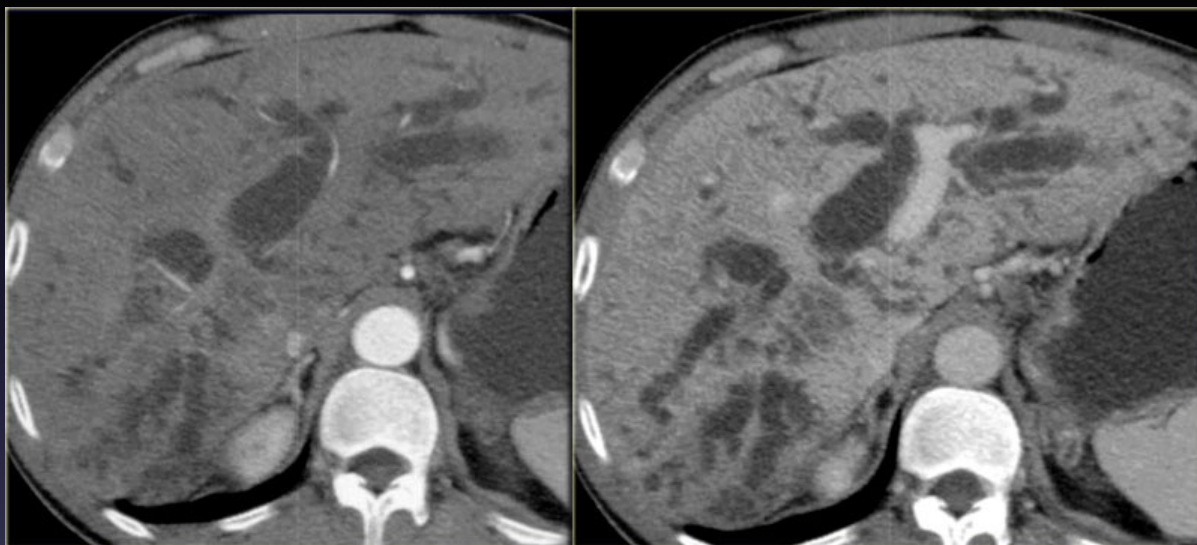
Choriocarcinoma

- Cholangiocarcinoma

Cholangiocarcinoma is a bile duct malignancy. The development of cholangiocarcinoma is associated with bile duct cysts and primary sclerosing cholangitis (PSC). The tumor may arise from both the intrahepatic and extrahepatic bile ducts. **Characteristic of cholangiocarcinoma is the fibrous nature with capsular retraction and persisting enhancement in the equilibrium/delayed phase and dilation of the proximal bile ducts**







Lesion morphology

Dimensions

Delineation

- *sharp*
- *vague*

Enhancement pattern (per phase):

- *homogeneous*
- *peripheral/central*
- *heterogeneous*

Scar

Calcifications

Capsule

- *Liver lesion summary:*

Multiple scan phases are advisable in order to characterize a liver lesion. Lesion morphology is then evaluated

Table. Important characteristics to look out for when evaluating a liver lesion.

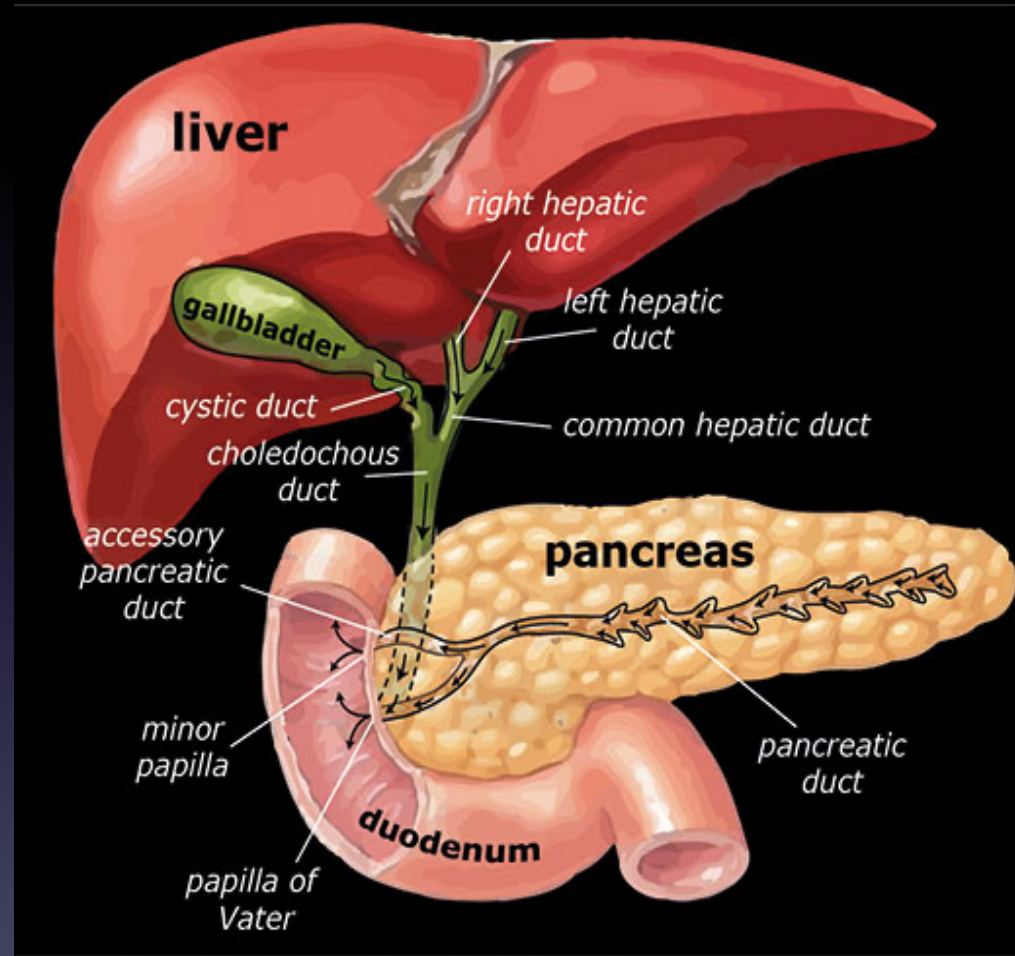
Hypervascular	Hypovascular
Benign <ul style="list-style-type: none"> - hemangioma - adenoma - focal nodular hyperplasia (FNH) Malignant <ul style="list-style-type: none"> - metastasis - hepatocellular carcinoma (HCC) 	Benign <ul style="list-style-type: none"> - cyst <ul style="list-style-type: none"> * simple cysts * Caroli's disease * biliary hamartomas (Von Meyenburg complex) - biloma - abscess - echinococcal cyst - cystadenoma Malignant <ul style="list-style-type: none"> - metastasis - cystadenoma carcinoma

- Based on lesion morphology, the patient's clinical status (e.g. fever) and medical history, a differential diagnosis can be made

Table. Summary of hypervascular and hypovascular liver lesions.

Gallbladder and bile ducts

- Normal undilated intrahepatic bile ducts are invisible on an abdominal CT.
The left and right hepatic duct join to form the common hepatic duct. These in turn join the cystic duct to form the choledochous duct. The choledochous duct eventually joins the pancreatic duct at the level of Vater's papilla, where the bile and pancreatic juice is released into the duodenum
The choledochous duct is frequently identifiable on CT scans; it should be < 6 mm.



- Bile stones

Bile stones may develop in the gallbladder (cholecystolithiasis) and may migrate to the bile ducts (choledocholithiasis). Bile stones are generally invisible on CT scans. Ultrasound is most suited to identify bile stones. However, the consequences of an obstructive bile stone can be seen on CT. The obstruction prevents the bile from passing.

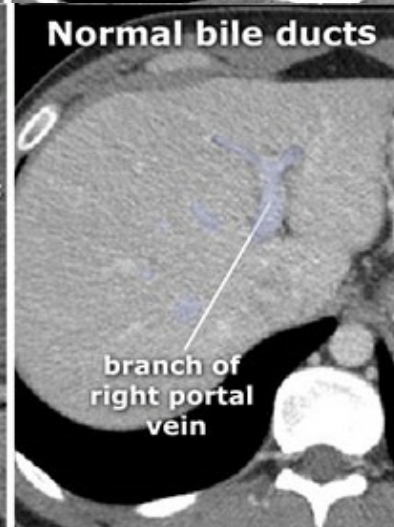
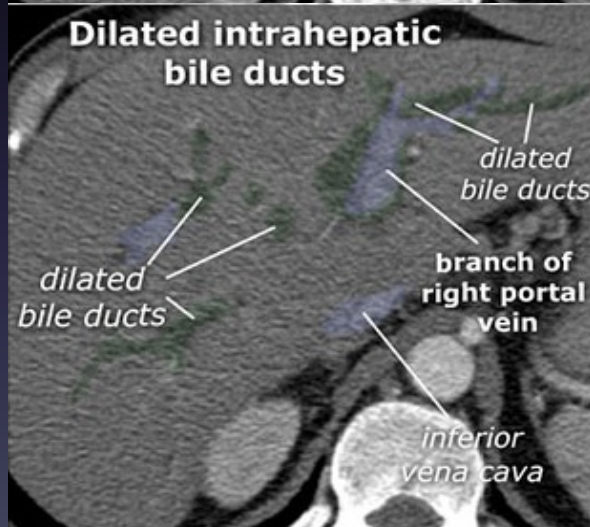
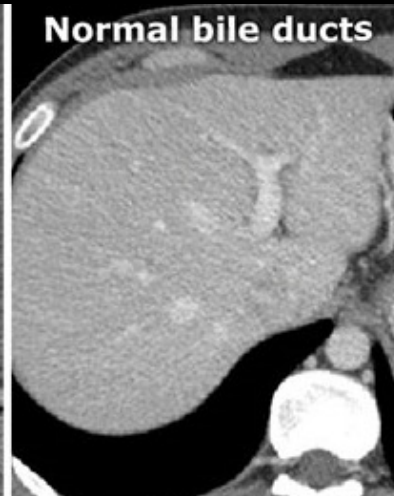
- With an obstructive stone in the gallbladder, the gallbladder becomes enlarged (hydropic).
- With an obstructive stone in the bile ducts, the bile ducts are dilated



intrahepatic bile ducts dilated > 2 mm



choledochous duct dilated > 6 mm



. Dilated intrahepatic bile ducts vs normal b

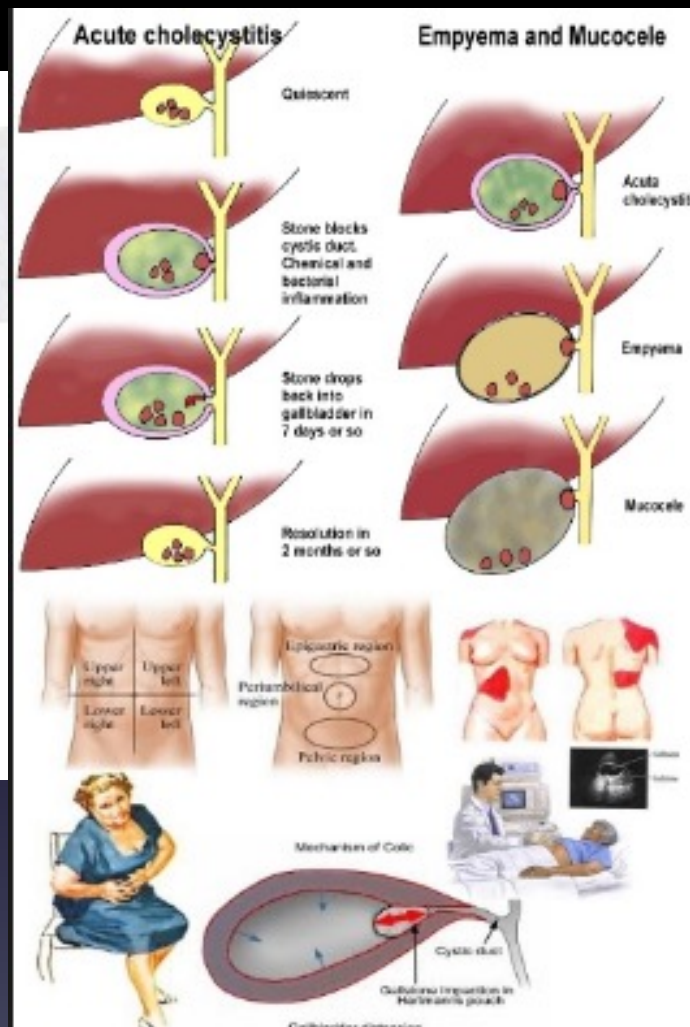
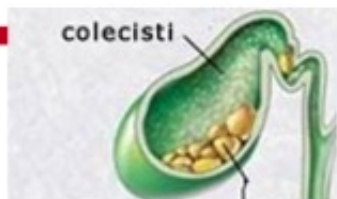
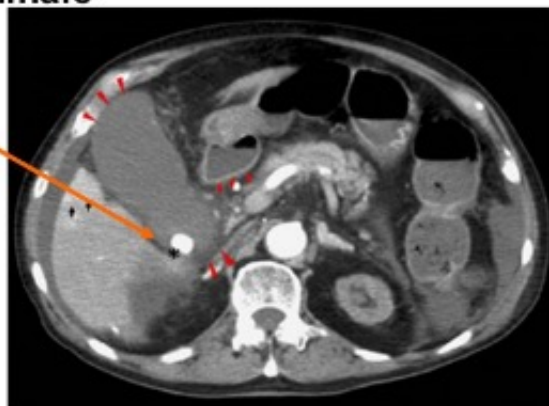
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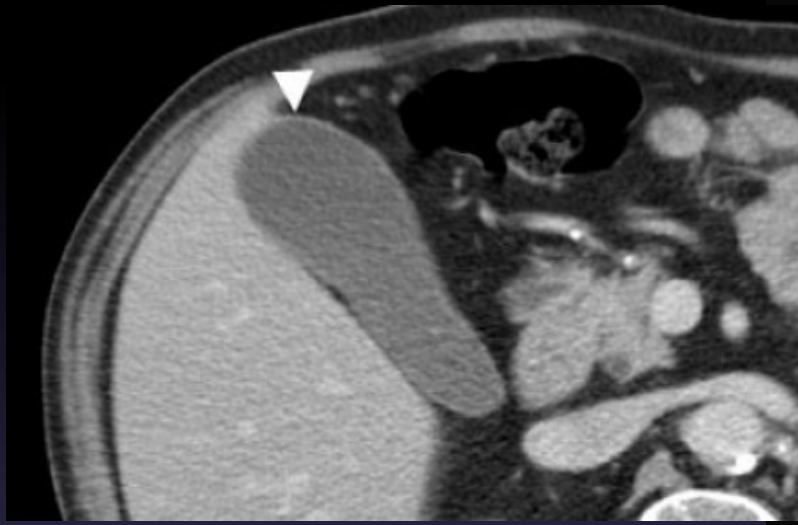
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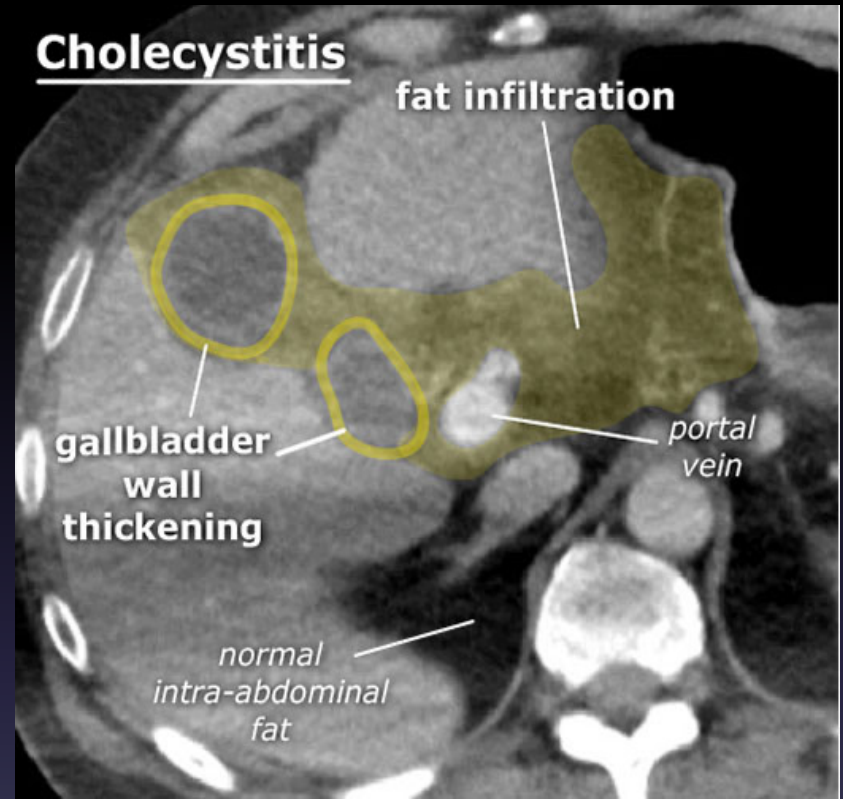
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- Cholecystitis

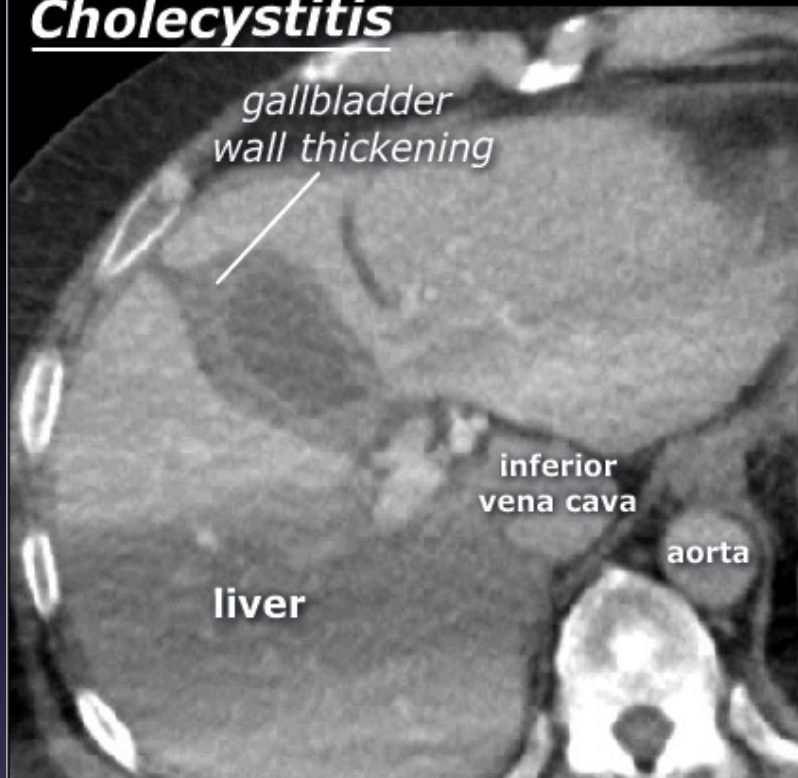
A complication of bile stones is an infected gallbladder or cholecystitis. Cholecystitis rarely occurs in the absence of bile stones. Ultrasound is also best suited to diagnose cholecystitis. Ultrasound improves the visibility of the bile stones, and gallbladder compressibility can be evaluated (dynamic examination). Absent compressibility constitutes a key characteristic of cholecystitis (see abdominal ultrasound class). Other characteristics of cholecystitis on CT include gallbladder wall thickening and infiltration of the fat surrounding the gallbladder. A common complication of cholecystitis is gallbladder perforation, where bile leaks into the abdominal cavity (biloma).



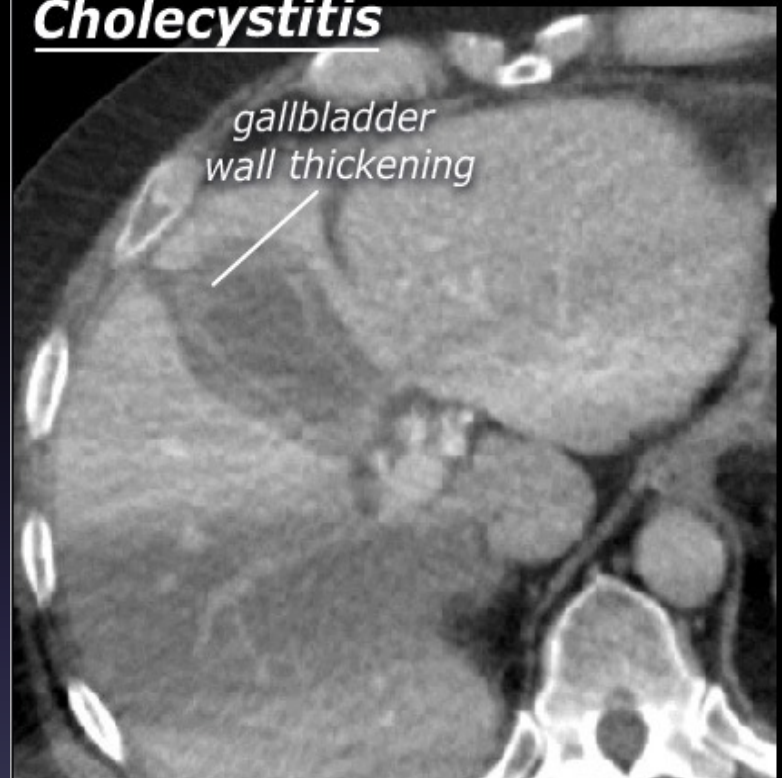


Scanned in the portal venous phase.
Cholecystitis with gallbladder wall thickening
and extensive fat infiltration in the gallbladder
bed.

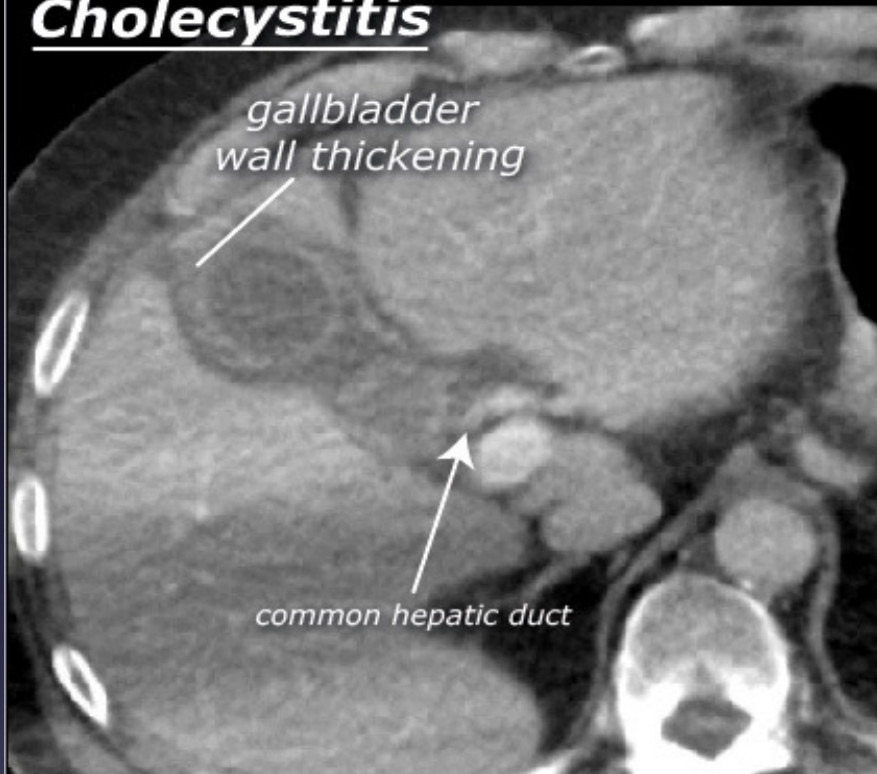
Cholecystitis



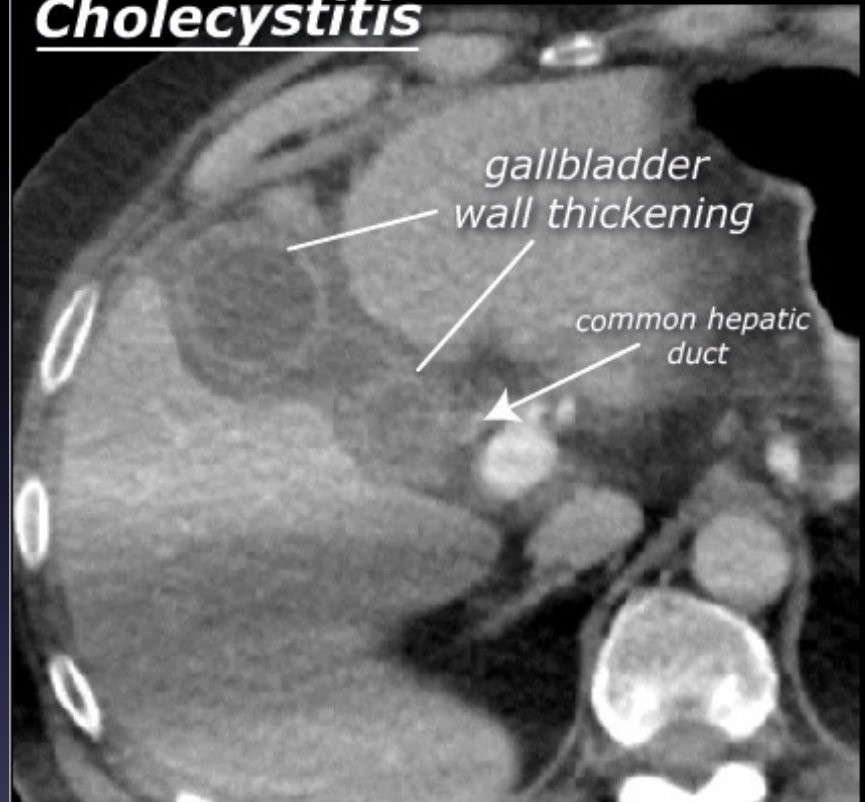
Cholecystitis



Cholecystitis



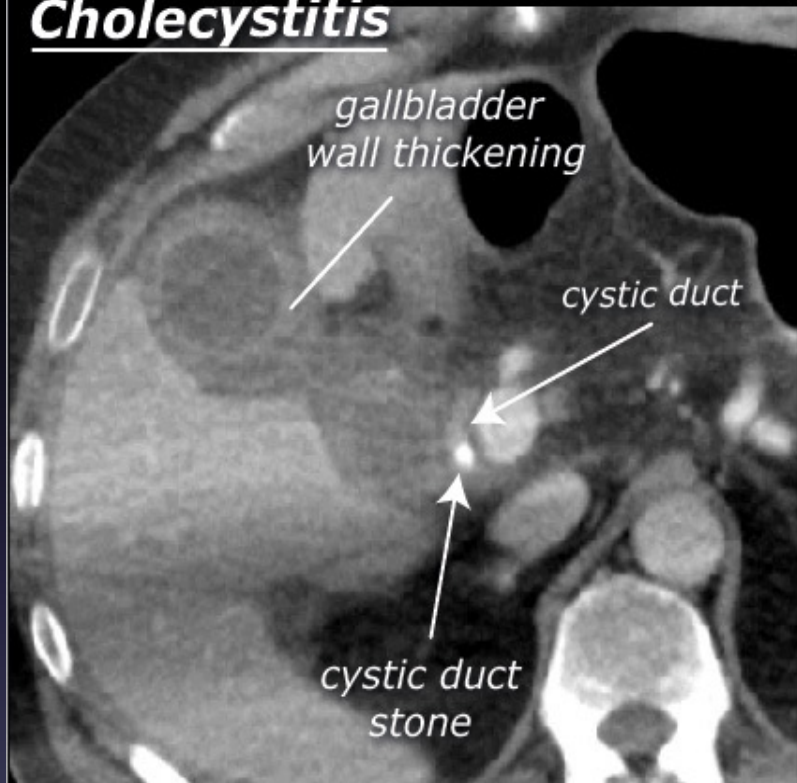
Cholecystitis



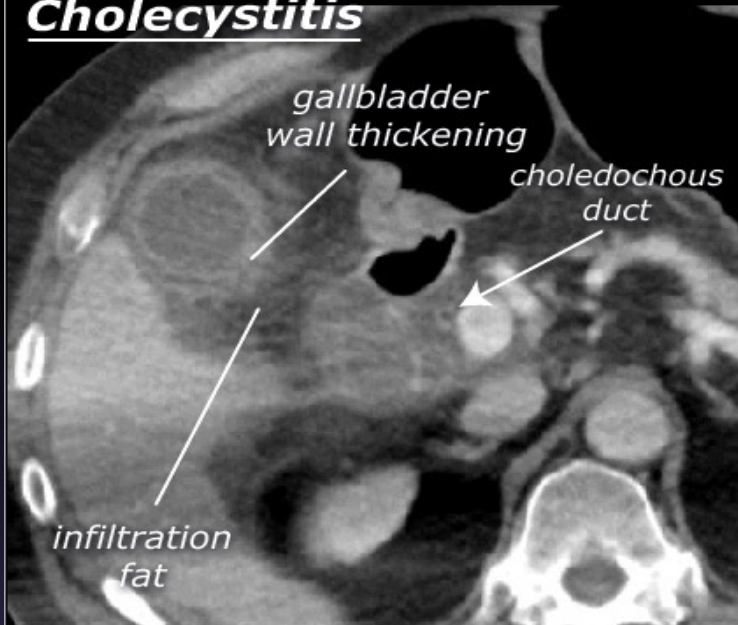
Cholecystitis



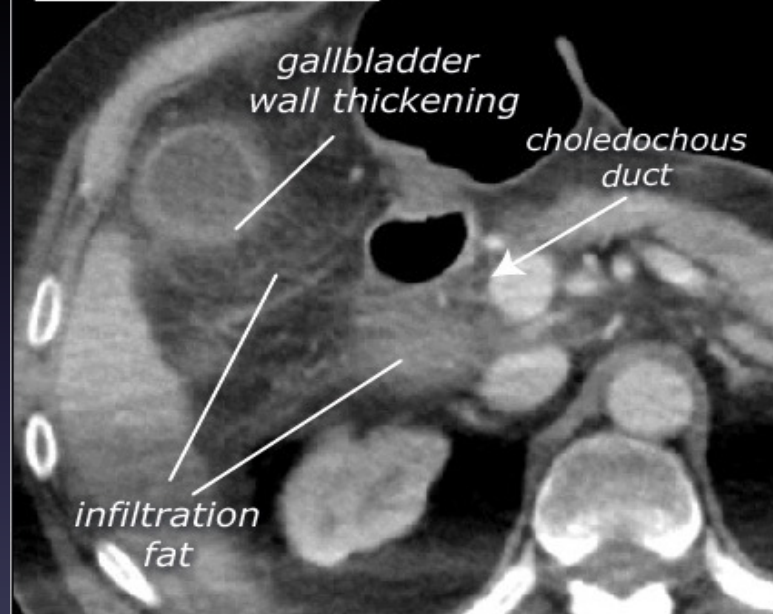
Cholecystitis



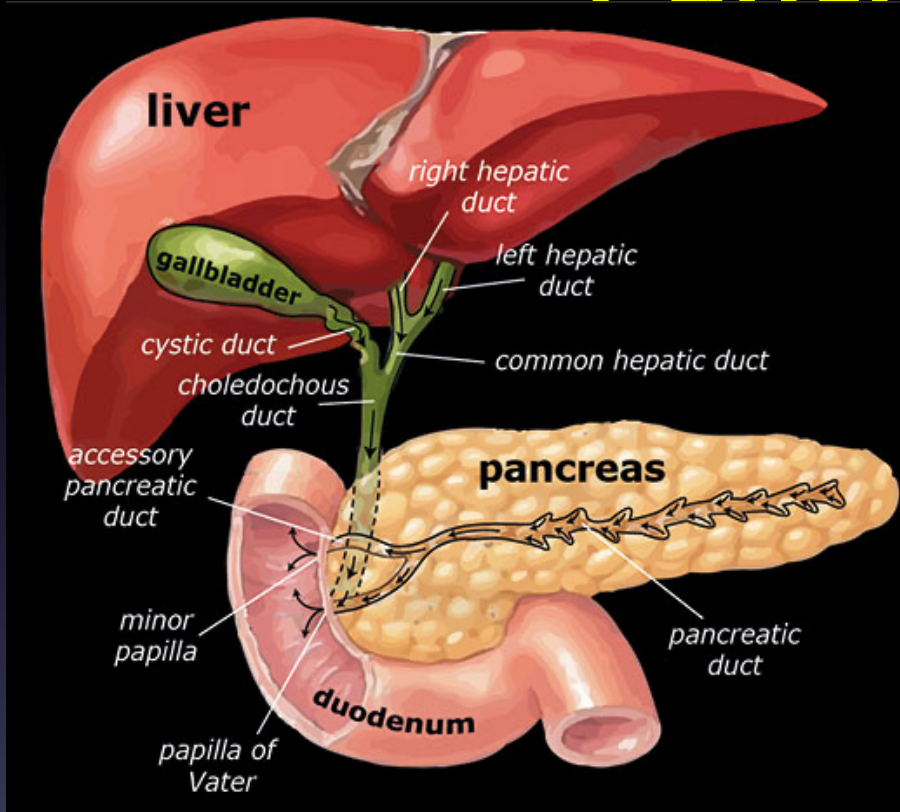
Cholecystitis



Cholecystitis



Pancreas



- The pancreatic drainage system is variable. Many people have one pancreatic duct which drains into Vater's papilla. Some people have an accessory pancreatic duct, also known as Santorini's duct (anatomic variation). The accessory pancreatic duct drains into the minor papilla .

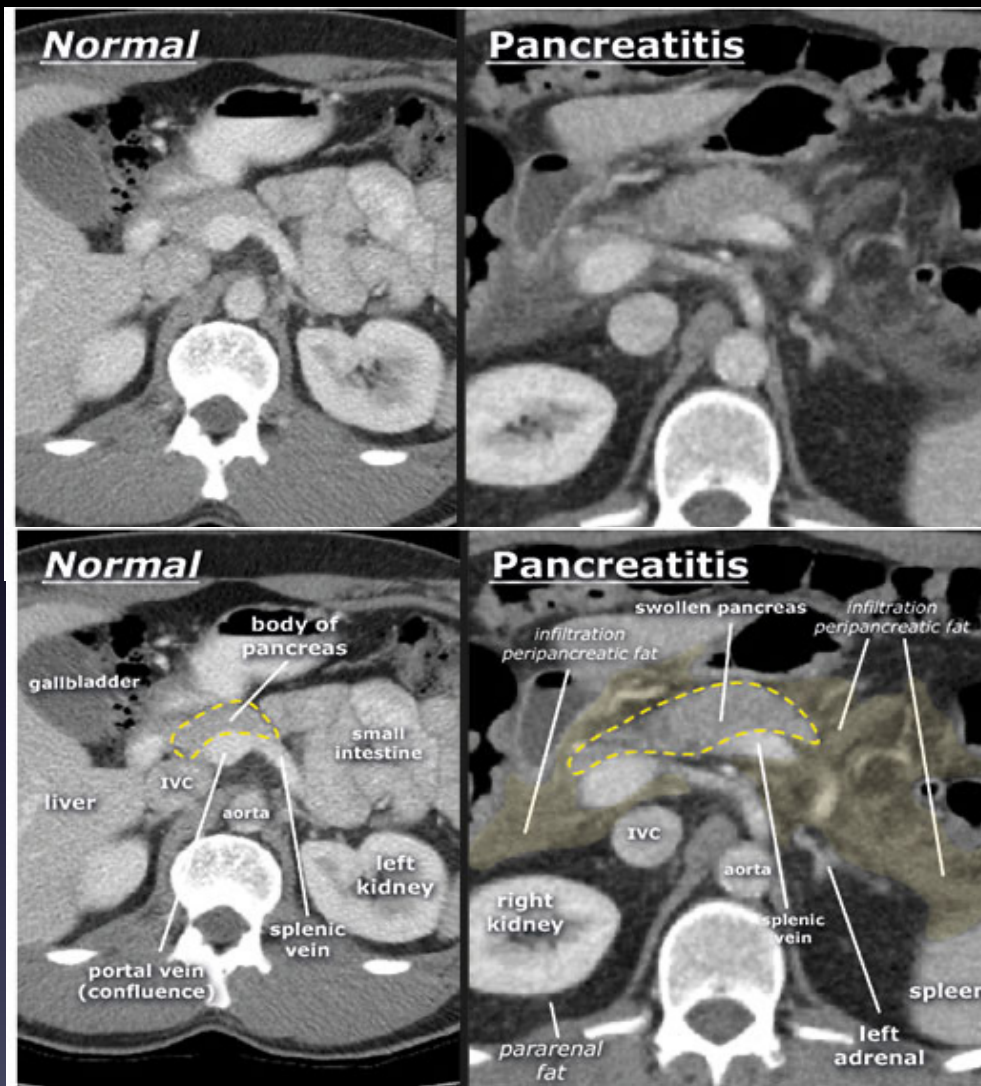
. Anatomy of the pancreas.

- The patient can be asked to drink extra water (about 400 mL) immediately prior to the examination to ensure optimal evaluation of the pancreas. This will cause the stomach and duodenum to distend and help to distinguish the peripancreatic structures.

The pancreas is located in the retroperitoneal cavity and is subdivided into three sections: the head, the body and the tail. A markedly atrophic pancreas can be difficult to recognize. **Tips for finding the pancreas: look for the spleen; the pancreatic tail is located close to the spleen. Starting at the tail, follow the pancreas (ventral of the lienal vein) to the head**

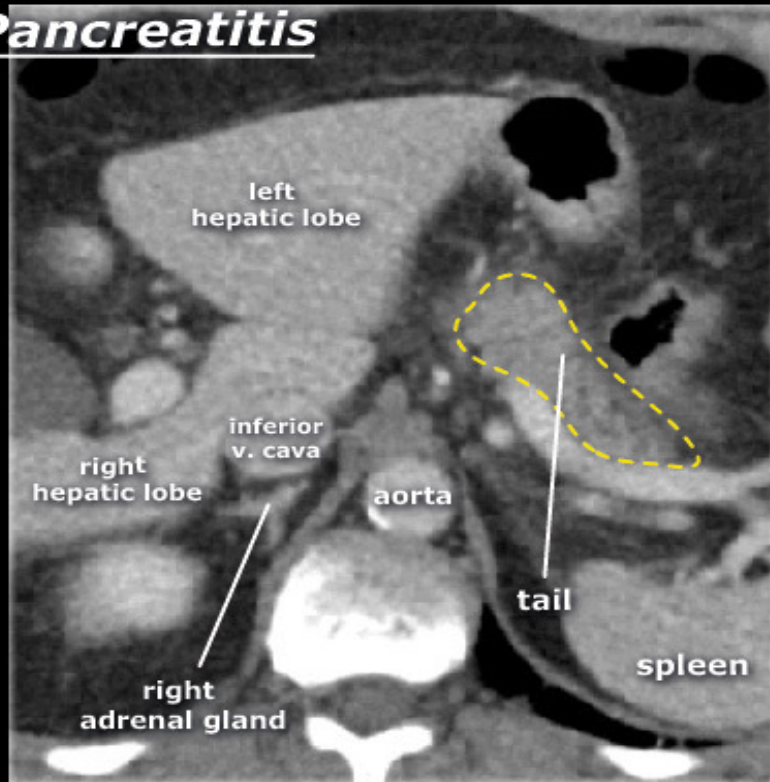
- Acute pancreatitis

Pancreatitis is associated with bile stones and alcohol consumption. Autoimmune pancreatitis may also develop. When the pancreas is infected, the pancreatic enzymes damage the parenchyma. Depending on the severity of the infection, infiltrative and necrotizing pancreatitis can be distinguished. Infiltrative pancreatitis is characterized by swelling of the parenchyma and infiltration of the peripancreatic fat. In necrotizing pancreatitis, there is necrosis of the parenchyma and/or the peripancreatic fat. Necrotic parenchyma enhances to a lesser degree than healthy parenchyma. Necrosis of the peripancreatic fat gives rise to peripancreatic fluid accumulation.

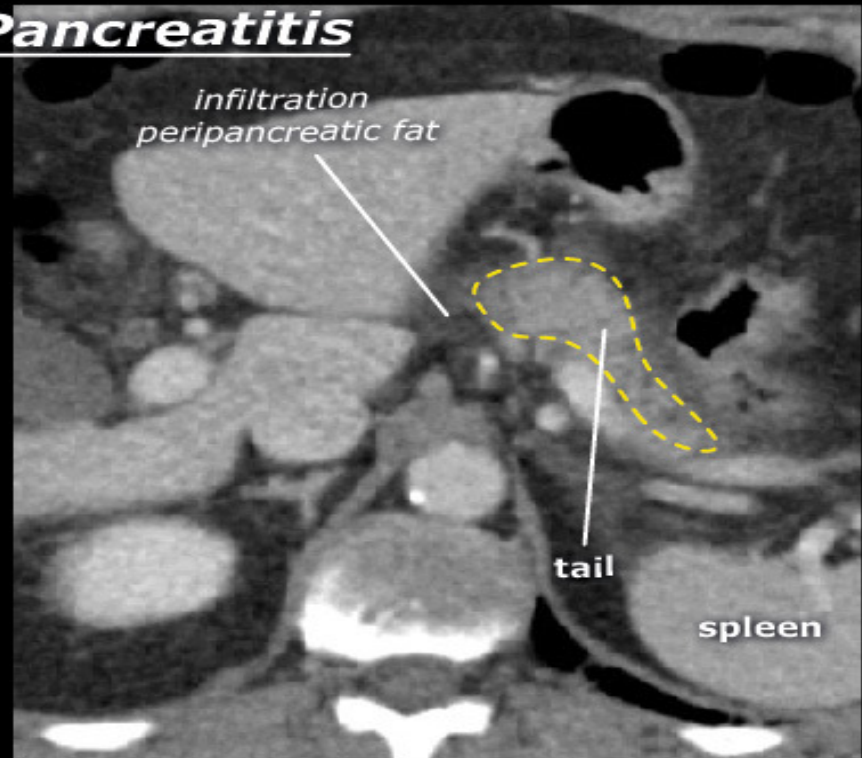


Normal pancreas vs infiltrative pancreatitis

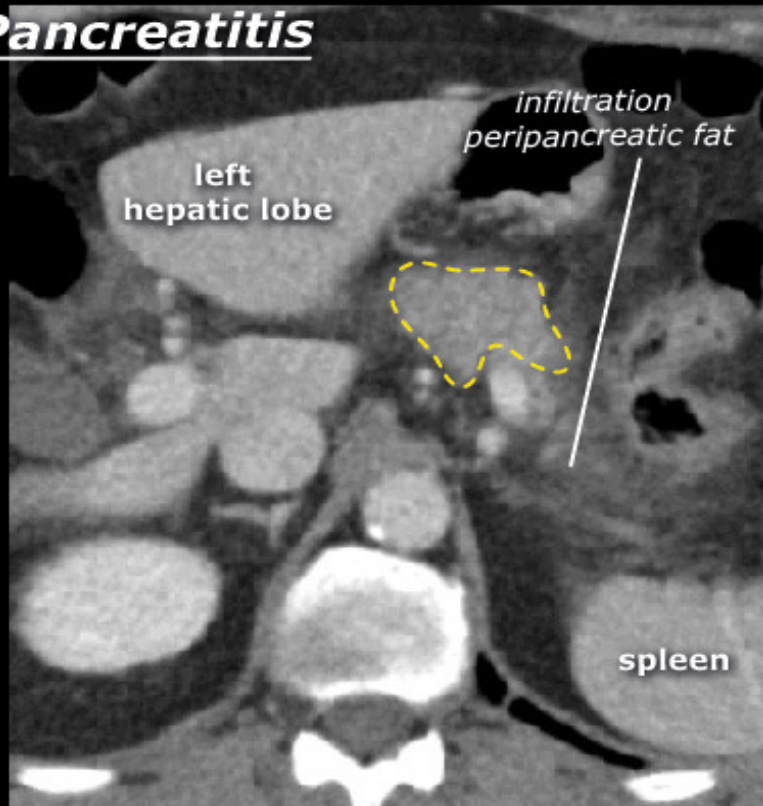
Pancreatitis



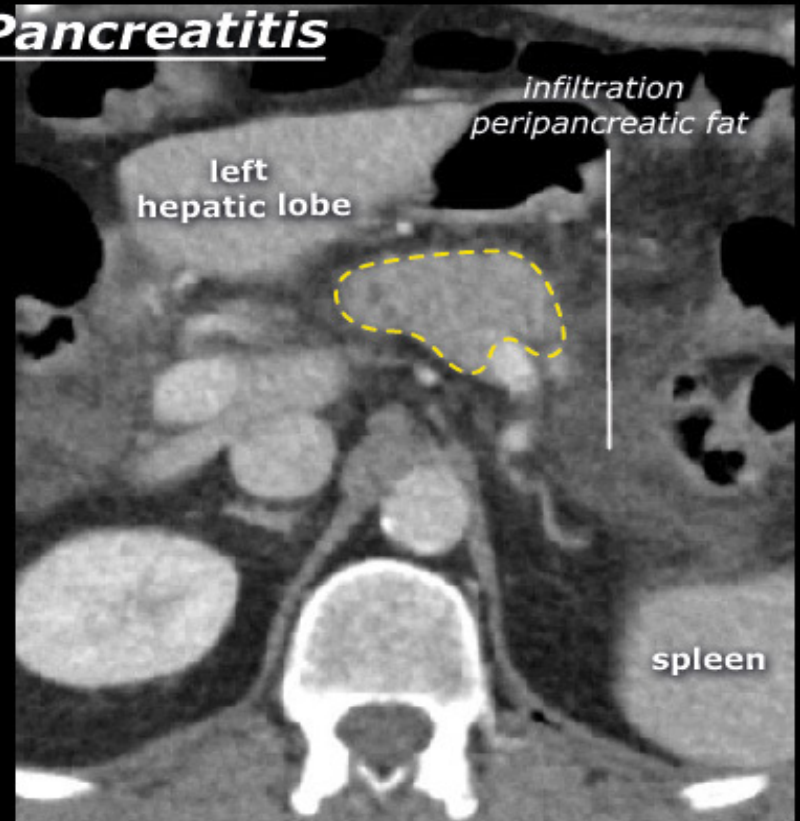
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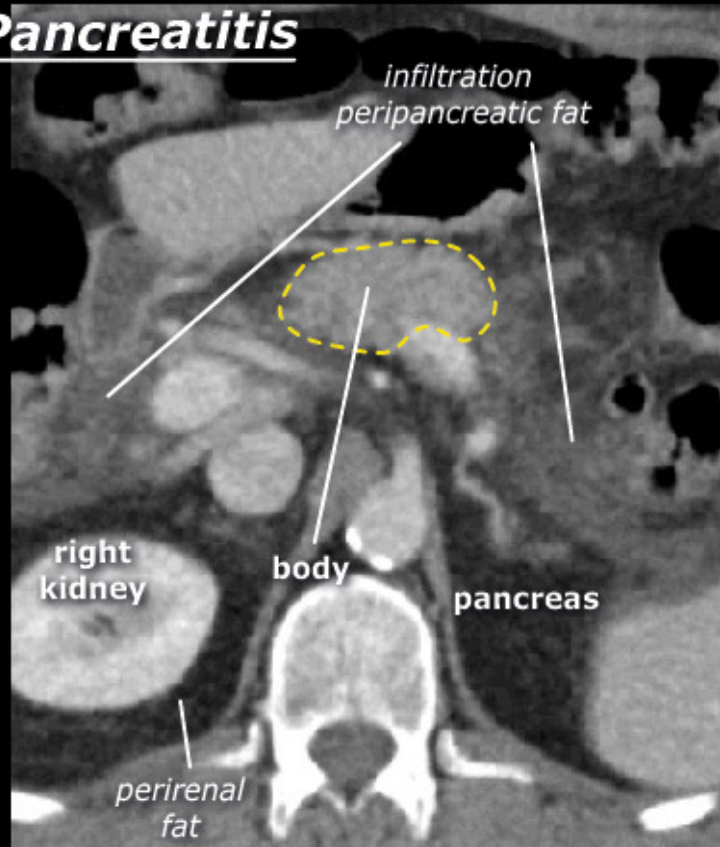
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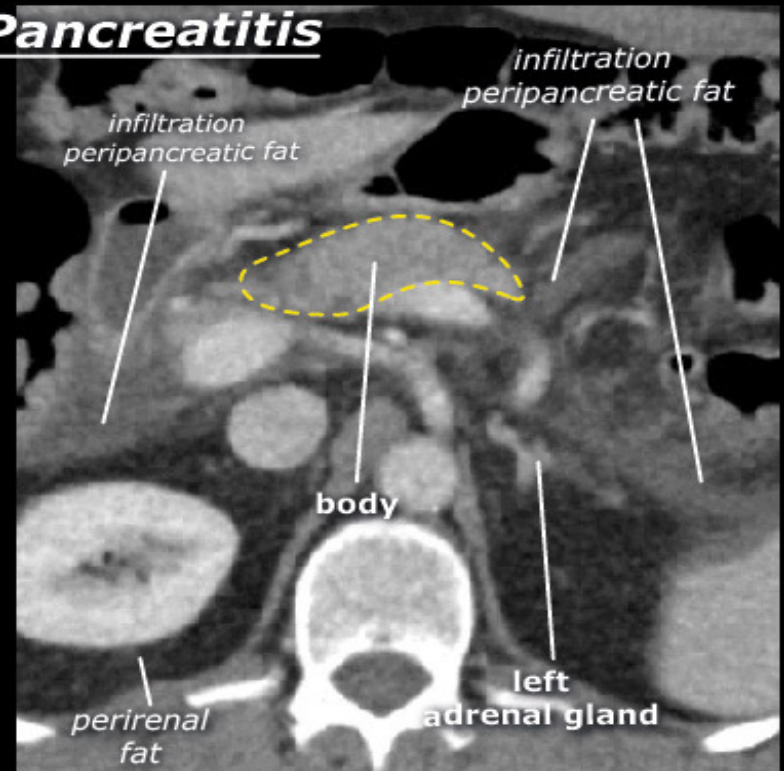
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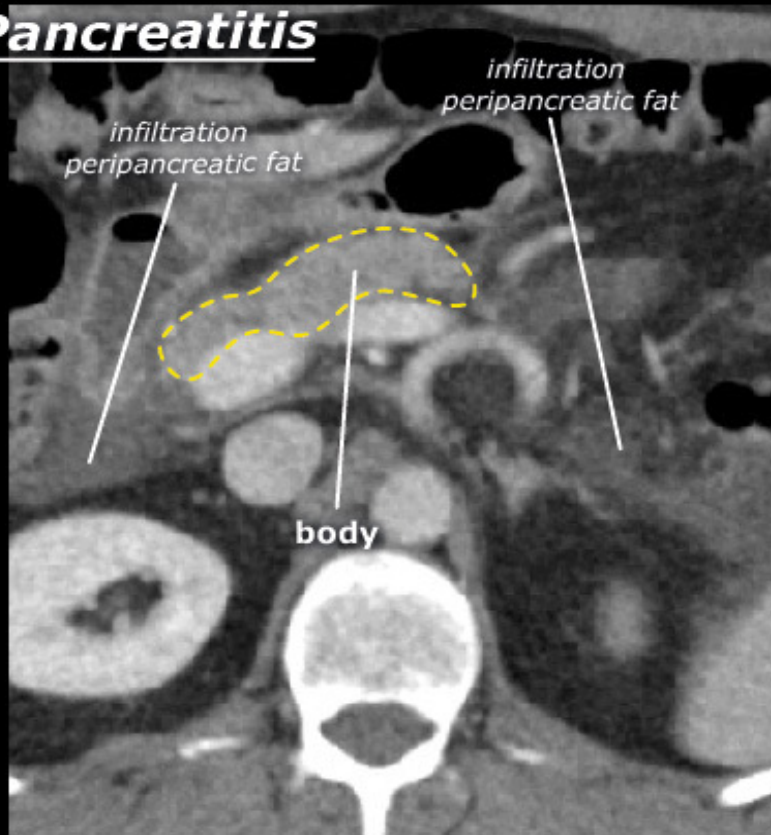
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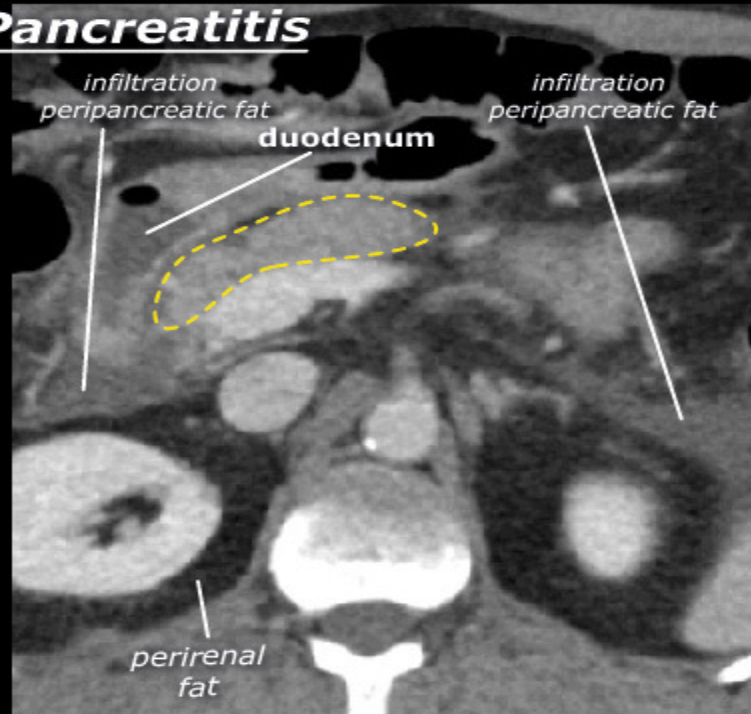
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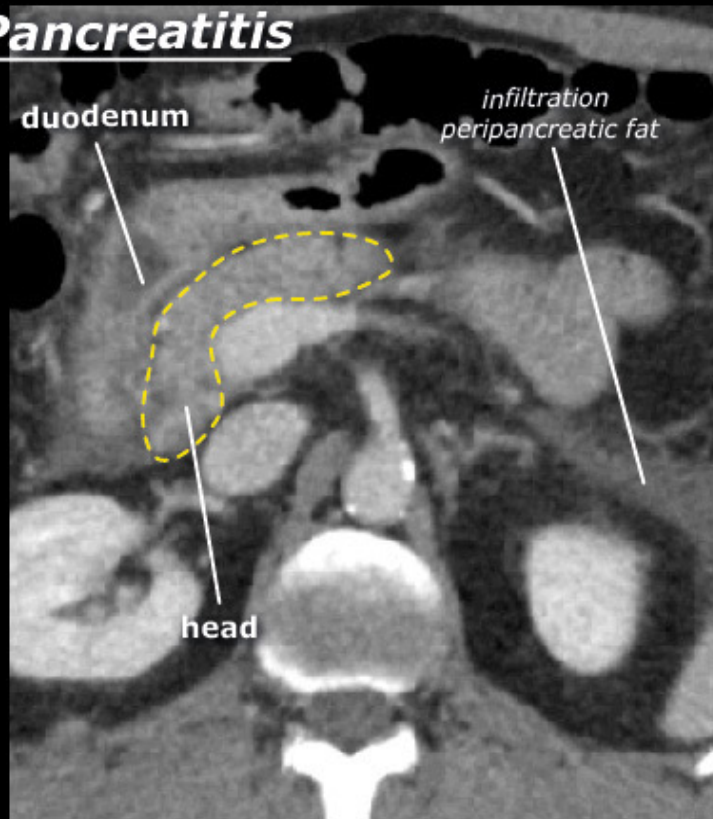
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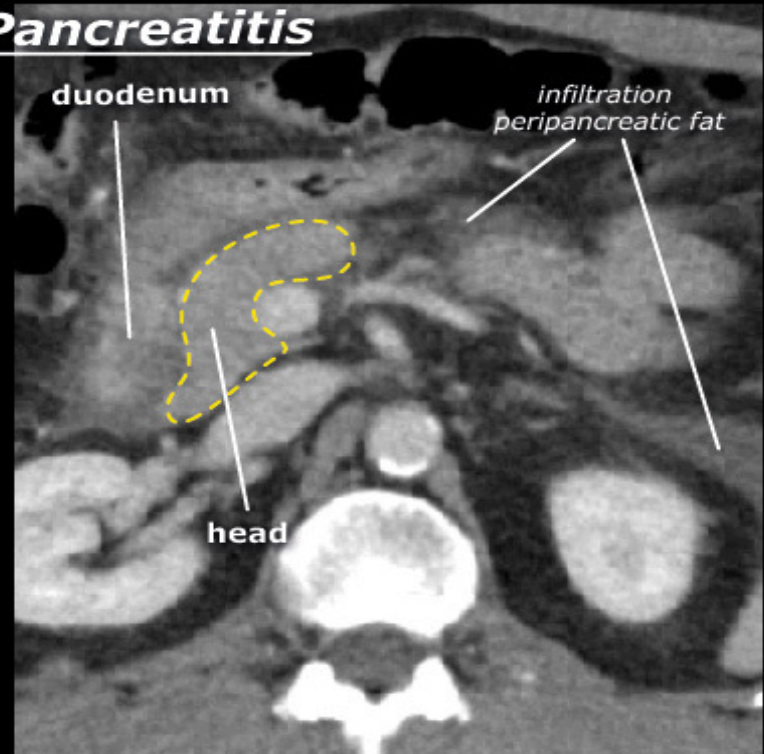
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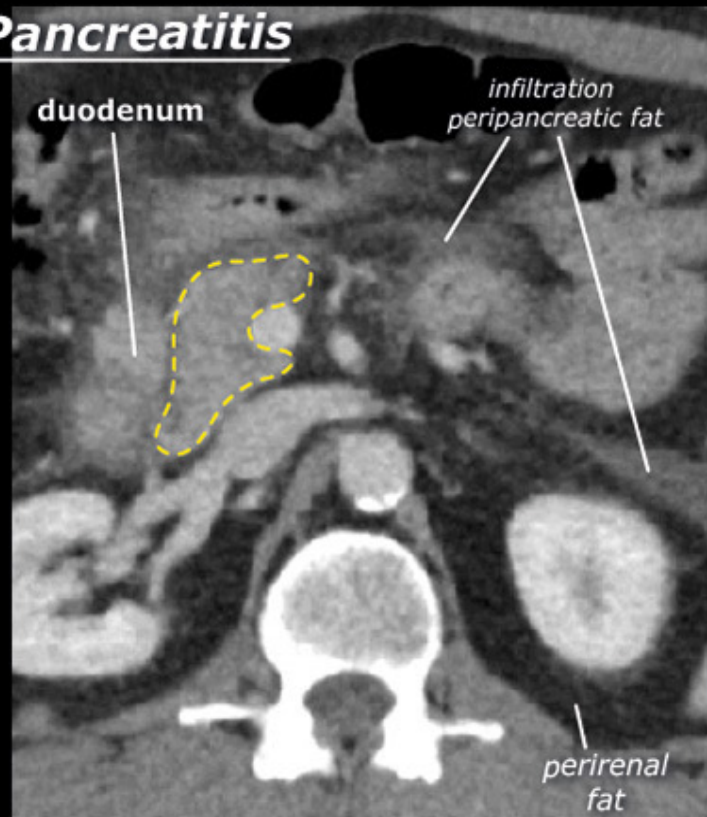
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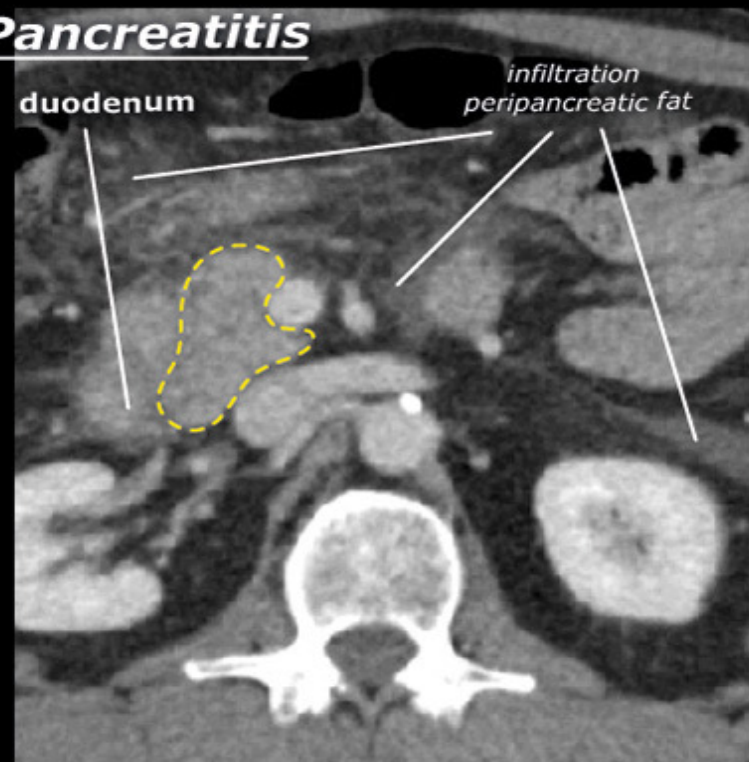
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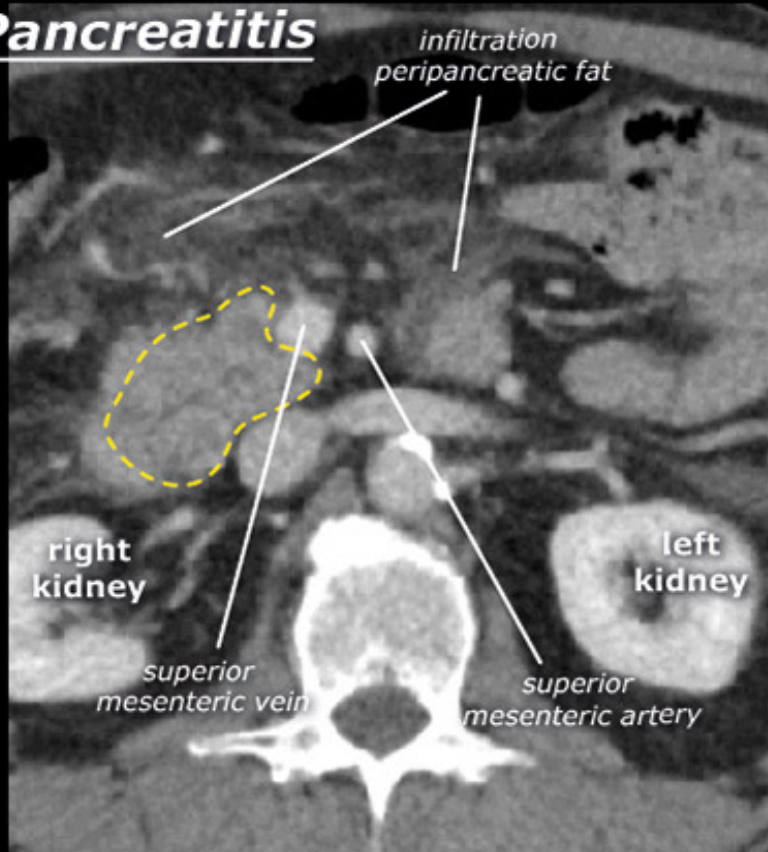
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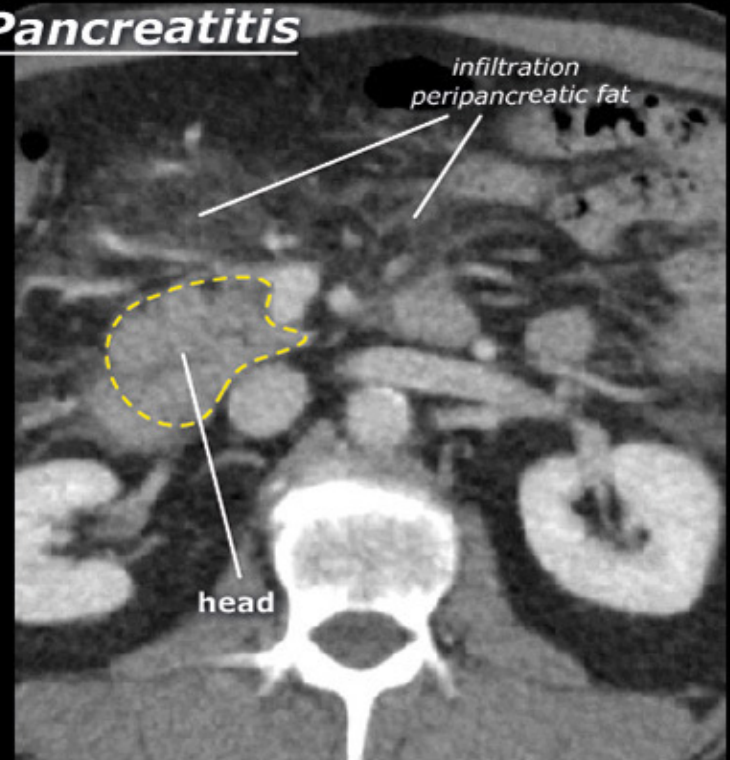
Pancreatitis



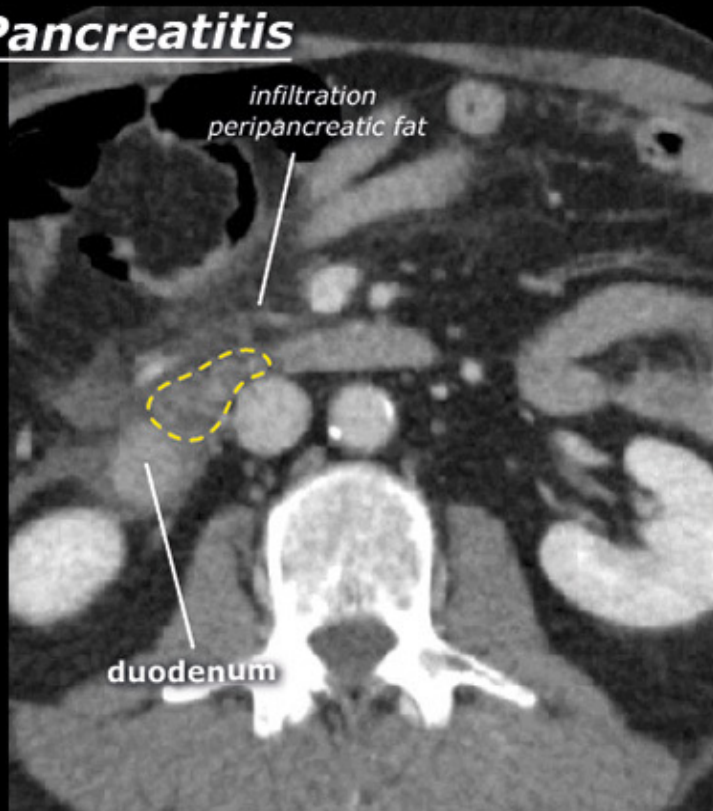
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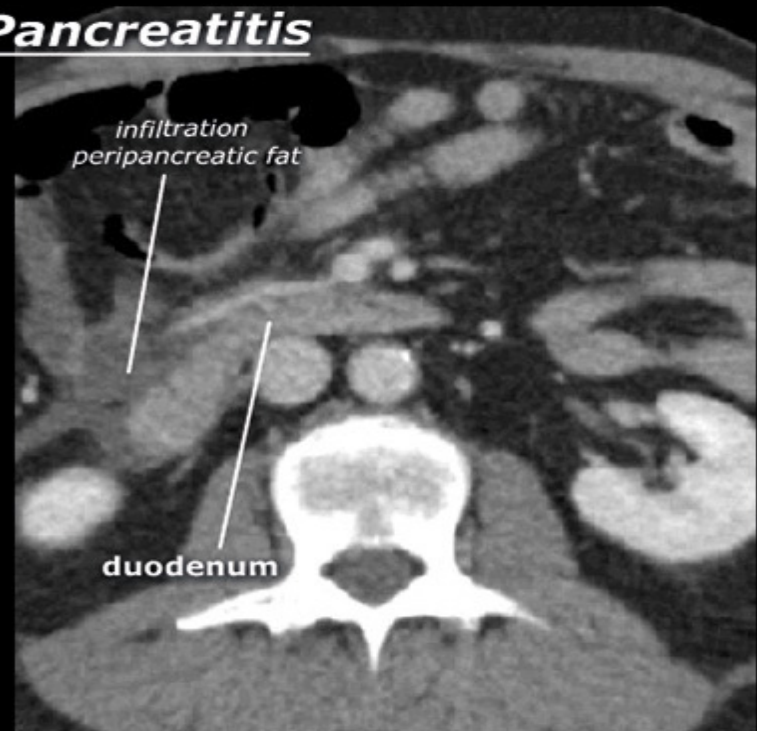
Pancreatitis



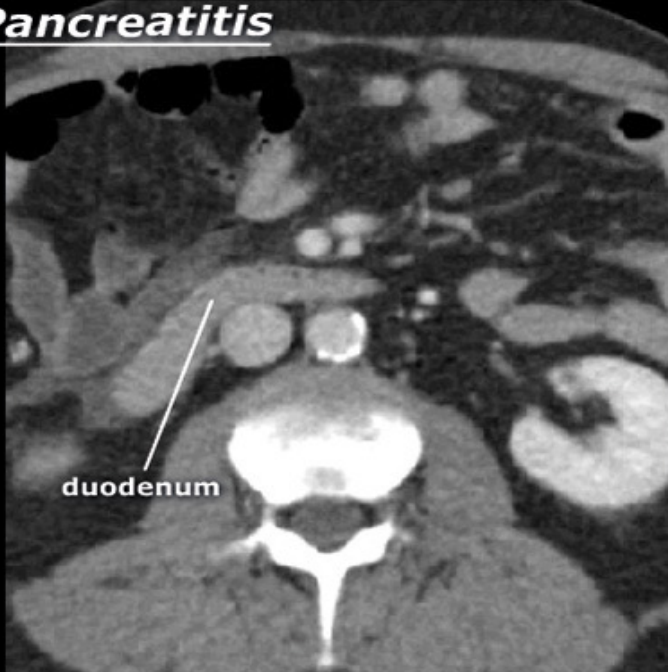
Pancreatitis



Pancreatitis



Pancreatitis



Important:

Pancreatitis is usually a clinical diagnosis. It is important to identify necrotizing pancreatitis. This diagnosis can be made until symptoms have been present for more than 72 hours. Performing a CT before this time is therefore ineffective

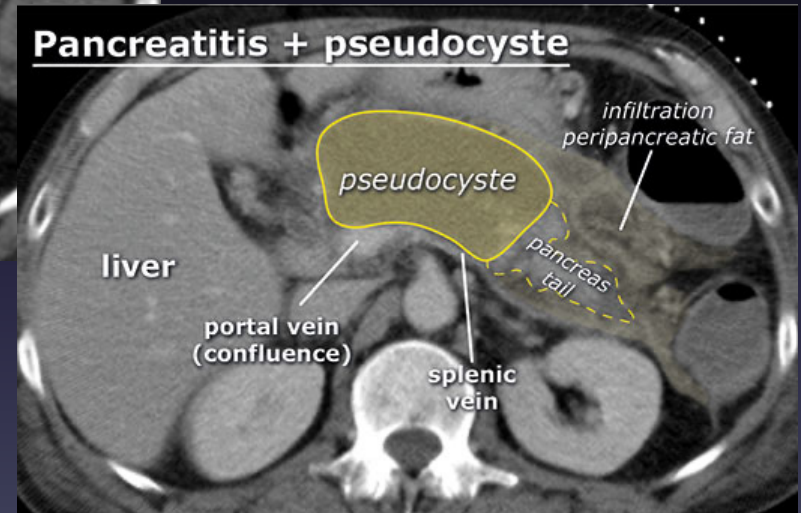
Pancreatitis with swelling of the pancreas and infiltration of the peripancreatic fat.

Pancreatitis + pseudocyst



Large pseudocyst after previous pancreatitis. There is also some fat infiltration around the pancreatic tail; signs of new active pancreatitis.

Pancreatitis + pseudocyst

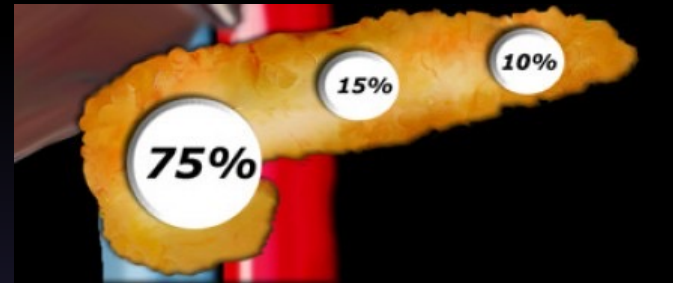
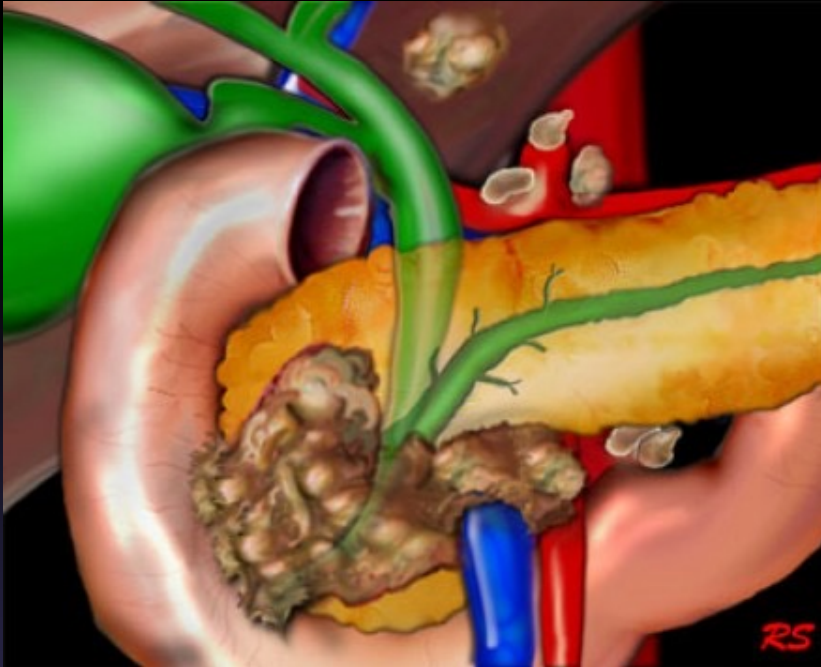


Pancreatic tumors

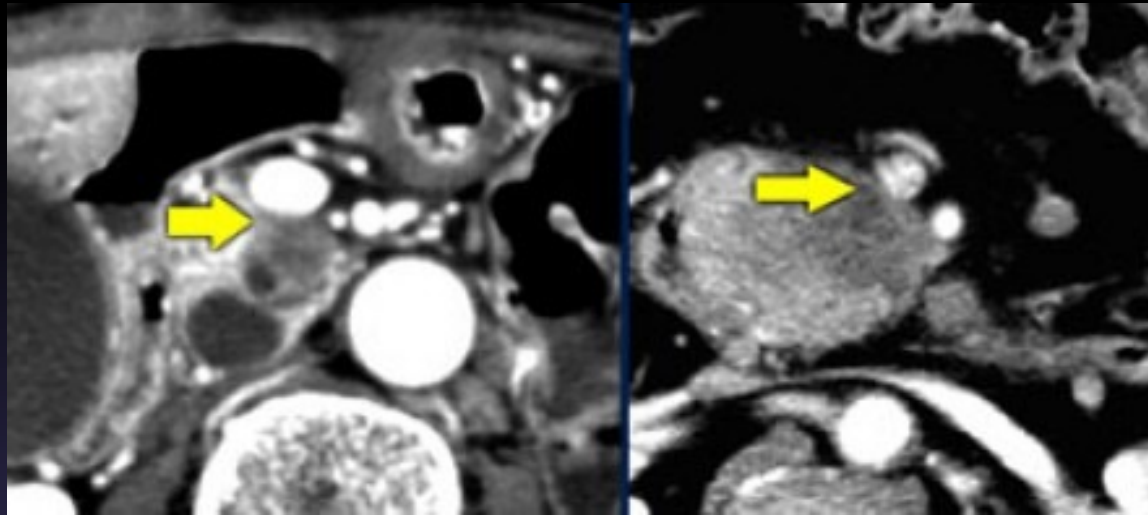
Solid pancreatic abnormalities

- Adenocarcinoma

Adenocarcinoma is the most common pancreatic malignancy. In the diagnostic workup, surgical options are usually limited by involvement of surrounding vessels (superior mesenteric vein, portal vein, superior mesenteric artery, hepatic artery, celiac trunk) or metastases. Pancreatic adenocarcinoma is a **hypovascular tumor**, usually arising in the pancreatic head. Depending on its size, the tumor compresses the pancreatic duct and choledochous duct, causing dilation: the double duct sign. The pancreatic tail is frequently atrophied. Preferential sites of metastasis formation include the lymph glands, liver, lungs and peritoneum

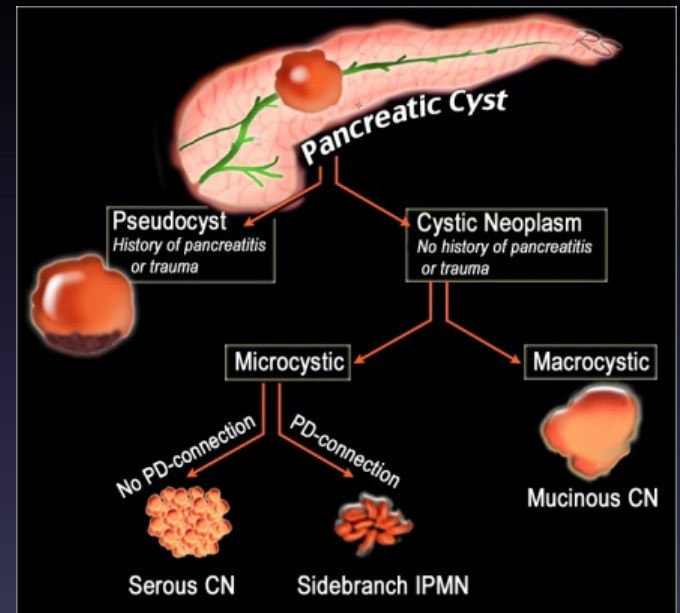
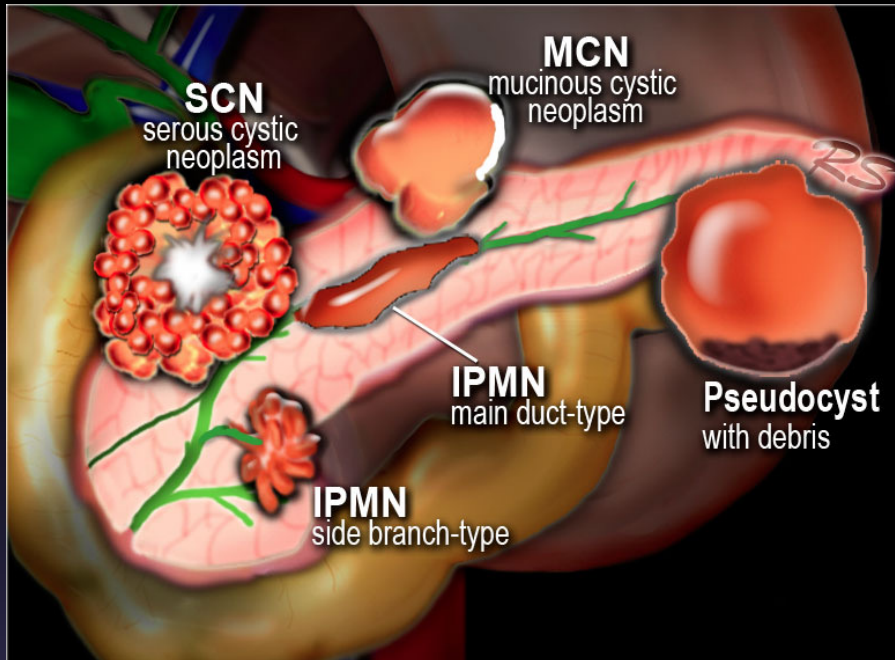


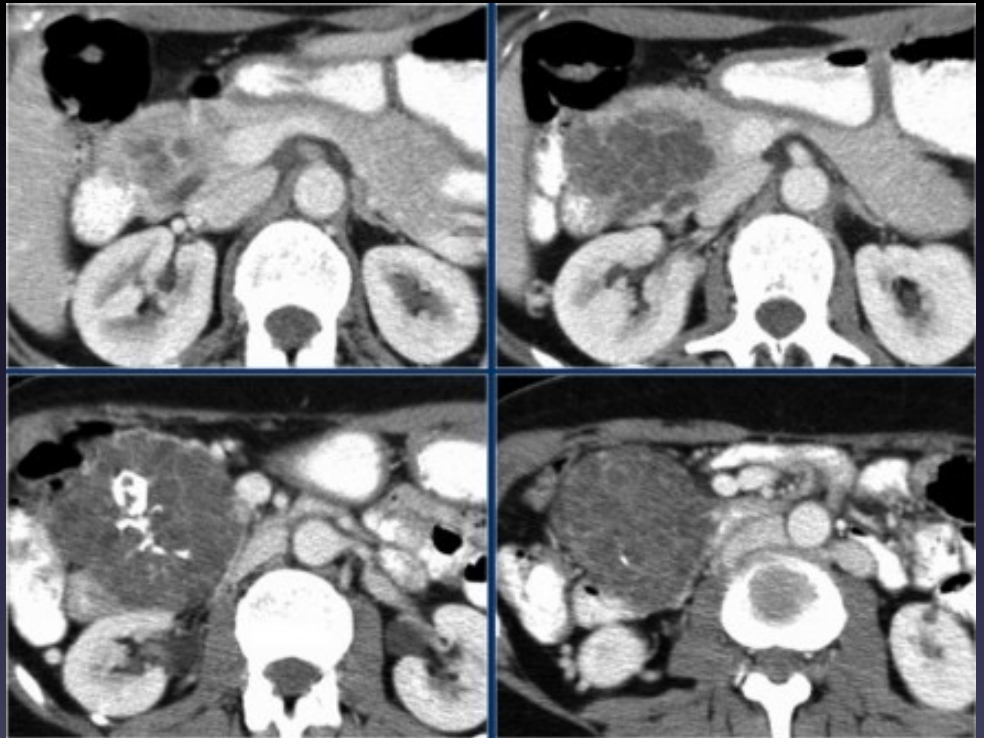
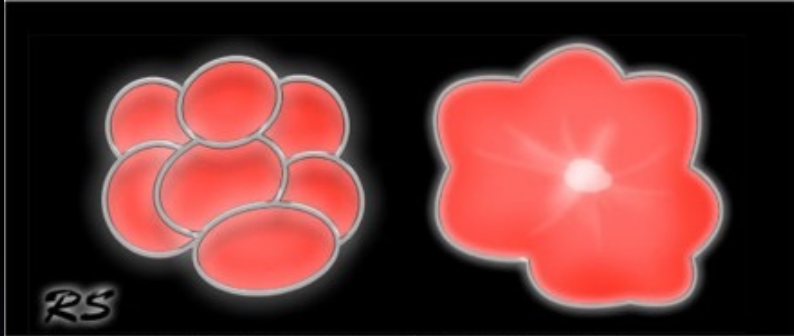
Non-resectable pancreatic head tumor obstructing the common bile duct and pancreatic duct. Tumor surrounds the superior mesenteric vein at the junction with the splenic vein. Paraaortic and celiac lymphnodes and a small liver metastasis.



Cystic pancreatic neoplasms

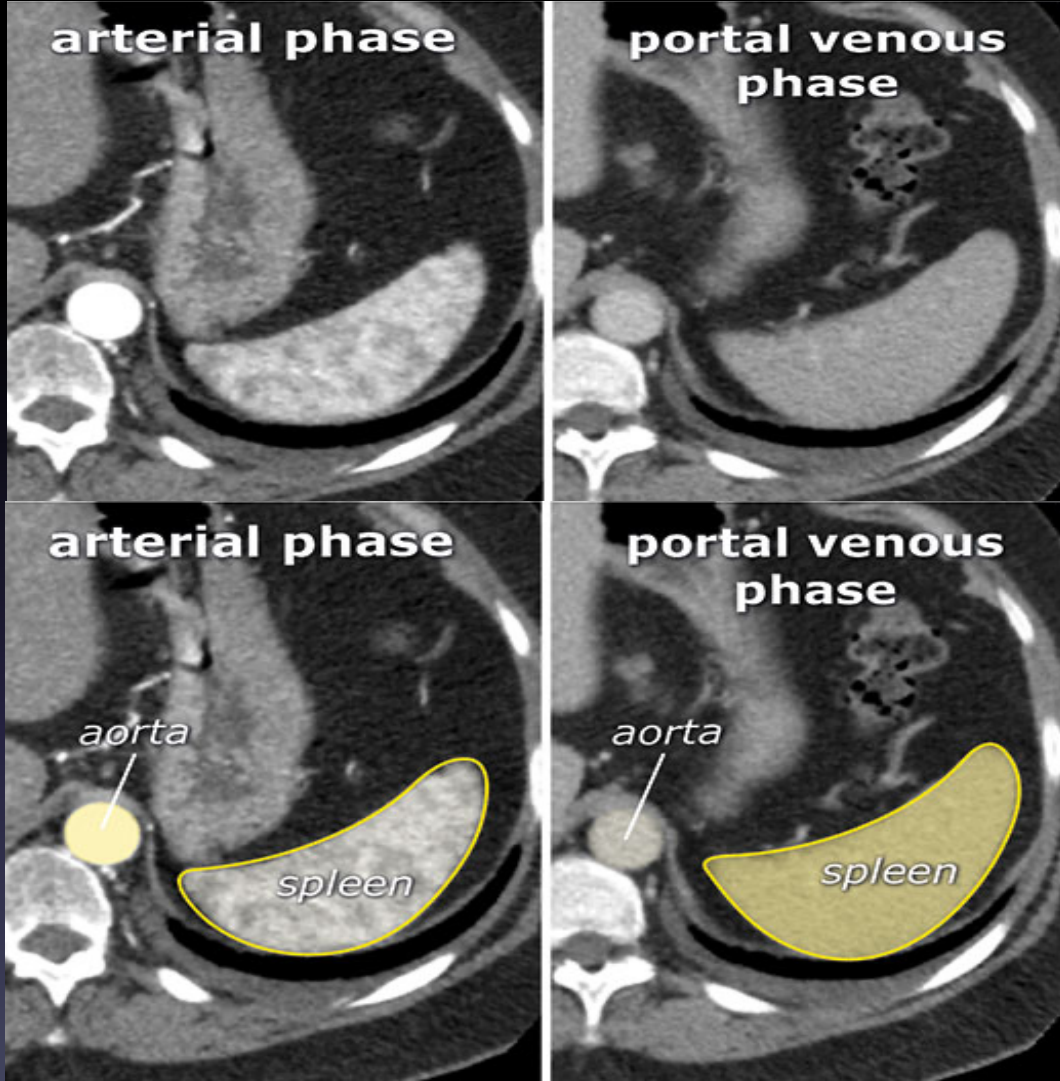
- Pseudocyst: a common benign abnormality is the pseudocyst. Pseudocysts are residual abnormalities after pancreatitis or abdominal trauma. The cyst is unilocular and has no solid components .
- Serous cystadenoma: occurs mostly in middle-aged/elderly women (> 60 years) and is a benign pancreatic lesion. Serous cystadenomas consist of multiple small cysts a few millimeters in diameter, filled with serous fluid (honeycomb-like), and are located predominantly in the pancreatic head. The lesion may contain a (calcified) central scar.
- Mucinous cystadenoma: occurs mostly in women aged 40-50 years. Mucinous cystadenomas consist of one or multiple larger, mucin-filled cysts and may contain parietal calcifications. The lesion may transform to become malignant and develops mostly in the pancreatic body & pancreatic tail.
- Intraductal papillary mucinous neoplasm (IPMN): originates from the pancreatic duct. IPMN may arise from the main branch or a side branch or both (mixed-type). IPMN is a premalignant abnormality; the main-branch type has the highest risk of becoming malignant.





Spleen

- Because of its specific vascularization, the spleen enhances inhomogeneously/with stripes in the arterial phase; this is a normal finding. However, the spleen should enhance homogeneously in the portal venous phase



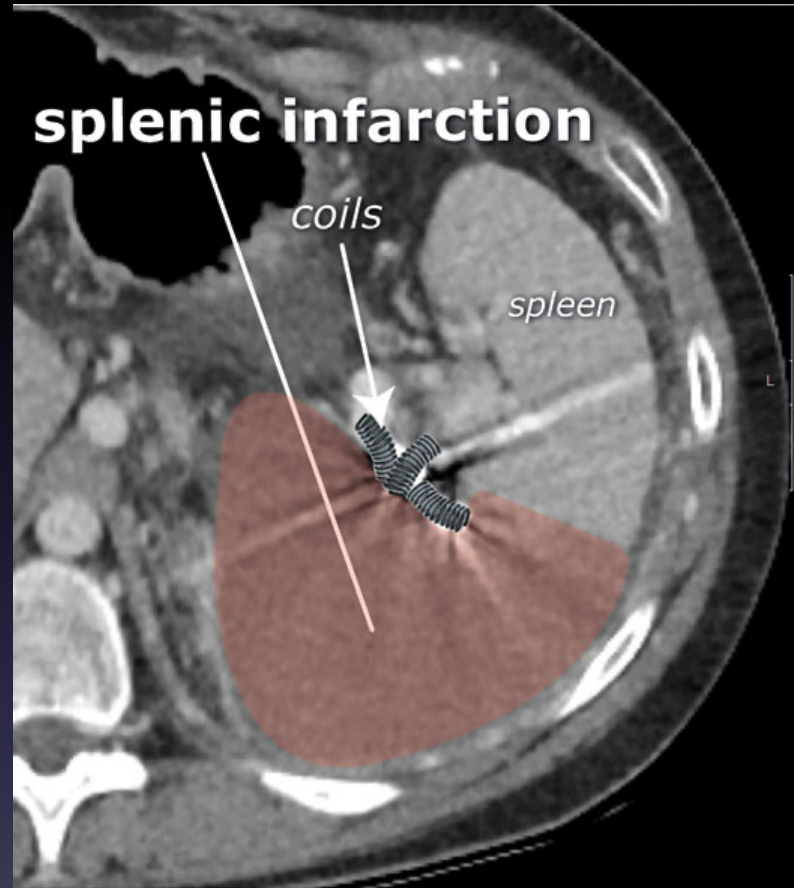
Inhomogeneous enhancement of the spleen in the arterial phase.

- Splenomegaly

The size of the spleen is measured in the coronal direction, from cranial to caudal. In adults, the normal cranial-caudal size of the spleen is under 12-13 cm.

- Infarction

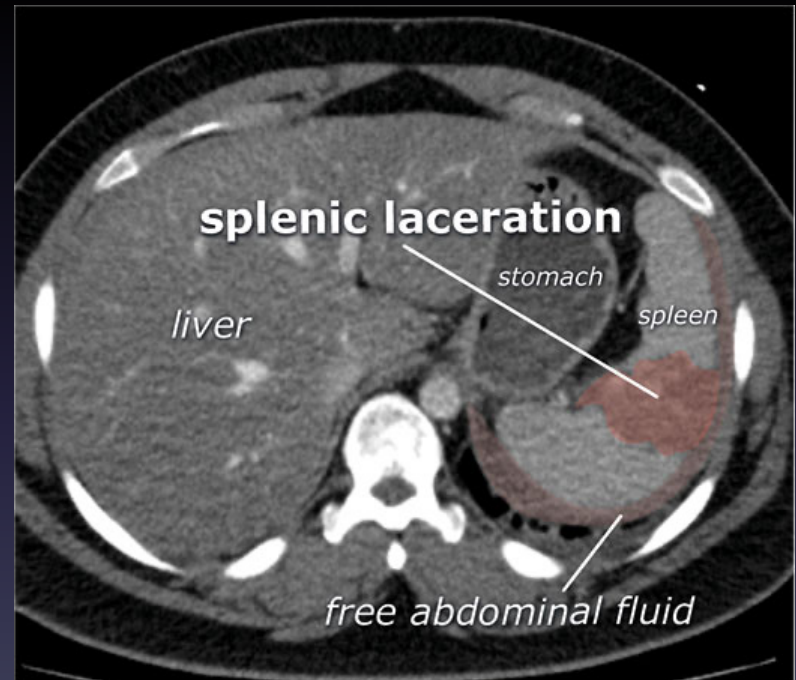
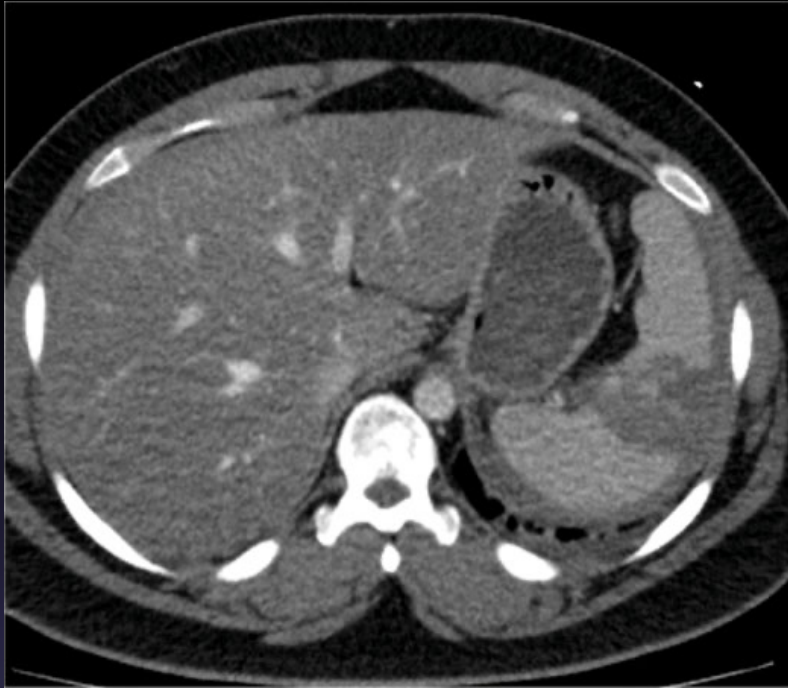
As mentioned previously, the spleen enhances inhomogeneously in the arterial phase. The spleen should enhance homogeneously in the portal venous phase. If the spleen does not enhance homogeneously in the portal venous phase, this may be caused by an infarction. A splenic infarction is characterized by a wedge-shaped, hypodense area



Scanned in the portal venous phase. Severe splenic infarction after coiling of the lienal artery.

- Splenic trauma

Traumatic splenic damage may result from both blunt and sharp abdominal trauma. As mentioned previously, a multiple-phase abdominal CT is performed when intra-abdominal injury is suspected. 'Contrast blush' is visible in the arterial phase in the event of an active bleeding. Splenic laceration is characterized by a linear hypodensity in the spleen in the portal venous phase. There is also free fluid in the abdominal cavity as a result of the bleeding.



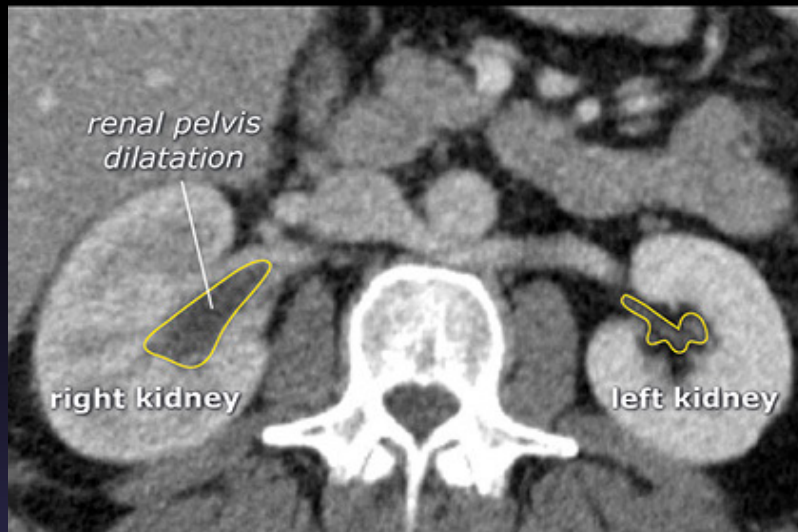
Scanned in the portal venous phase. Splenic laceration from blunt abdominal trauma (car vs scooter).

Urinary tract

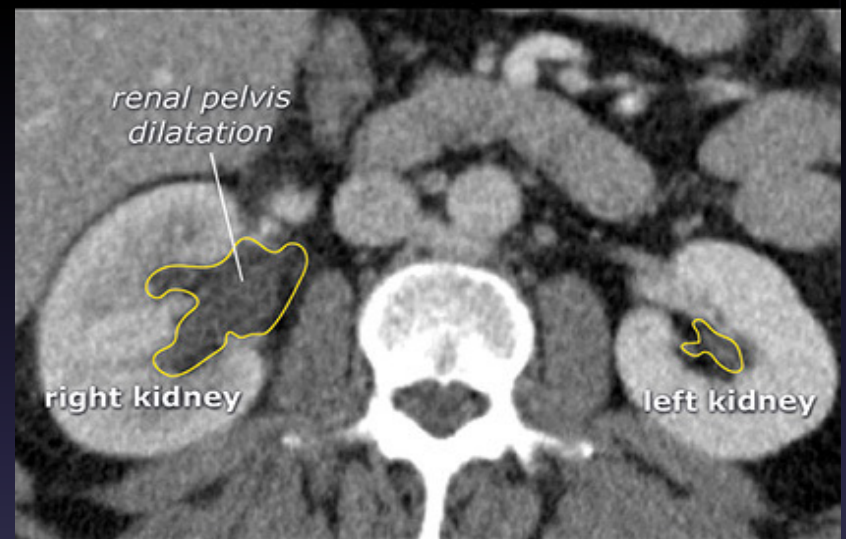
Kidney, ureter and bladder stones

- An abdominal CT without contrast agent is performed to detect kidney, ureter and bladder stones. Stones are hyperdense and may form at any location in the urinary tract. Depending on their size, ureteral stones may cause obstruction. Signs of obstruction include dilation of the collecting system of the kidney ('hydronephrosis') and the ureter proximal of the obstruction

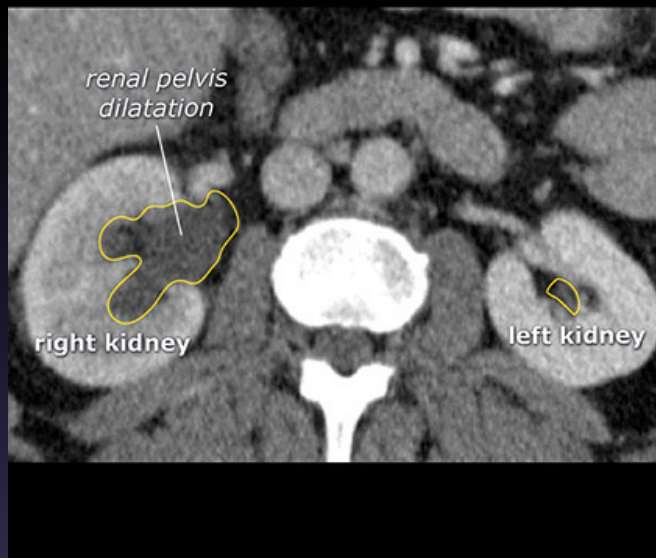
Hydronephrosis secondary to a distal ureteral stone



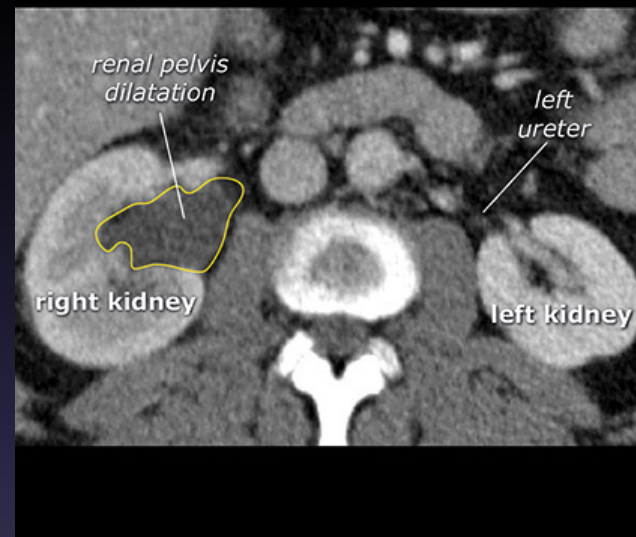
Hydronephrosis secondary to a distal ureteral stone



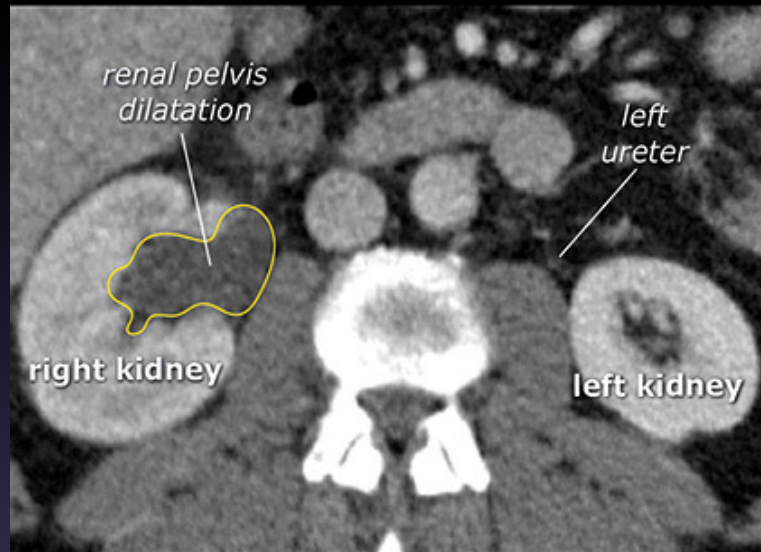
Hydronephrosis secondary to a distal ureteral stone



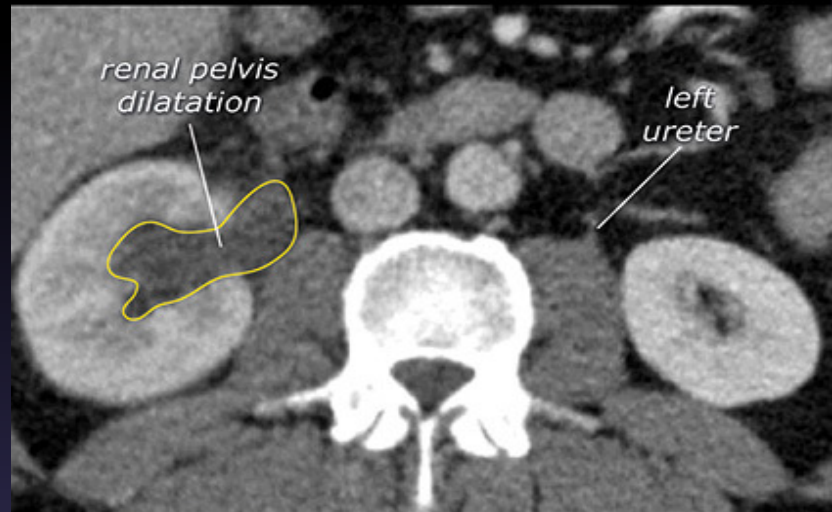
Hydronephrosis secondary to a distal ureteral stone



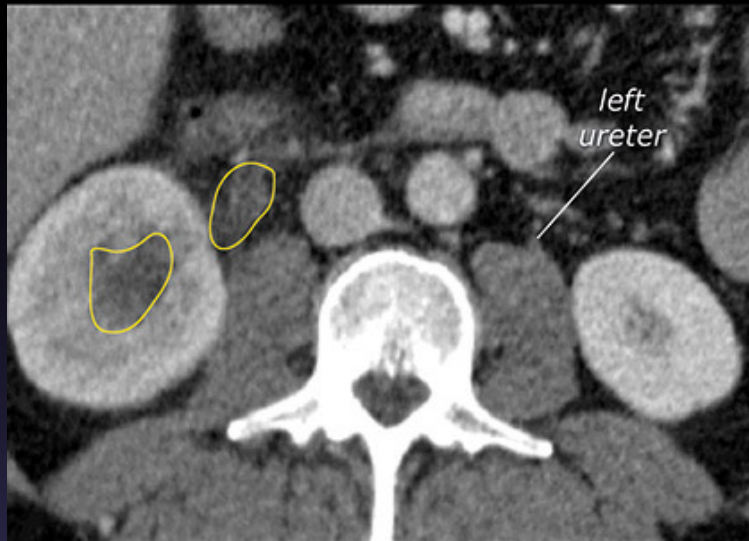
Hydronephrosis secondary to a distal ureteral stone



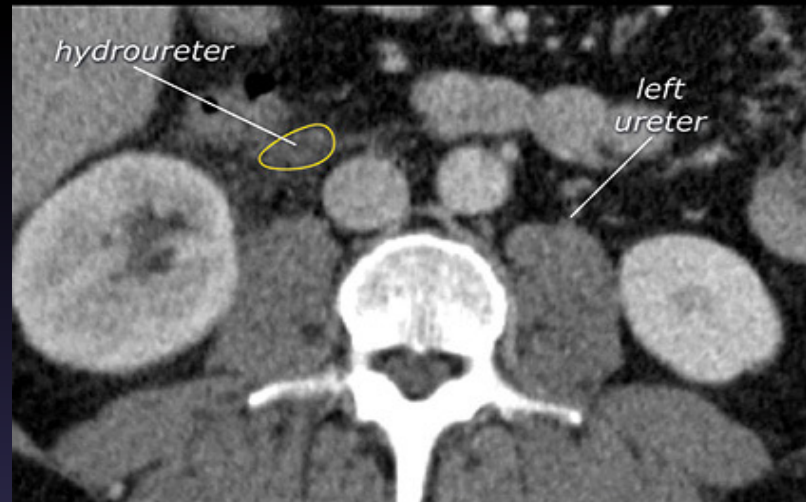
Hydronephrosis secondary to a distal ureteral stone



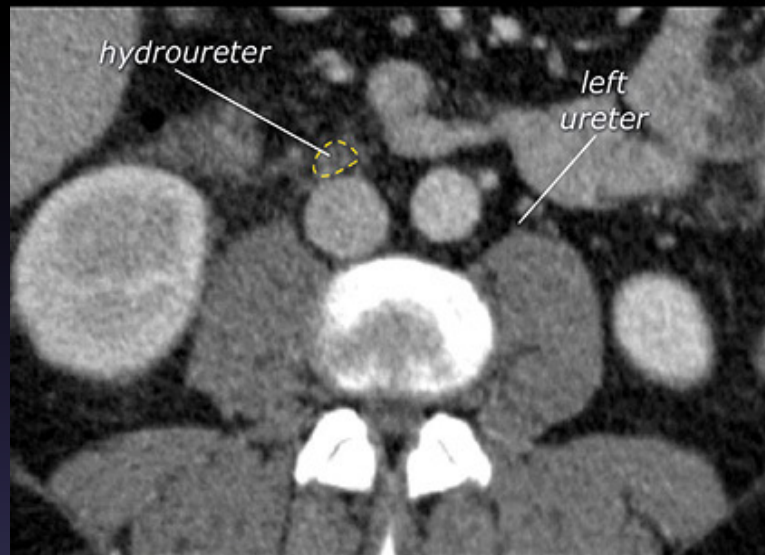
Hydronephrosis secondary to a distal ureteral stone



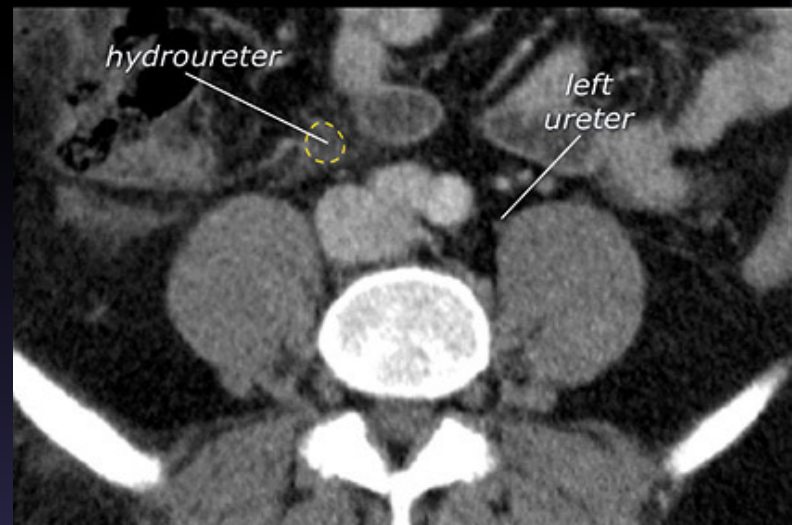
Hydronephrosis secondary to a distal ureteral stone



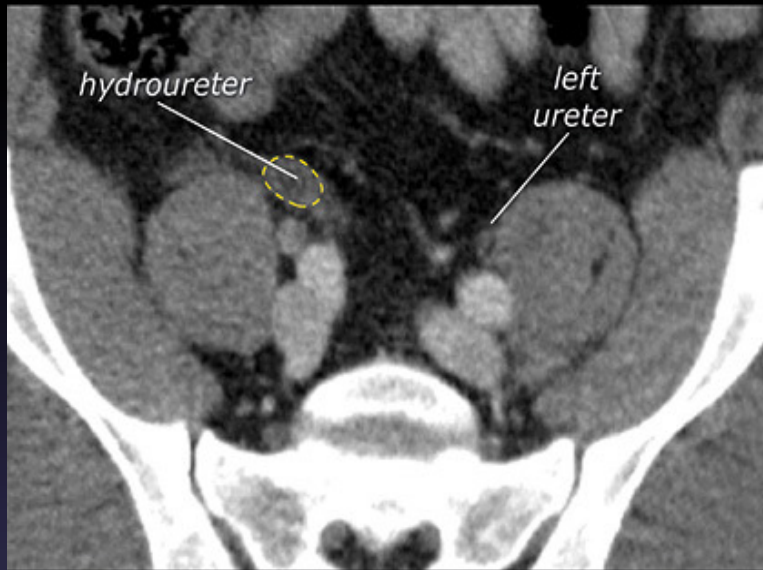
Hydronephrosis secondary to a distal ureteral stone



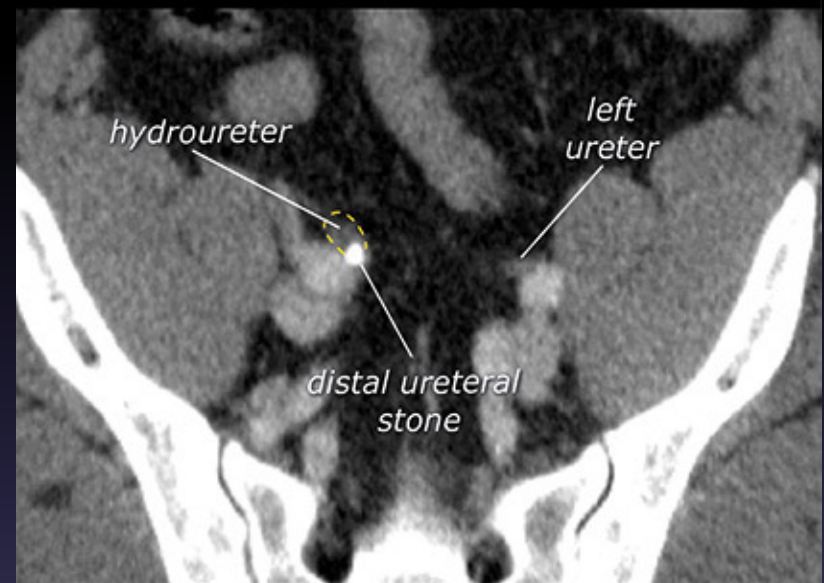
Hydronephrosis secondary to a distal ureteral stone



Hydronephrosis secondary to a distal ureteral stone



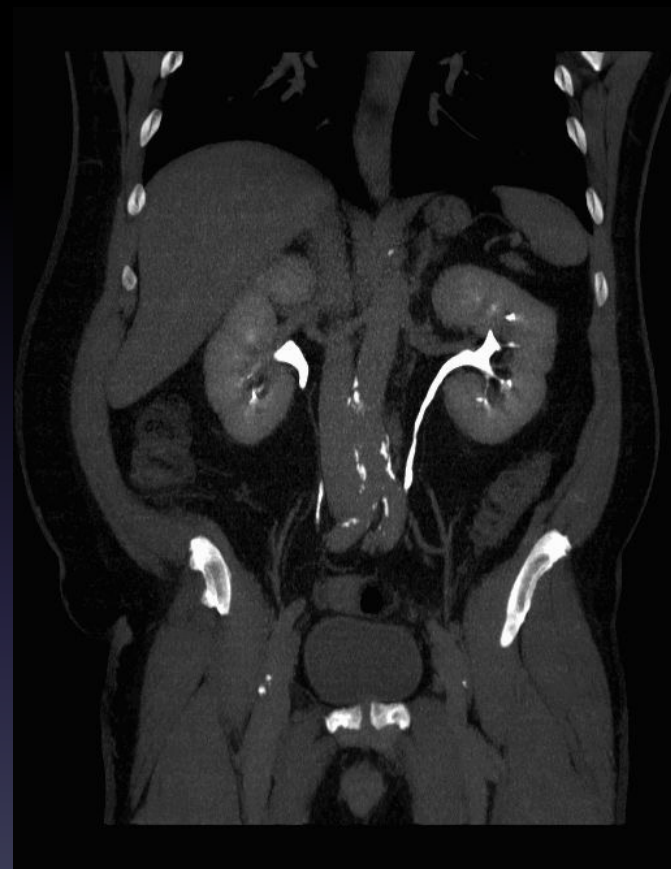
Hydronephrosis secondary to a distal ureteral stone



- Logically, ureteral stones are in the ureter. Sometimes however, the ureter is not readily identified. In such cases it is difficult to distinguish between a ureteral stone or e.g. a phlebolith. The 'tissue-rim sign' is helpful in such situations. The density of a ureteral stone is surrounded by a rim of soft tissue, in this case the ureter. This is not the case for phleboliths.

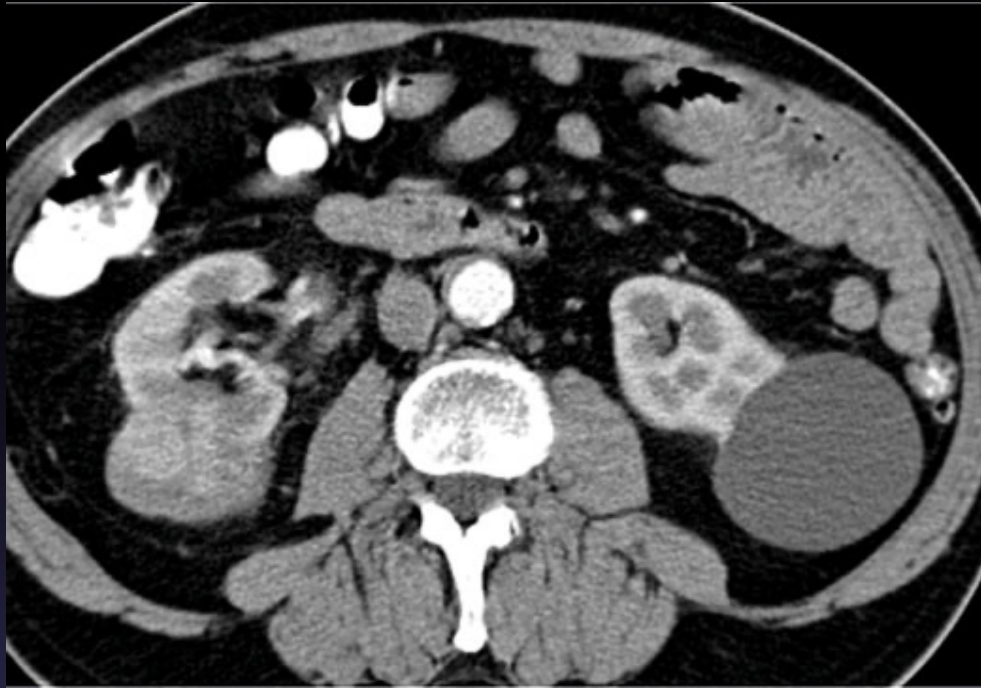


Transversal slice in the pelvis minor. Distal ureteral stone at right with the tissue-rim sign.

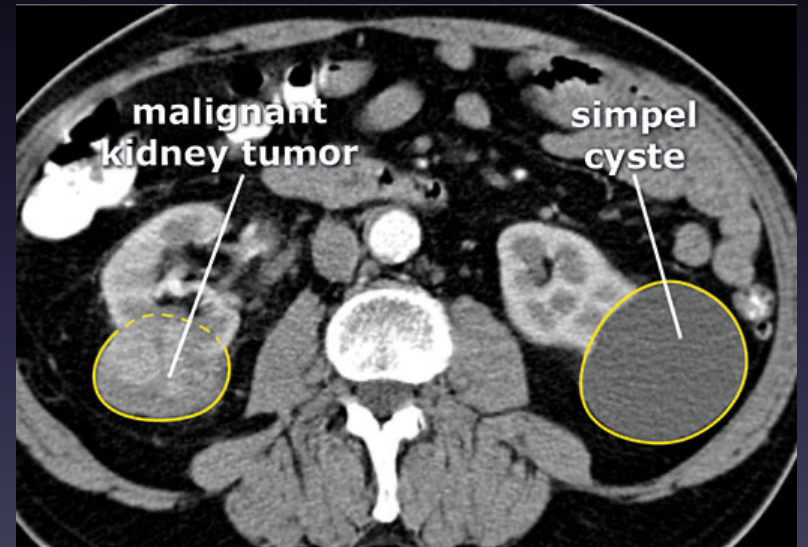


- Cyst

Cysts are a common abnormality in the kidneys. Cysts are fluid-filled cavities and therefore have a low density ($HU < 20$). Characteristic of an uncomplicated cyst is that it is hypodense with no enhancement. A cyst may also be complicated, however, and may be hyperdense and contain partitions, calcifications or enhanced mural nodes. Cysts may be subdivided by morphology into four categories using the Bosniak classification. Depending on the category, treatment is either conservative or surgical.



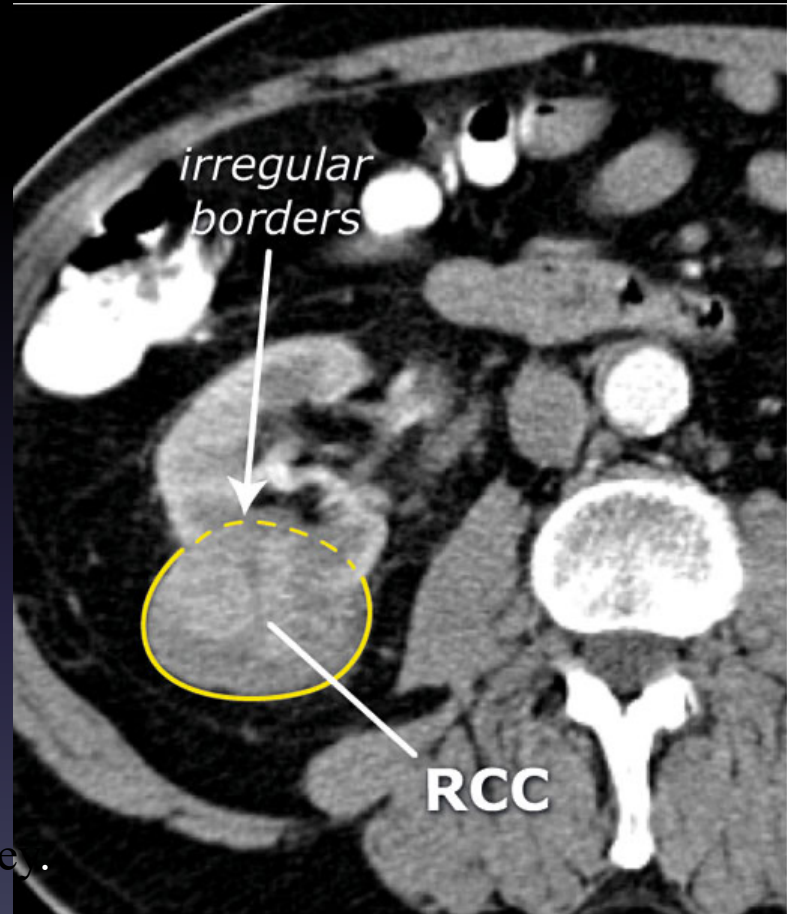
Example of a simple cyst in the left kidney vs malignant tumor in the right kidney.



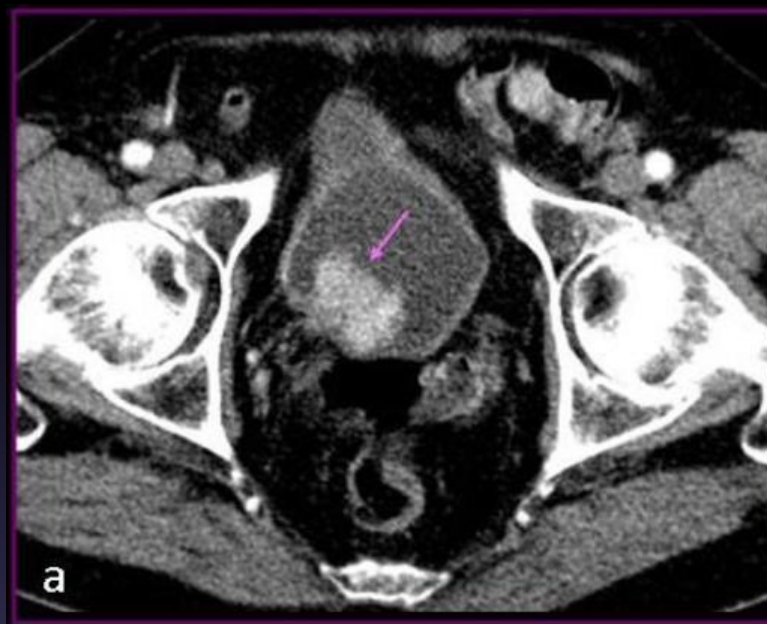
- **Most common malignant kidney tumors**

- Renal cell carcinoma (RCC)

RCC is the most common malignant kidney tumor. RCC originates from the renal cortex and is characterized by its **hypervascular** nature, which can be seen in the corticomedullary phase in particular. Rarely, RCC contains fat and/or calcifications. In advanced stages, RCC may spread into the renal vein and inferior caval vein (tumor thrombus). Preferential sites for RCC metastases include the lungs, liver, lymph nodes (para-aortic) and skeleton (lytic lesions).



RCC originating from the right kidney.



Bowel

Bowel wall thickening

- Enhancement pattern



White



Gray



Target
Water



Target
Fat



Gas

- Length of involvement

- Mural thickness

- Mesentery
 - Patency of mesenteric vessels
 - Edema
 - Lymph nodes
 - Fistula

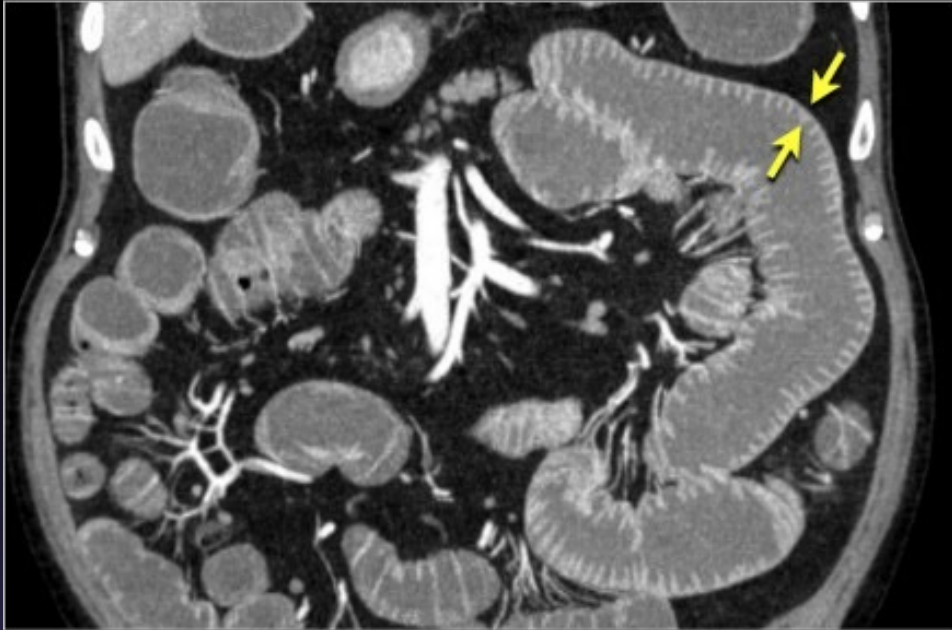
- Lumen contents
 - Blood - Fat
 - Small bowel feces sign

Bowel wall thickening is a common finding in imaging.

CT can be helpful in the differentiation of intestinal disease.

Important features to look for are:

- Enhancement pattern
- Length of involvement
- Degree of mural thickening
- Patency of the mesenteric vessels
- Mesenteric changes
- Lumen contents

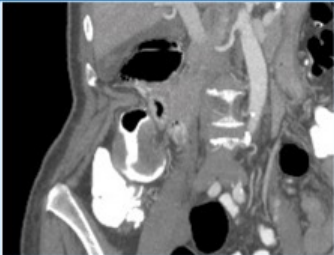
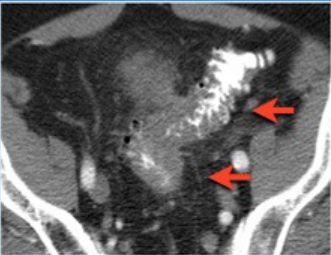

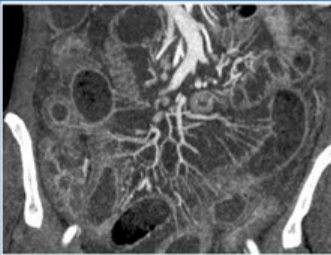







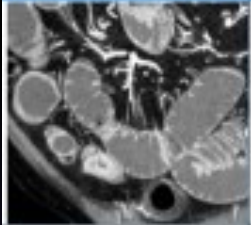
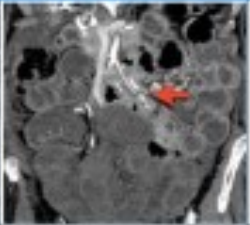
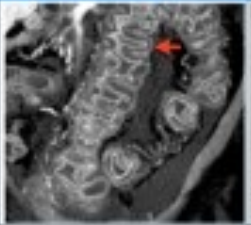
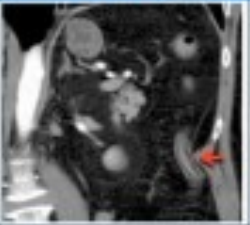
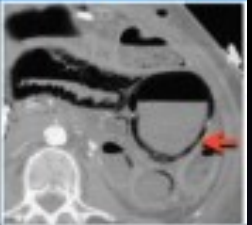
enhancement pattern

The normal bowel will enhance bright especially if the scan is in the late arterial phase, i.e. 35-40 seconds post injection. If the bowel wall is not thickened, this is normal enhancement.

When there is bright enhancement in thickened bowel, it is sometimes difficult to differentiate between the white enhancement pattern and the water-target-sign pattern

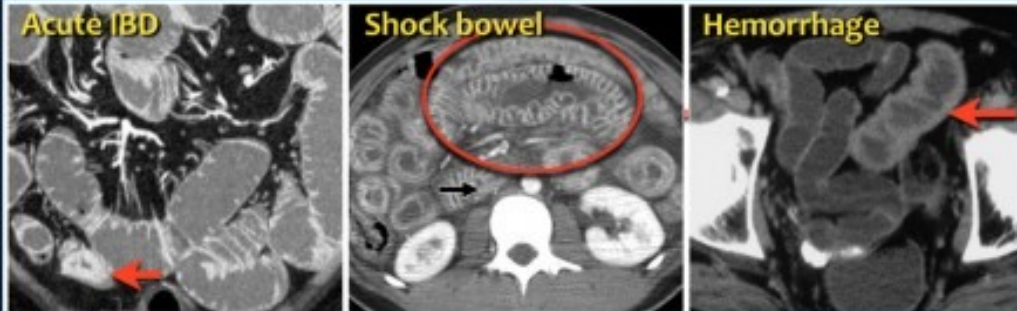
length

Focal < 5 cm	Focal 5 - 10 cm	Segmental 10-30 cm	Diffuse
			
<ol style="list-style-type: none"> 1. Adenocarcinoma 	<ol style="list-style-type: none"> 1. Diverticulitis 2. Crohn's disease 3. Ischemia 	<ol style="list-style-type: none"> 1. Ischemia 2. Submucosal hemorrh. 3. Radiation 4. Infection 5. Crohn's disease 6. Lymphoma 	<ol style="list-style-type: none"> 1. Infectious Enterocolitis 2. Ulcerative Colitis 3. Edema from low protein or cirrhosis 4. SLE

White 	Gray 	Target - Water 	Target - Fat 	Gas 
				
<ol style="list-style-type: none"> 1. Acute IBD due to vasodilatation with acute hyperemia 2. Shock Bowel injury to intramural vessels 3. Reperfusion after ischemia 4. Hemorrhage 	<ol style="list-style-type: none"> 1. Chronic Crohn's 2. Ischemia 3. Neoplasm 	<ol style="list-style-type: none"> 1. Portal hypertension 2. Infection <ul style="list-style-type: none"> - Shigella, Salmonella, E. Coli, CMV, Crypto - Pseudomemb. colitis - AIDS 3. Acute Ulc. Colitis 4. Acute Crohn's 5. Typhilitis 6. AIDS 7. Ischemia 	<ol style="list-style-type: none"> 1. Chronic Ulc. Colitis 2. Chronic Crohn's 3. Obesity 4. Chemotherapy 5. Celiac disease 	<ol style="list-style-type: none"> 1. Ischemia 2. Infection 3. Trauma 4. Benign causes <ul style="list-style-type: none"> - Connect tissue disease - IBD - COPD - Obstruction 5. Pseudo-pneumatosis

enhancement pattern

White



1. **Acute IBD**
due to vasodilatation with acute hyperemia
2. **Shock Bowel**
injury to intramural vessels
3. **Reperfusion after ischemia**
4. **Hemorrhage**

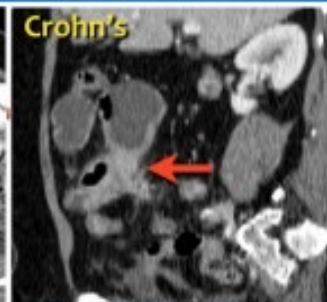
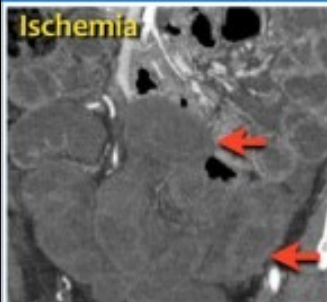
There are many pathophysiologic events that can cause a white attenuation pattern:

Bright enhancement of the bowel wall is seen in vasodilatation in acute inflammatory bowel disease.

Injury to the intramural vessels with interstitial leakage in shock bowel. Hypoperfusion results in increased permeability and increased enhancement.

Intramural hematoma is seen in trauma and treatment with anticoagulation.

Gray

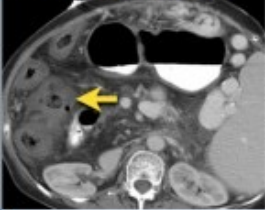


1. Chronic Crohn's
2. Ischemia
3. Neoplasm

Target sign- Water



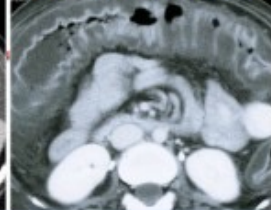
Portal hypertension



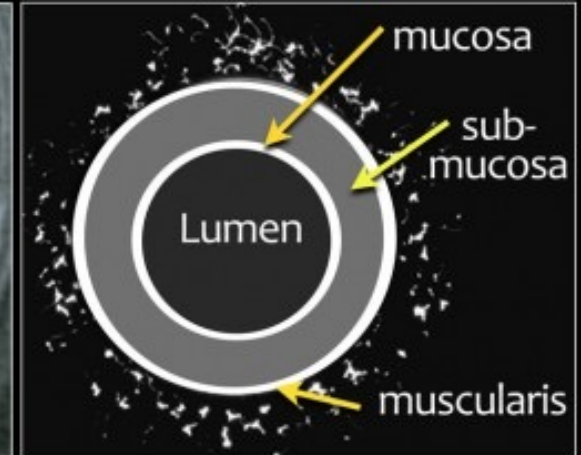
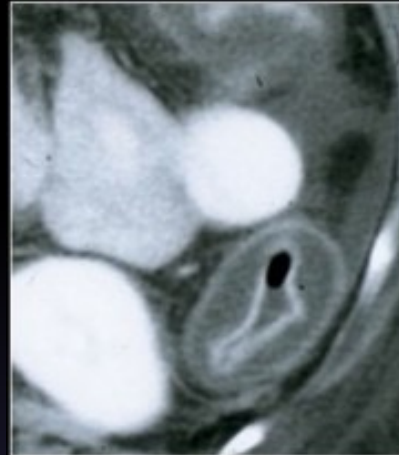
Pseudomembranous

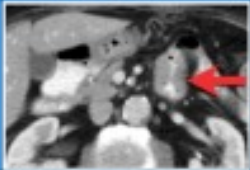
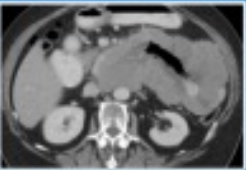

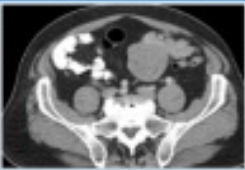


Infectious enterocolitis

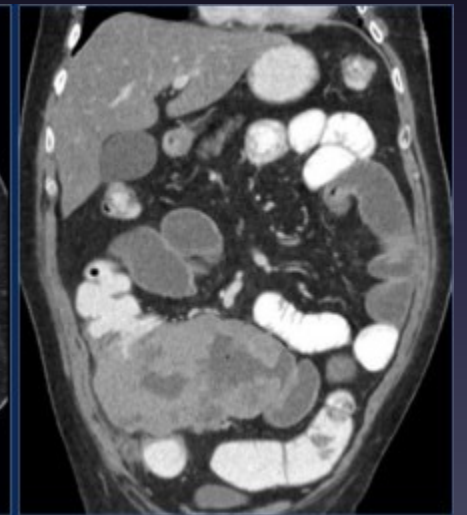
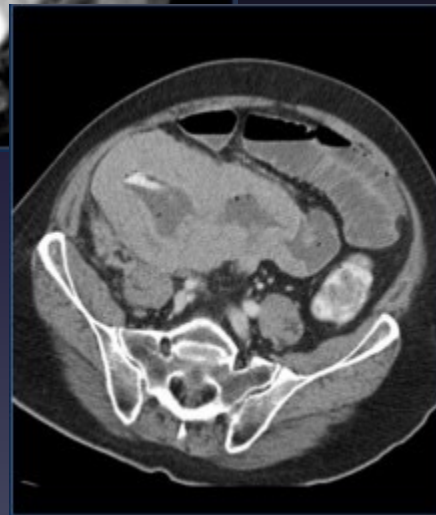


1. Portal hypertension
2. Infection
 - Shigella, Salmonella, E. Coli, CMV, Crypto
 - Pseudomemb. colitis
 - AIDS
3. Acute Ulcerating Colitis and Acute Crohn's
4. Typhlitis
5. AIDS
6. Ischemia



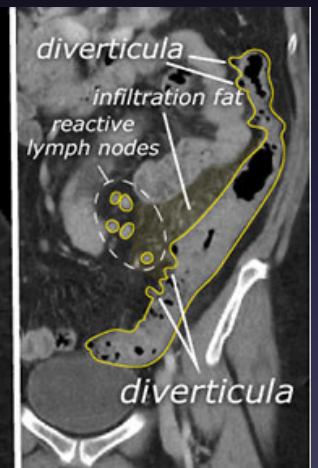
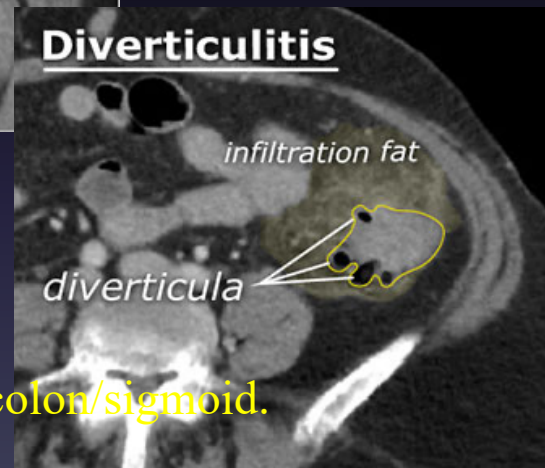
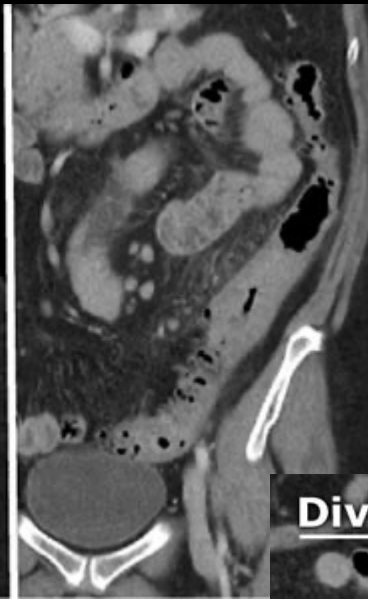
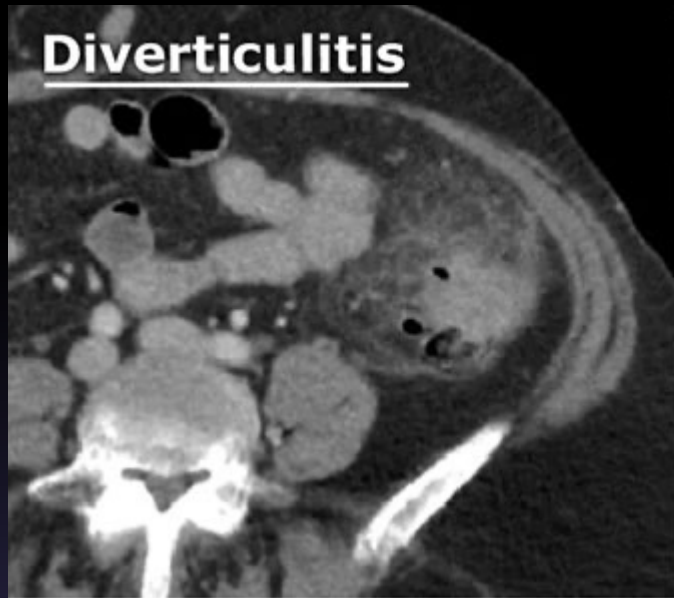
	Adenocarcinoma	Lymphoma	Carcinoid	GIST
				
Risk factors	HNPCC Familial adenomatous polyposis Peutz-Jeghers Celiac disease Crohn's disease	Celiac disease Crohn's disease, SLE Immunocompromised state Post-Chemotherapy Extra-intestinal lymphoma		
Location	Duodenum > Jejunum > Ileum	Terminal ileum	Distal ileum appendix	Stomach >> Small bowel
Key feature	Focal circumferential mass with shouldered borders	Thick walled infiltrating mass with aneurysmal dilatation	Transmural hypervascular mass Mesenteric mass with Ca++ Desmoplastic reaction Bowel wall thickening.	Well defined exophytic mass
Enhancement	Moderate and heterogeneous	Homogeneous	Hypervascular	Heterogeneous
Associated features		Splenomegaly Mesenteric and retroperitoneal lymphadenopathy	Carcinoid syndrome (<10%) Liver metastases	Hypervascular liver metastases. No lymph node metastases. Mesenteric metastases often in recurrent disease
Diff. Diagn.	Large lymphoma	Large adenocarcinoma	Sclerosing mesenteritis	Lymphoma





Intestines

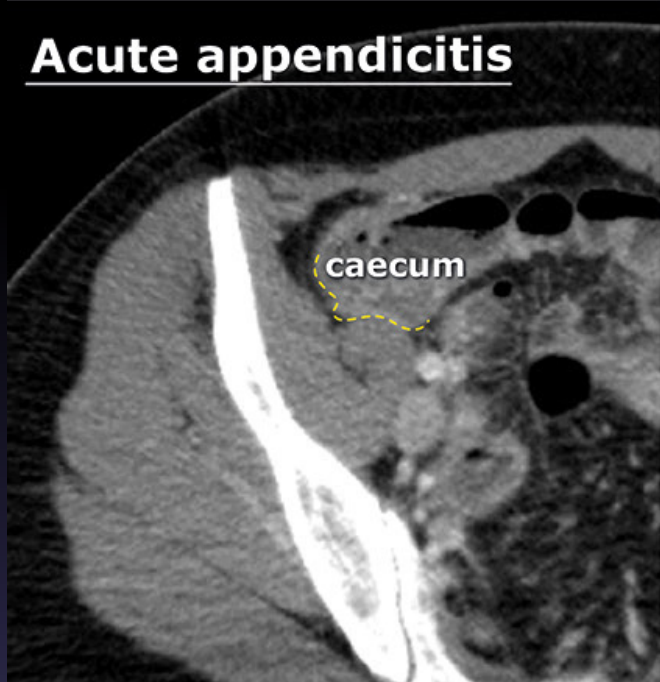
- **Diverticulitis**
- Colonic diverticula originate primarily in the sigmoid and descending colon. Right-sided diverticula do occur, but much less frequently. One of the diverticula may become infected. As a result, the mesocolon surrounding the diverticulum will have an increased density. There will also be segmental diffuse wall thickening of the affected part of the colon. Diverticulitis usually responds to conservative treatment with dietary modifications. However, diverticulitis may be complicated by perforation and/or the formation of abscesses. When the intestine is perforated, air in the intestine moves through the wall defect into the abdominal cavity. An abscess is an encapsulated collection of fluid (pus) with enhancement of the wall



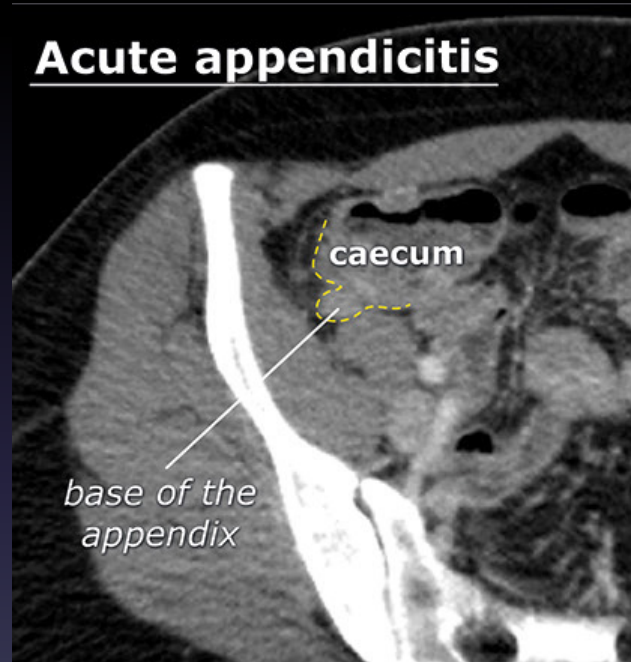
Uncomplicated diverticulitis in the descending colon/sigmoid.

- **Appendicitis**
- The appendix is generally in the right lower quadrant of the abdomen. However, the appendix may also be in a different location, e.g. along the right liver tip or centrally in the abdomen. An infected appendix is enlarged (> 6 mm). The mesenterial fat surrounding the appendix will have an increased density due to reactive inflammation. Appendicitis may also be complicated by perforation and/or the formation of abscesses

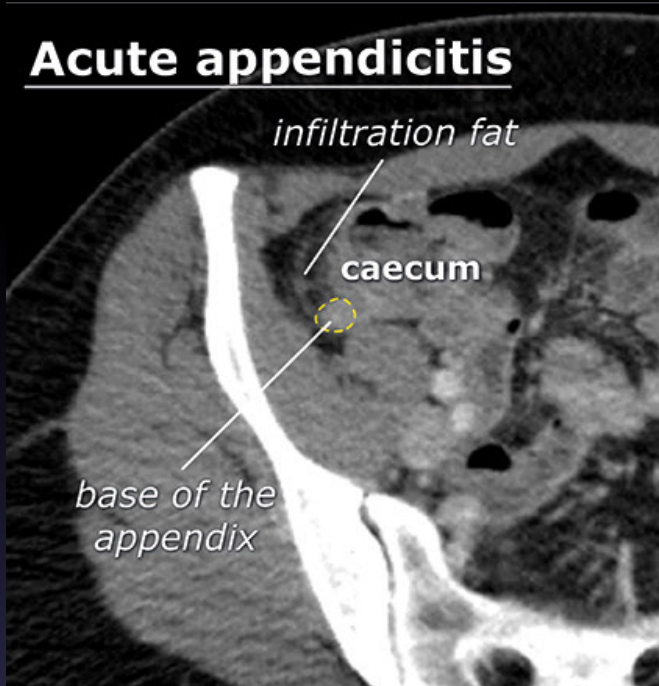
Acute appendicitis



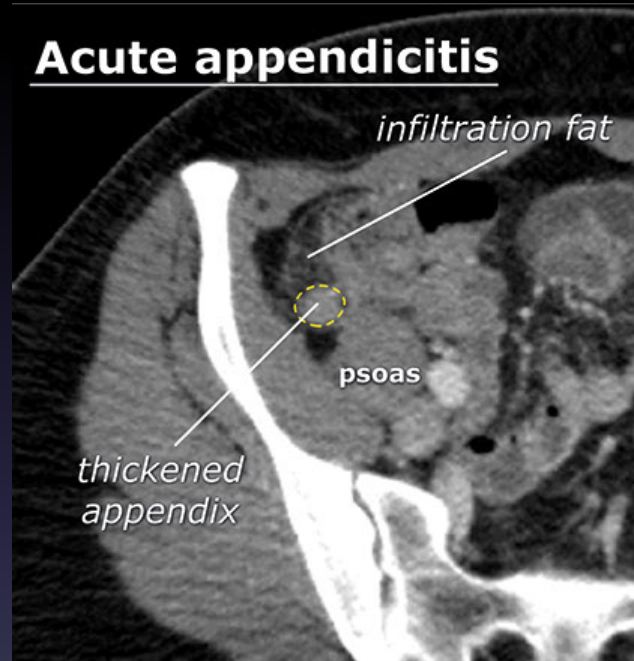
Acute appendicitis



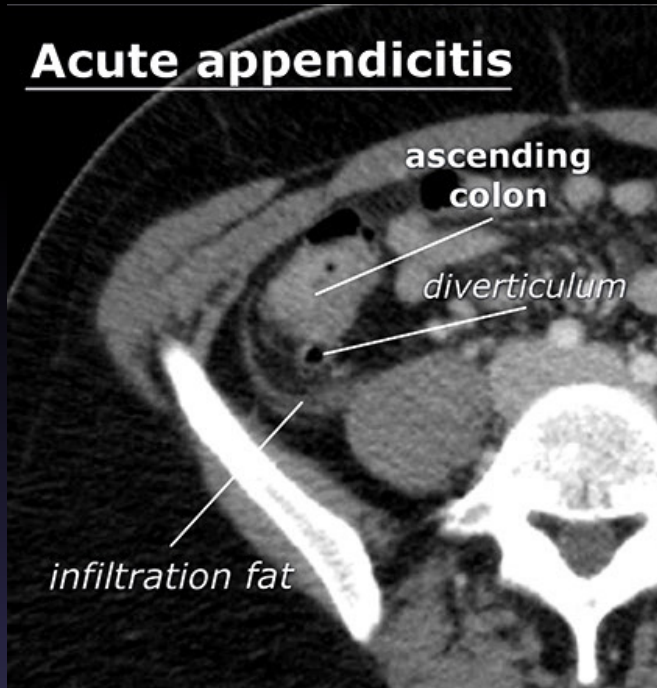
Acute appendicitis



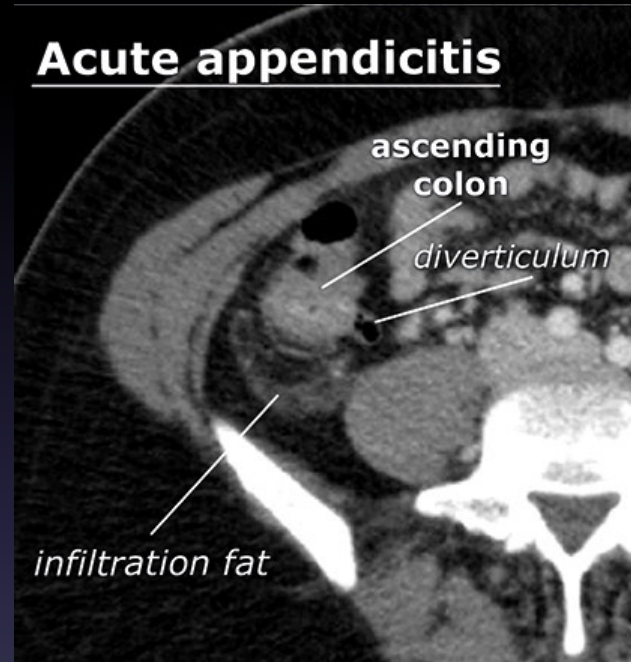
Acute appendicitis



Acute appendicitis



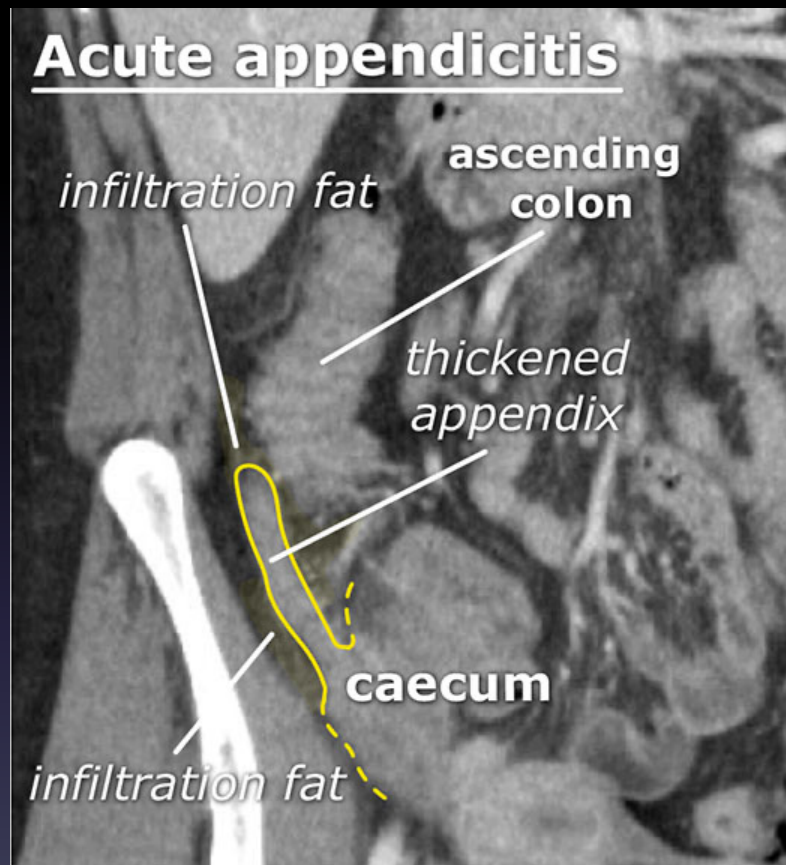
Acute appendicitis



Acute appendicitis



Acute appendicitis

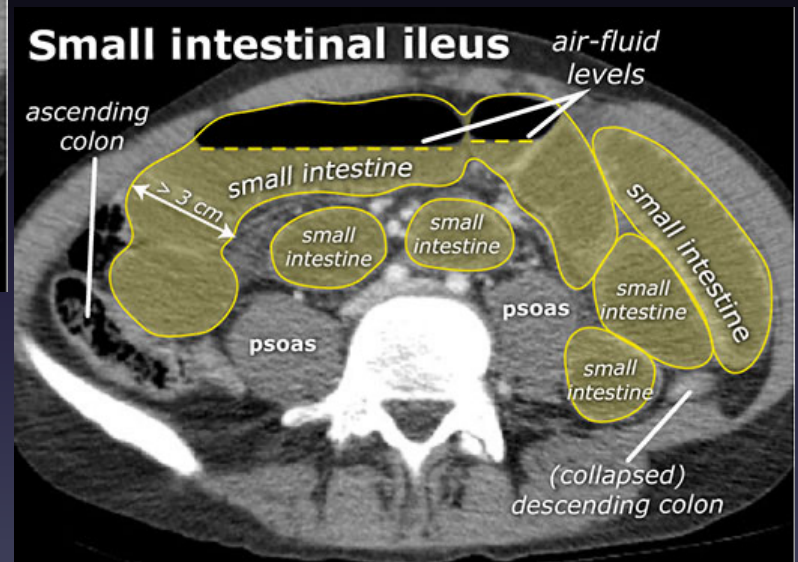


- **Ileus**
- Ileus refers to reduced intestinal passage, with fecal accumulation and intestinal dilation. Loops in the small intestine are dilated when their diameter exceeds 3 cm. For the cecum this is more than 9 cm and for the remainder of the colon more than 6 cm. An ileus may develop in the small or large intestine or in both, and may have various causes. The causes are subdivided into two groups: paralytic ileus and mechanical ileus.



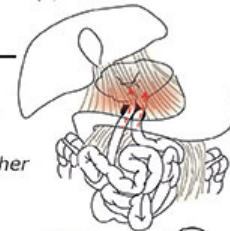
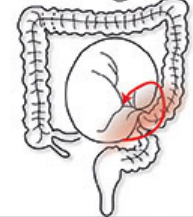
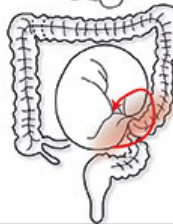
Small intestinal ileus



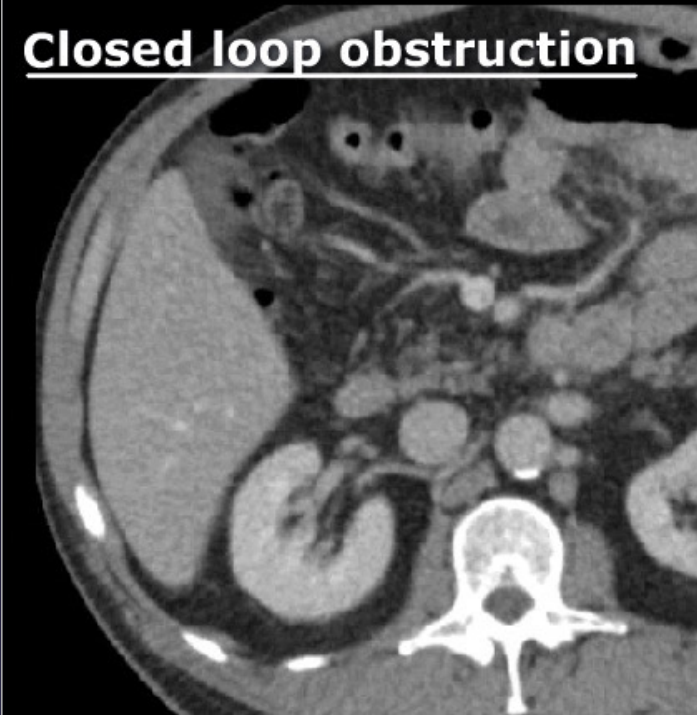
Small intestinal ileus; diffuse fluid-filled dilated small intestinal loops, associated with a number of air-fluid levels.



Causes of mechanical ileus.

Mechanical ileus	
Cause	CT characteristics
Tumor Clinical: - prolonged intestinal symptoms - Weight loss	Mass Mostly in the colon 'Apple core' aspect Other signs of malignancy, e.g. infiltration of mesenteric fat, lymphadenopathy or metastases 
Adhesion Clinical: - history of abdominal surgery	Usually the adhesion cannot be identified 
'Closed loop' 1. Adhesion Clinical: - history of abdominal surgery	Usually the adhesion cannot be identified 
2. Internal herniation Clinical: - possibly history of abdominal surgery	The intestinal loops herniate through a 'hole' in the mesentery. The hole is either congenital or acquired (e.g. after surgery) 
3. Torsion/ Volvulus Clinical: - Dolichocolon	The intestinal loops are twisted around each other's axis (e.g. in malrotation) Can be in both small and large intestine 

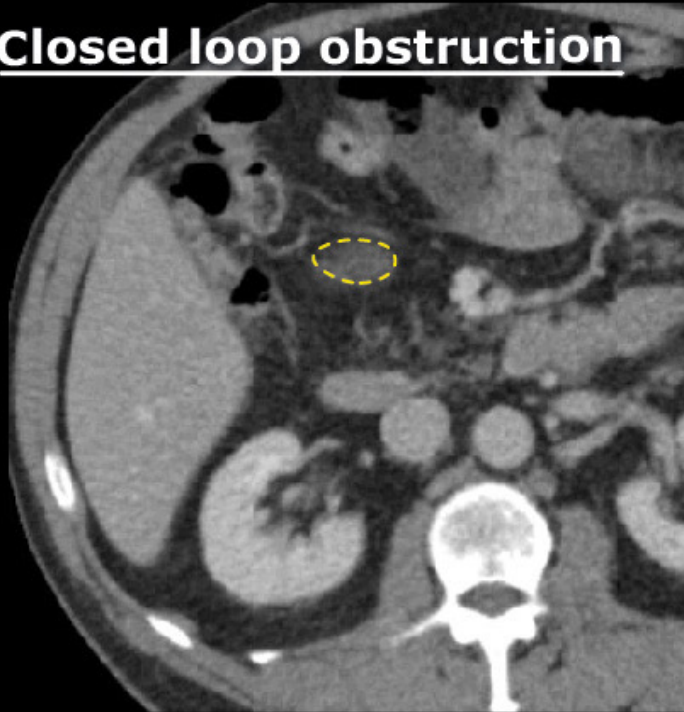
Closed loop obstruction



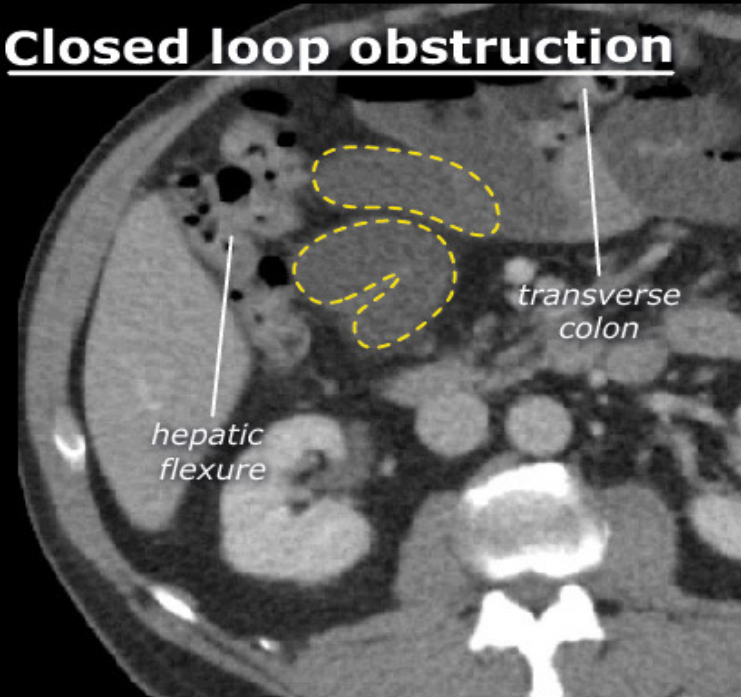
Closed loop obstruction



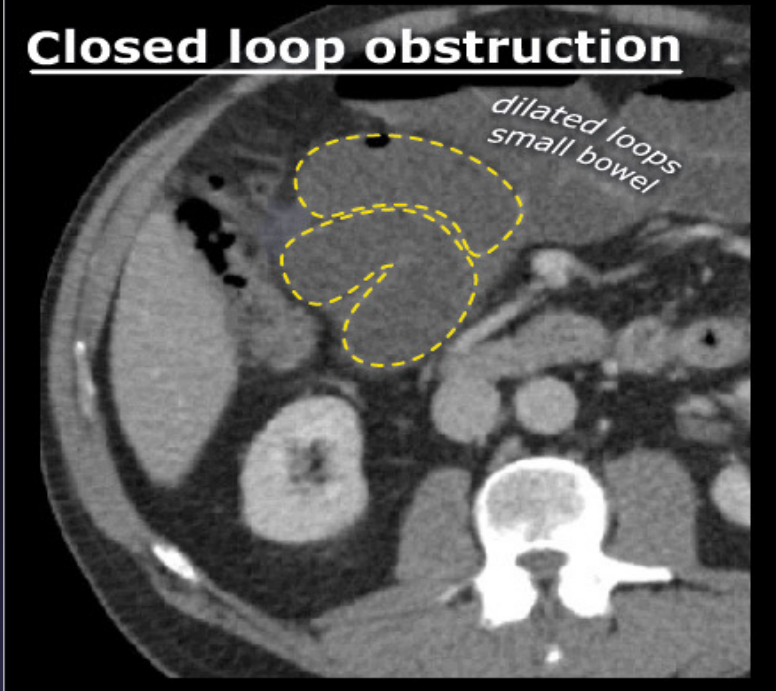
Closed loop obstruction



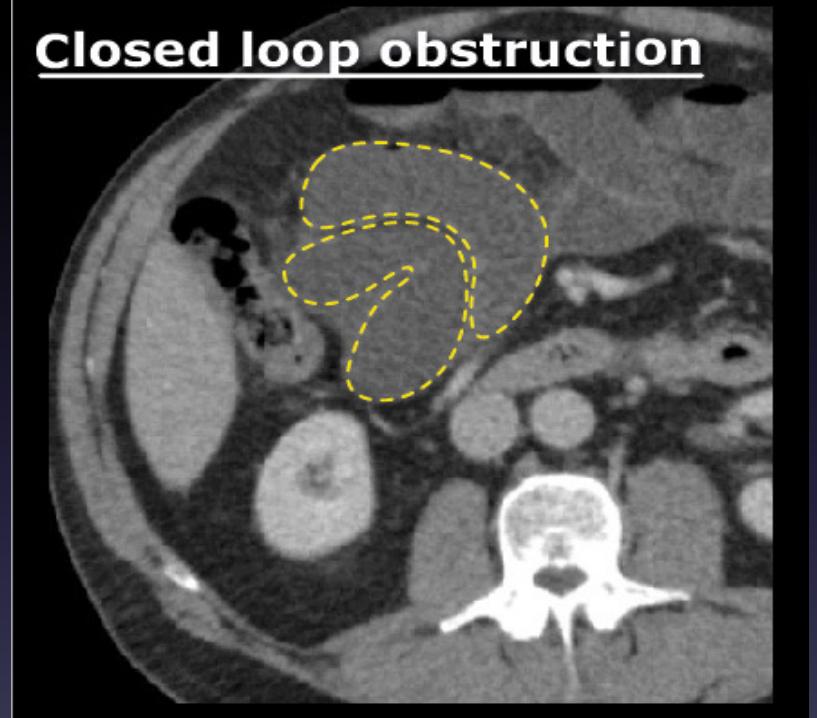
Closed loop obstruction



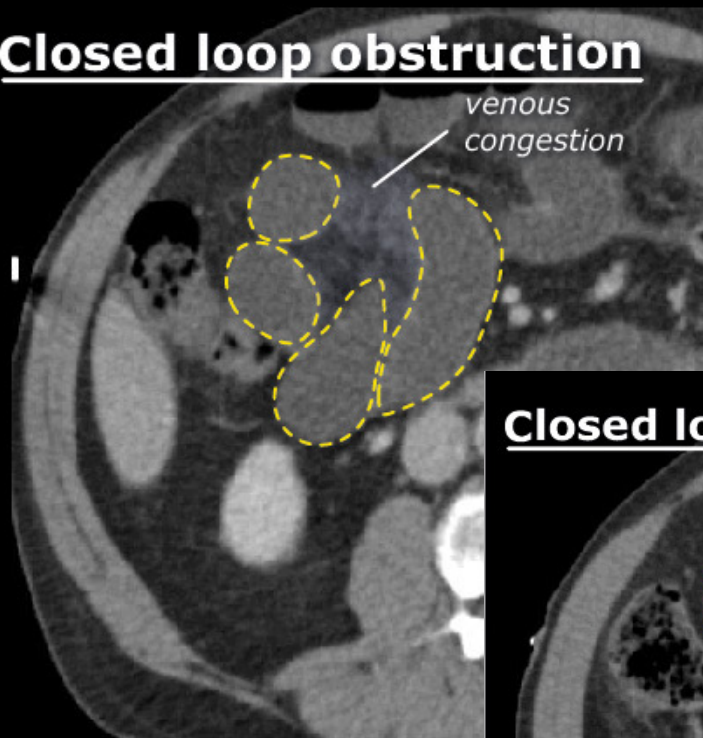
Closed loop obstruction



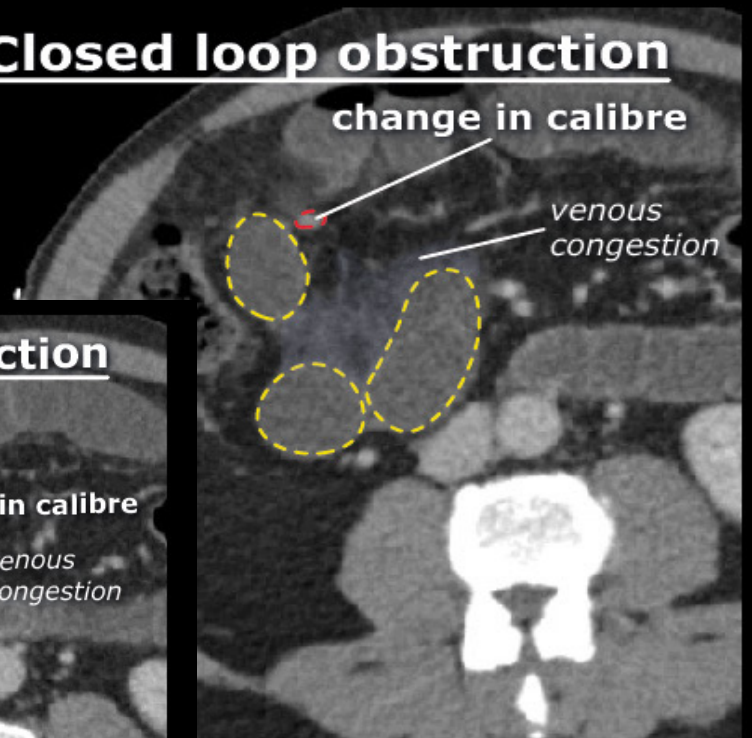
Closed loop obstruction



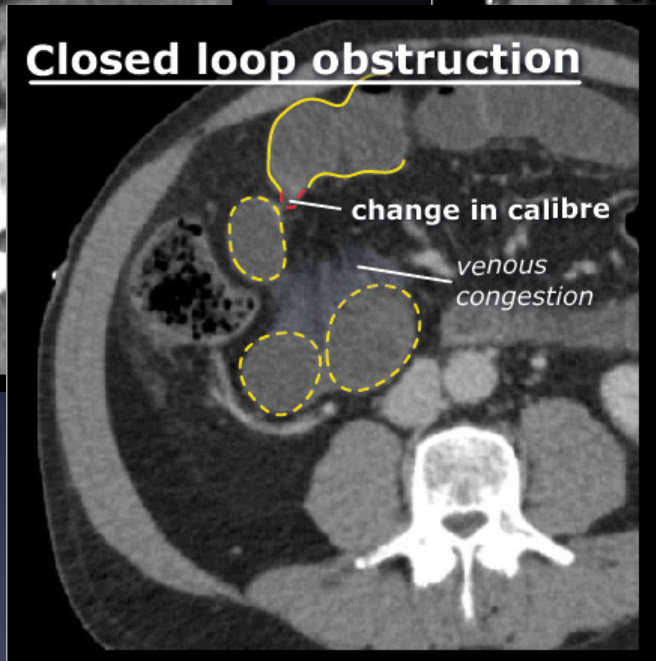
Closed loop obstruction



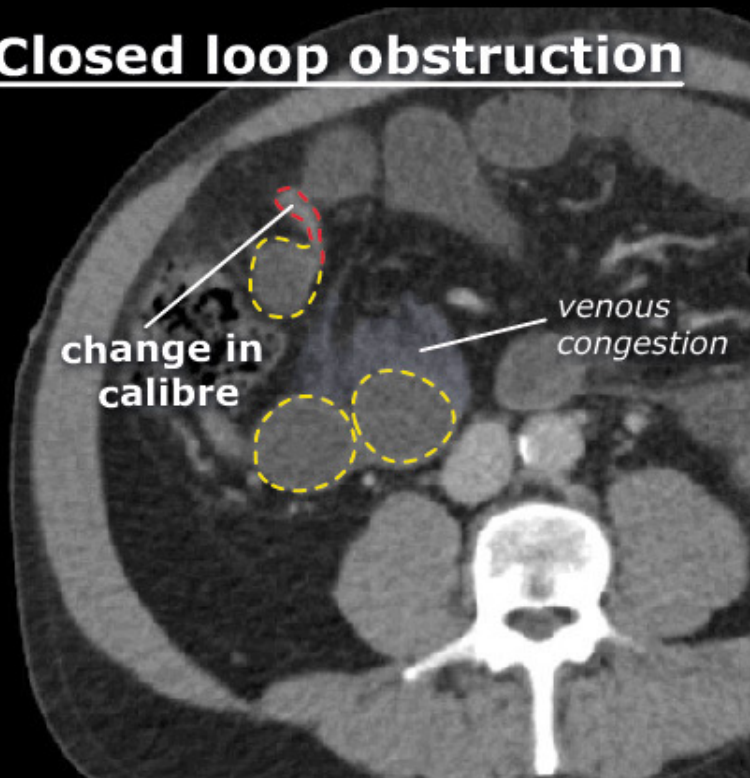
Closed loop obstruction



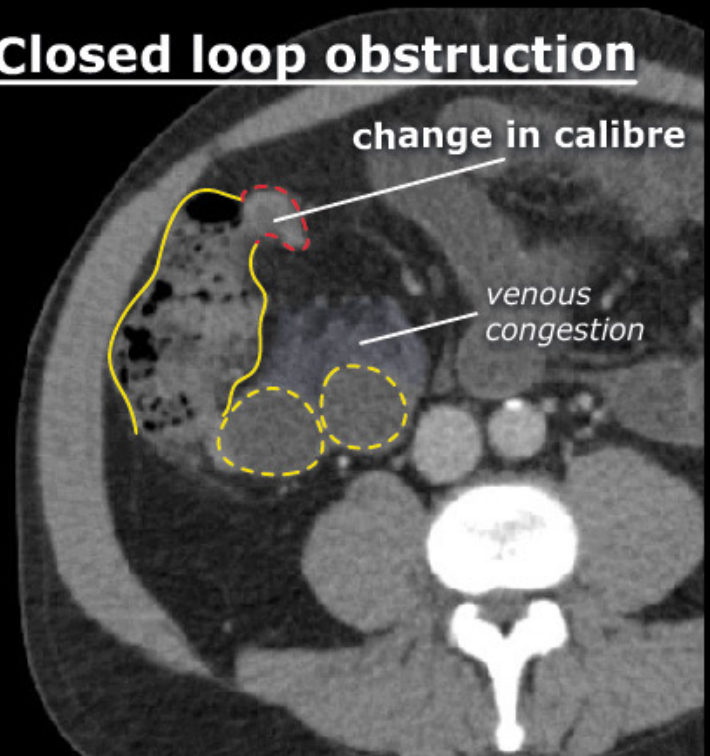
Closed loop obstruction



Closed loop obstruction



Closed loop obstruction



- **Intestinal perforation**
- Intestinal perforation is characterized by extraluminal, 'free', gas in the abdominal cavity. The free gas is usually located around the perforation site, allowing some conclusions as to the location of the perforation. There is also free fluid in the abdominal cavity resulting from leaking intestinal contents or peritoneal irritation.



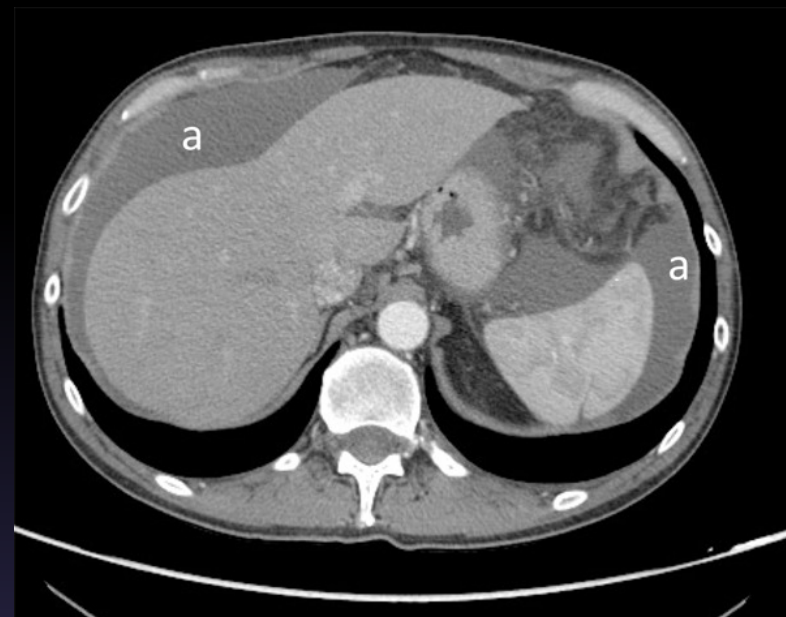
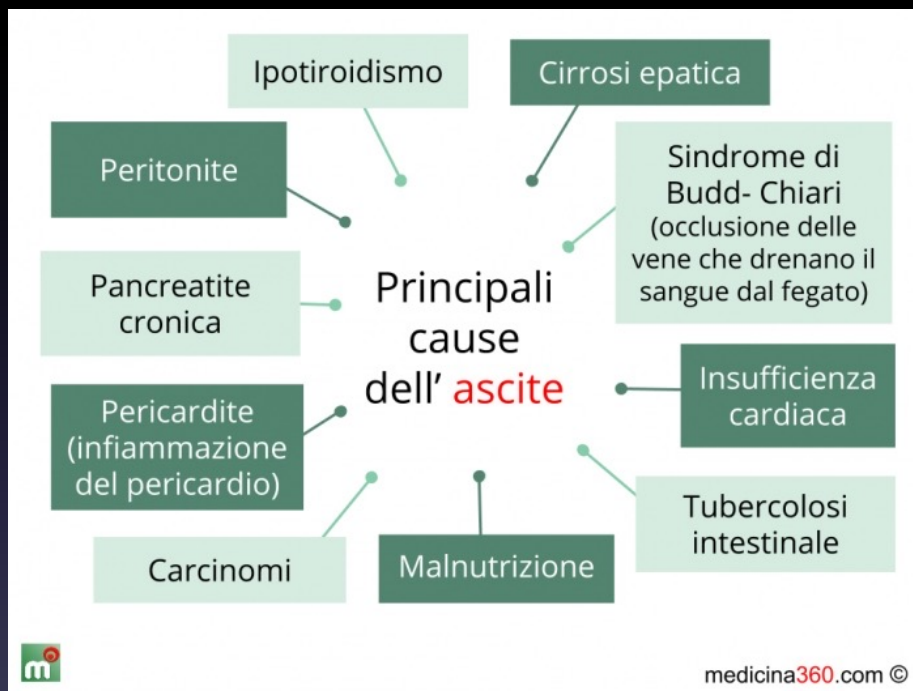
Gastric perforation with free gas.

- Tip: the free gas is in most cases easily detected by examining the abdomen in the 'lung setting'.



Organ	Normal values	
Abdominal aorta	<i>Luminal diameter</i>	< 2,5 cm
Inferior vena cava	<i>Diameter</i>	< 2,0 cm
Liver	<i>Craniocaudal dimension</i>	< 15,0 cm
Bile ducts	<i>Intrahepatic diameter</i>	< 2 mm
	<i>Choledochous duct diameter</i>	< 6 mm
Kidneys	<i>Longitudinal dimension</i>	10 - 12 cm
Spleen	<i>Craniocaudal dimension</i>	< 12-13 cm
	<i>Thickness</i>	< 4 cm
Lymph nodes	<i>Short-axis diameter</i>	< 10 mm
Intestines	<i>Small intestinal diameter</i>	< 3,0 cm
	<i>Colonic diameter</i>	< 6,0 cm
	<i>Cecal diameter</i>	< 9,0 cm
Appendix	<i>Transversal diameter</i>	≤ 6 mm
Prostate	<i>Transversal diameter</i>	< 5,0 cm

- Normal values
- Below is a table with common normal values of abdominal organs/structures.



PELVIC SPACE

PERIHEPATIC AND PERISPLENIC SPACES

