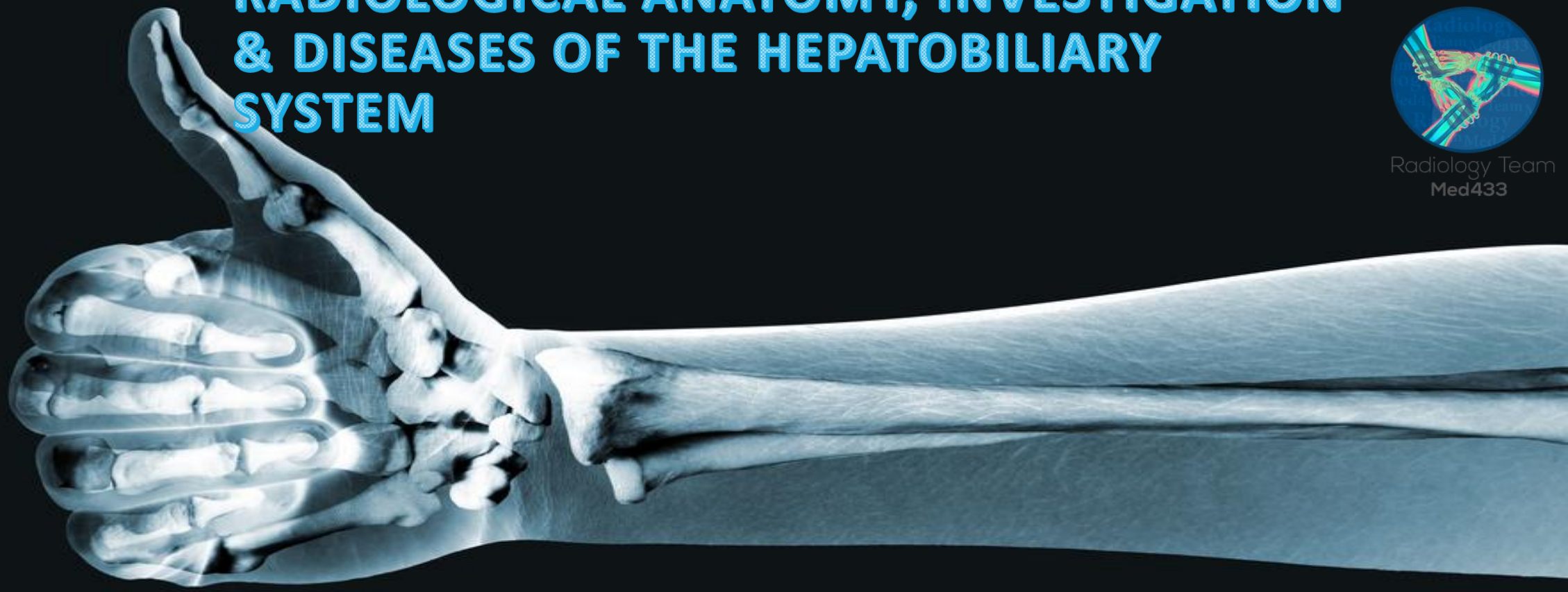
Lecture 11 :

RADIOLOGICAL ANATOMY, INVESTIGATION & DISEASES OF THE HEPATOBILIARY SYSTEM



Radiology Team
Med433

● Slides ● Explanation ● Notes ● Additions ● Important

Objectives

- ✓**Not given**

x-Ray:

What is Abdominal X-ray :

- X-ray is a form of radiation, that are focused into a beam
- X-ray can pass through most objects including the human body.
- When X-rays strike a piece of photographic film, they make a picture.

Advantages:

- Widely available
- Cheap
- **Excellent** in diagnosing **free air** in the abdomen
- **Good** in diagnosing **bowel obstruction** & stones/calcifications

.

Disadvantages:

- Radiation
- Poor soft tissue details

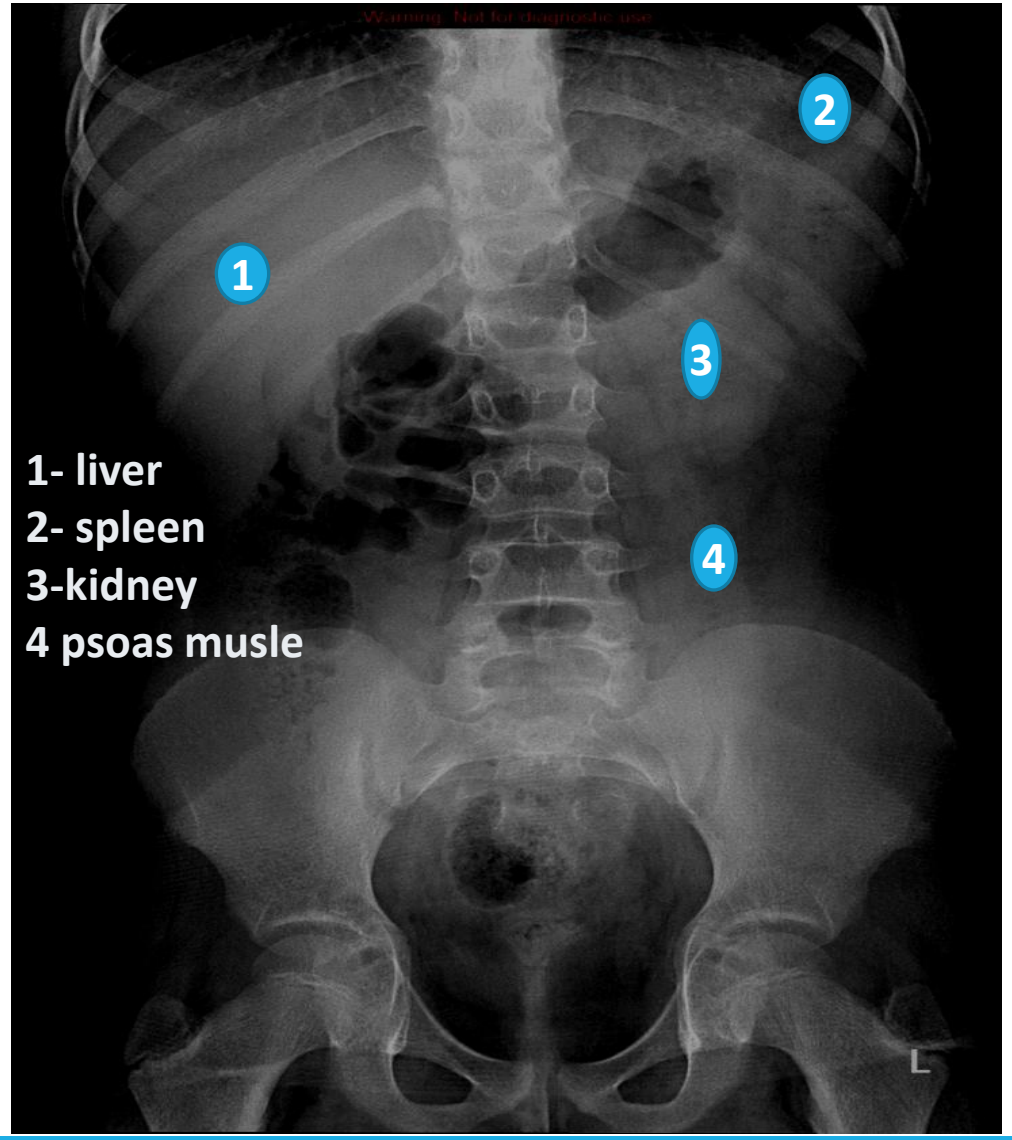
Indications:

- Abdominal pain
- Bowel obstruction
- Stones
- Masses
- Trauma
- Others, foreign body, supportive lines.. Etc

Contraindications:

Pregnancy.

Soft tissue: (Grey in color on CXR)

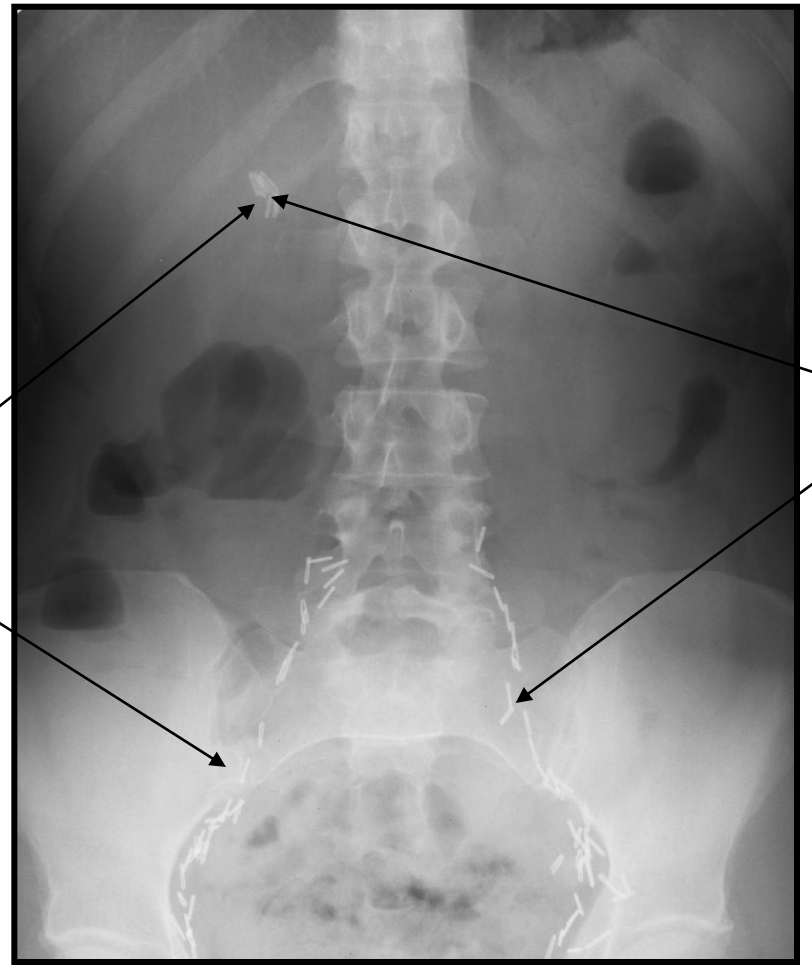


POST Operation of ABDOMEN

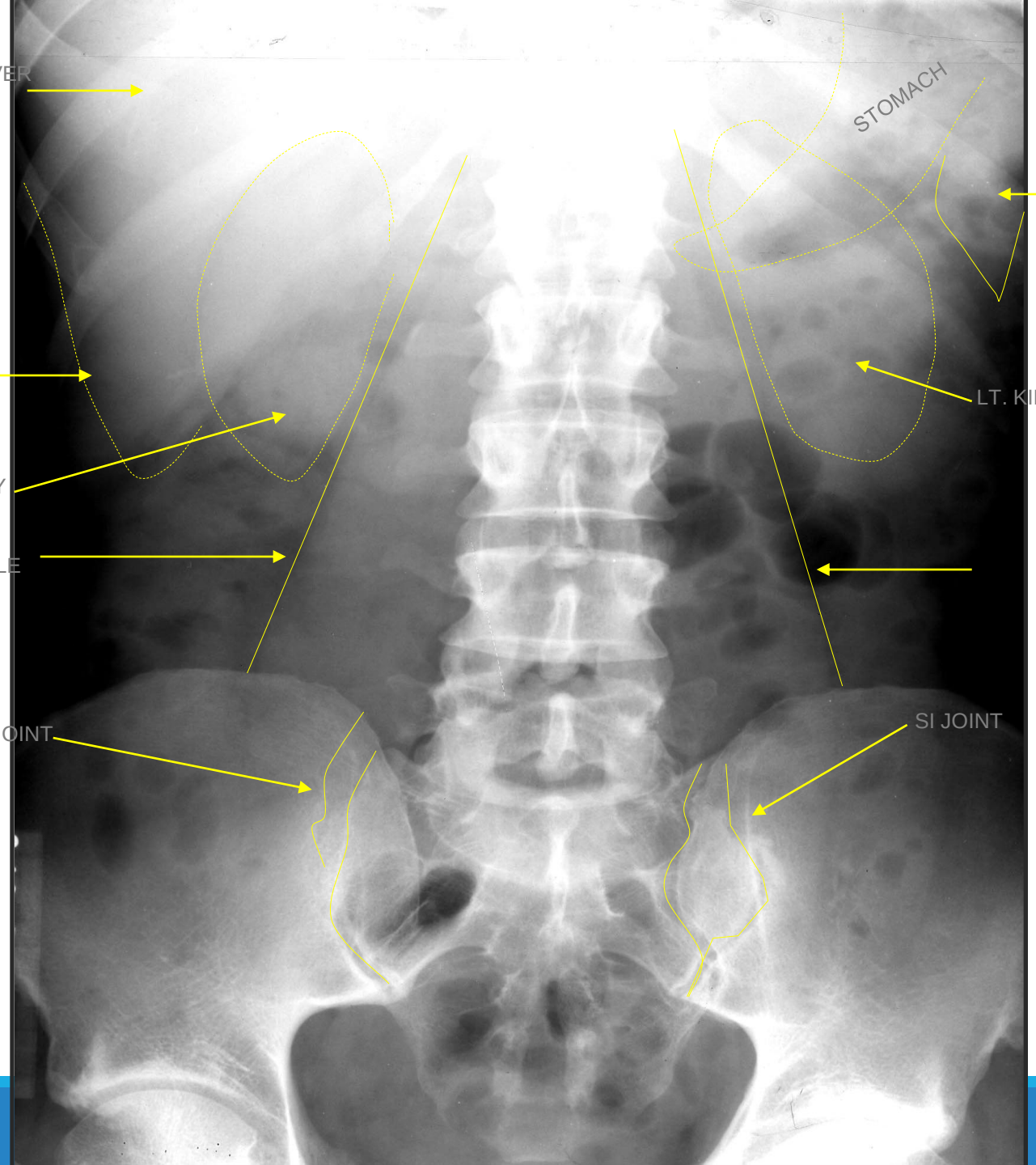
MULTIPLE SURGERIES

GALLBLADDER REMOVED

LYMPH NODE RESSECTION



SURGICAL CLIPS


LIVER
STOMACH
SPLEEN
TIP OF LIVER
LT. KIDNEY
RT. KIDNEY
PSOAS MUSCLE
PSOAS MUSCLE
SI JOINT
SI JOINT

ULTRASOUND

- **Not expensive**
- **allows comparison with the opposite side, normal side**
- **uses no ionizing radiation,**
- **performed at bed side or in the operating room.**
- **It is a non invasive modality**

-One of the most important modalities , It is the initial test in hepatobilliry investigation.

sagital

transverse

Segmental liver anatomy

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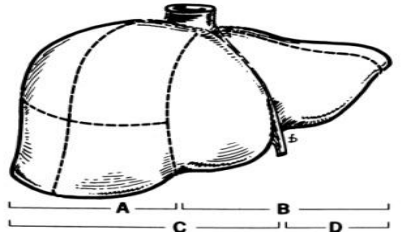
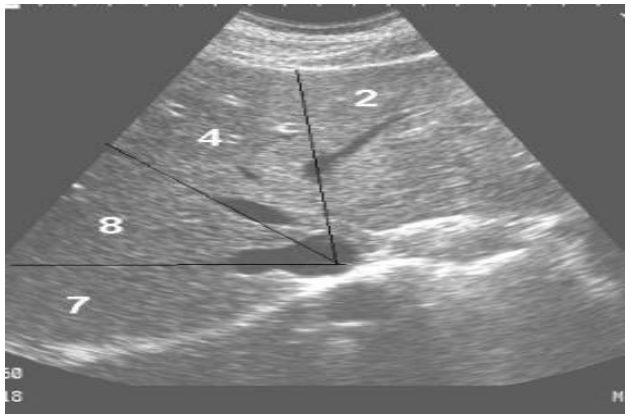
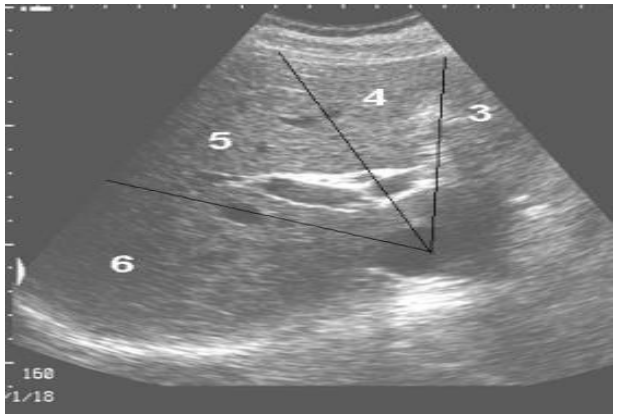
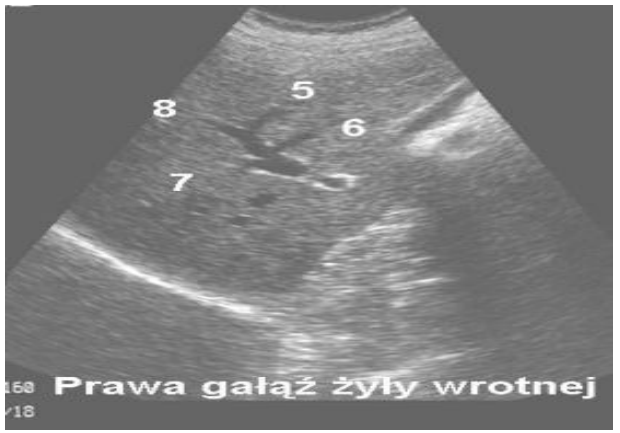
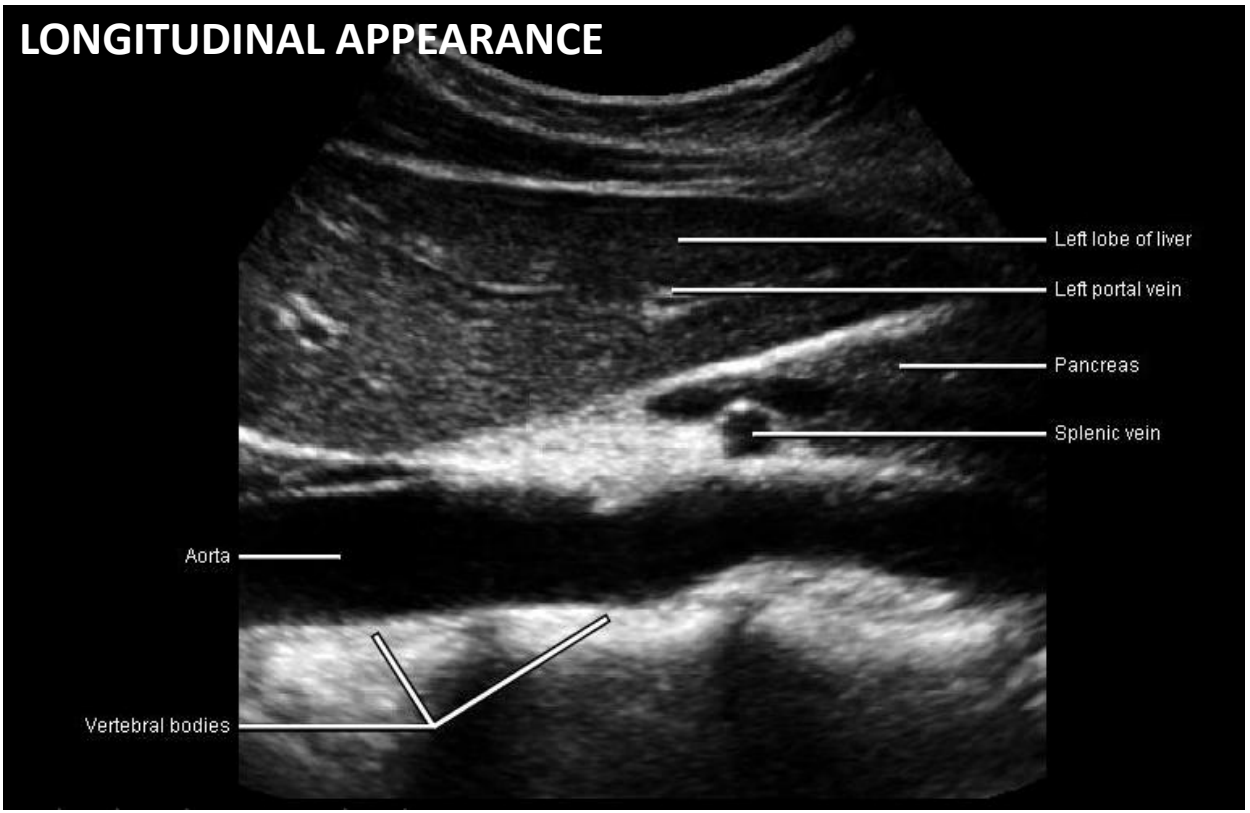


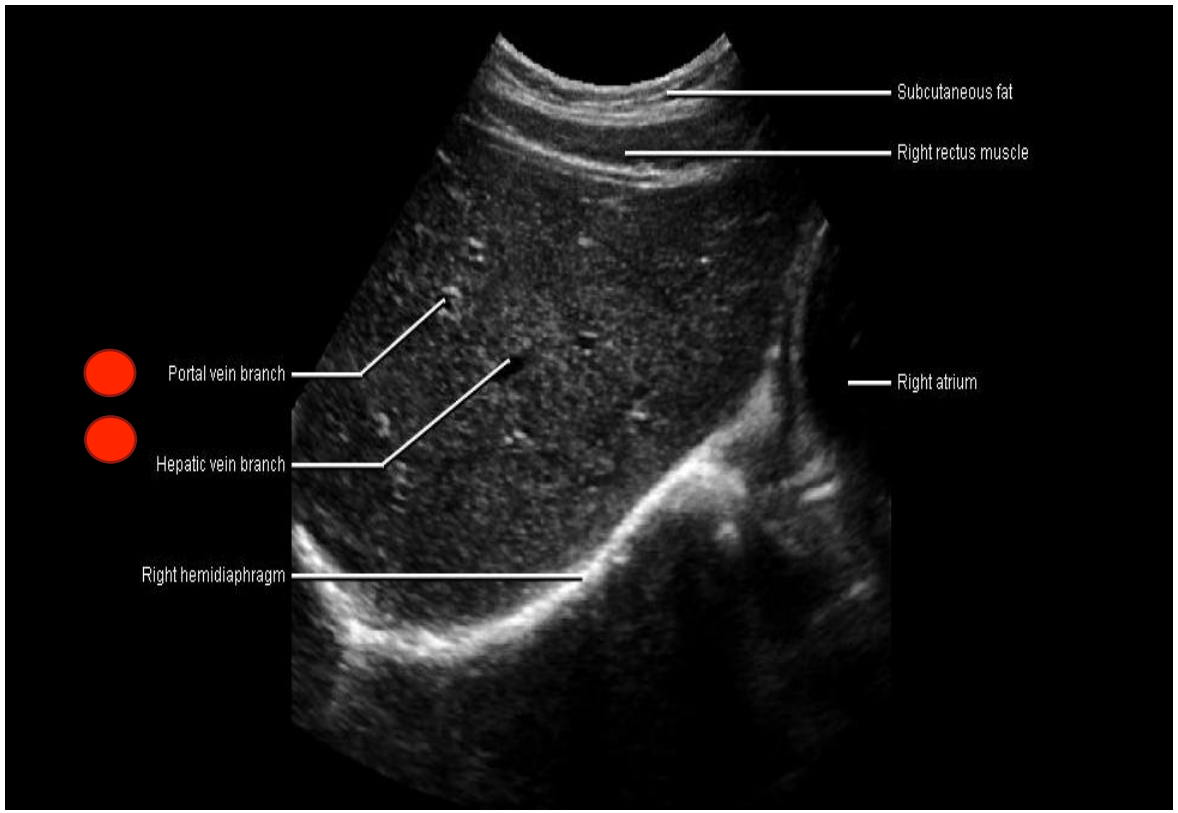






doctor said: I don't think it is important to know the segments but at least separate it according to hepatic veins as a land mark .

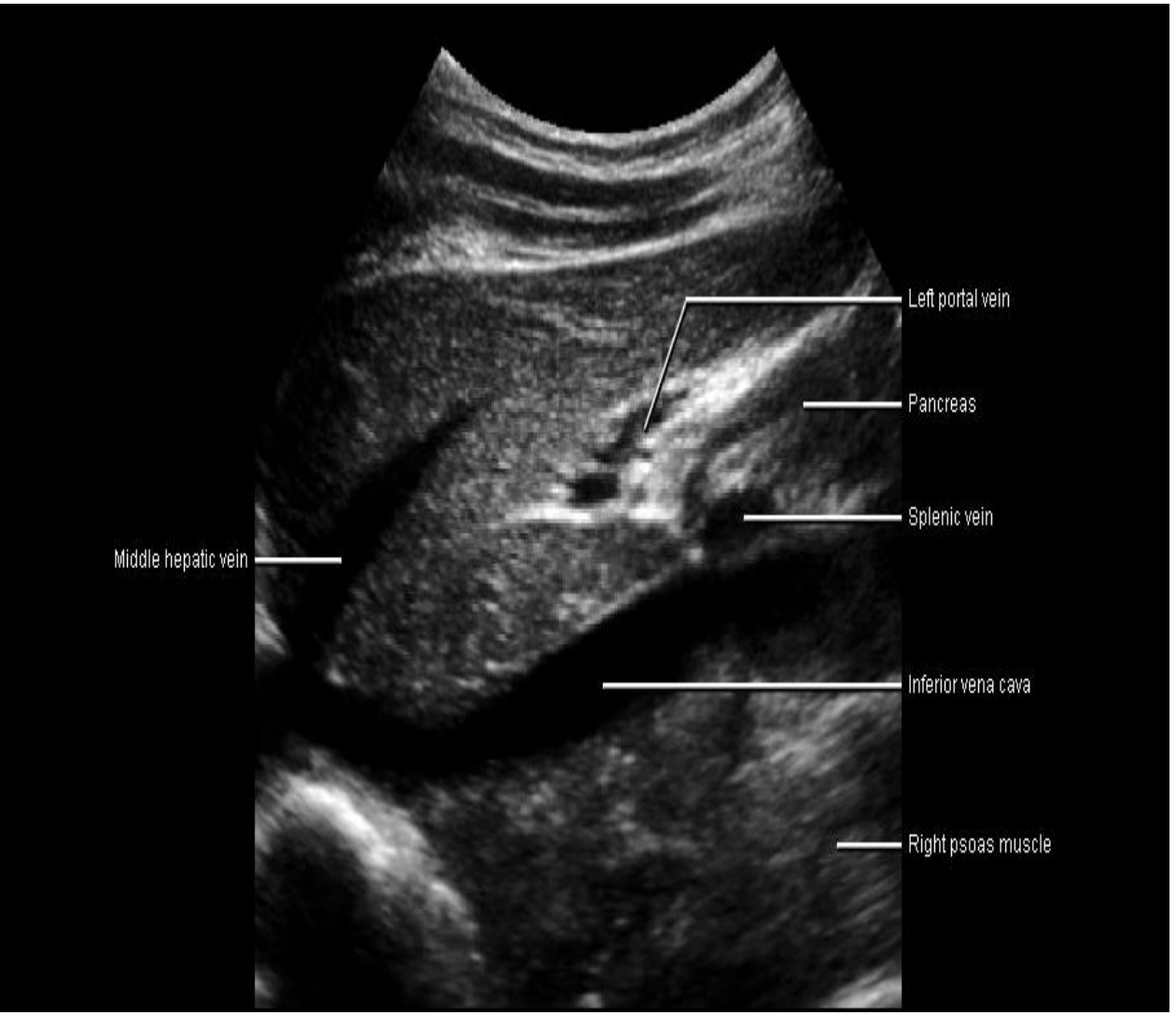


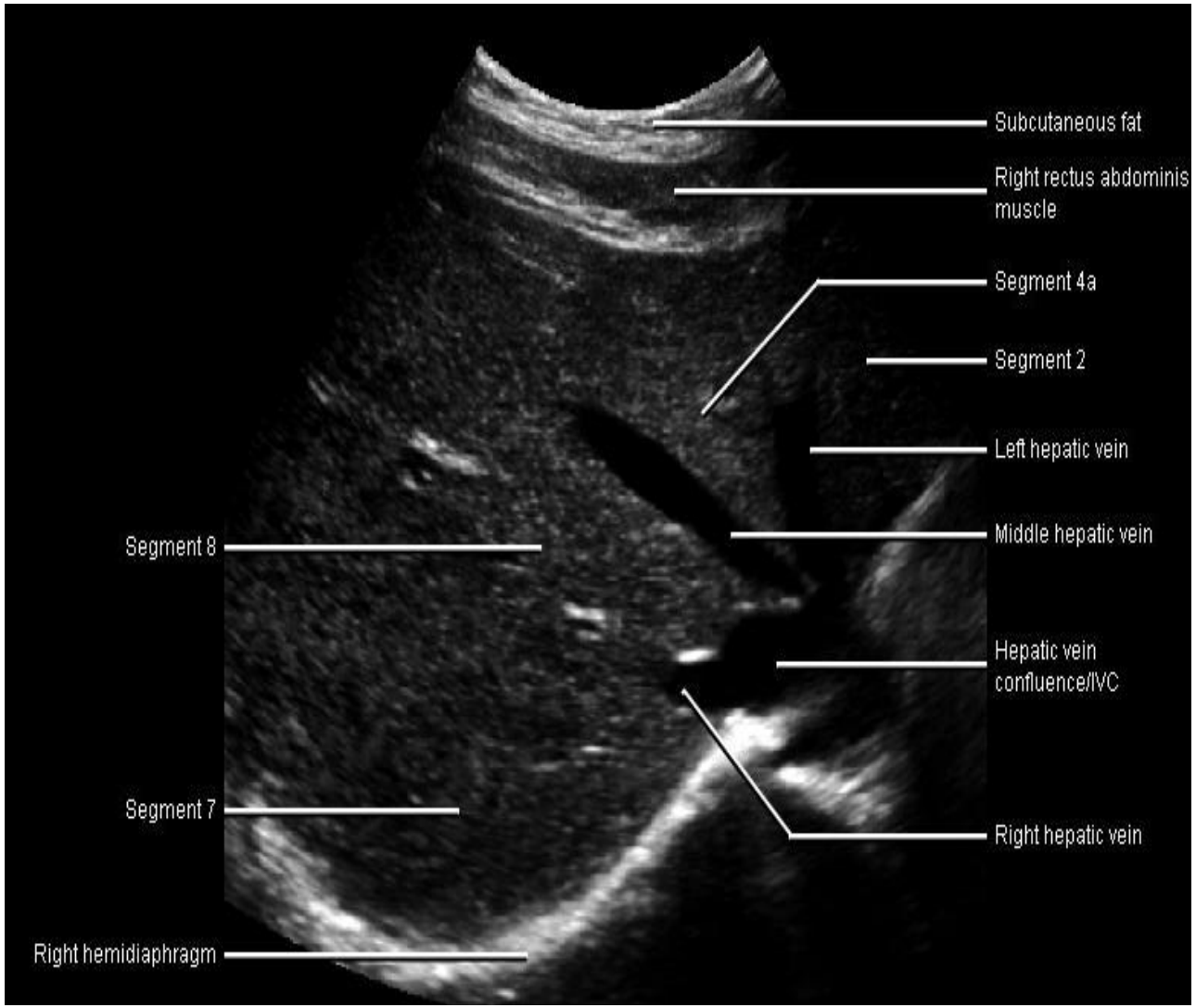


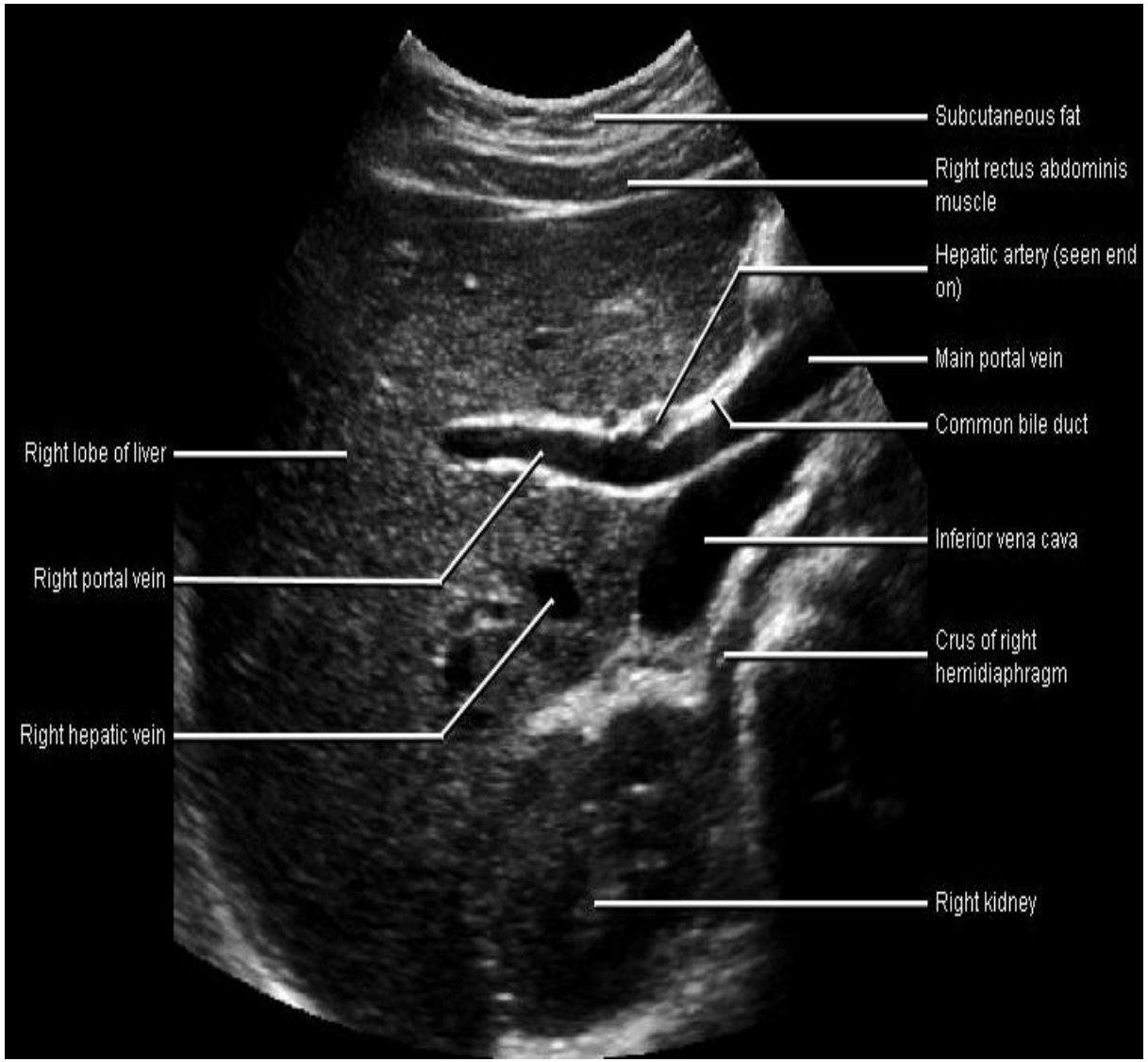
bile ducts and portal radicals they are together and hepatic veins have other pathway

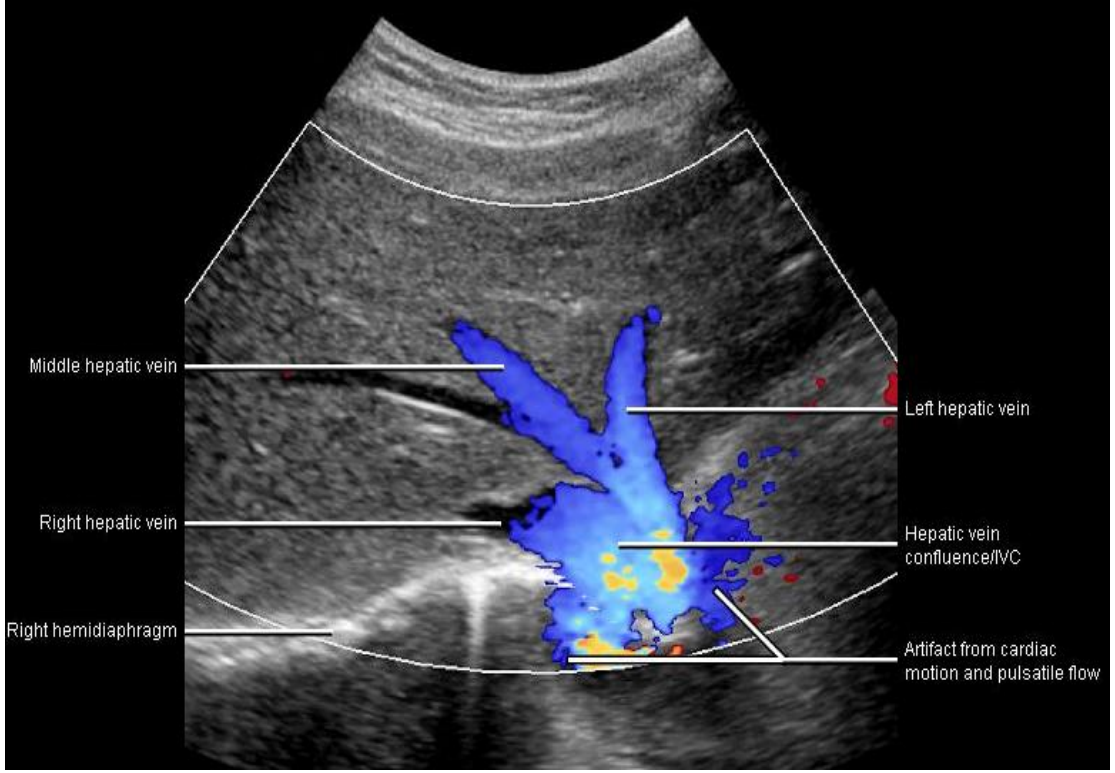
Remember:
In ultrasound :
black = fluid
grey=tissue
bright = fat or fibrous (ABNORMAL)

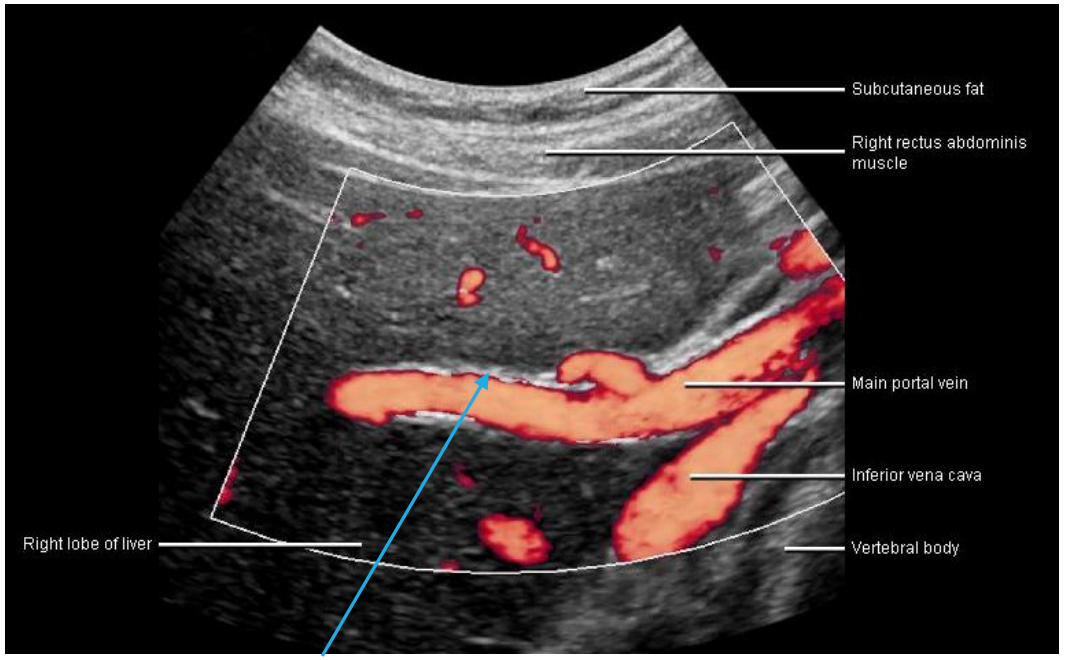
- The portal vein is surrounded by an Echogenic (bright) line and bloody flow , while the hepatic vein is anechoic (no bright shadow surrounding it).
- if it has a bright wall it can be a portal or bile duct , so we will do colour doppler to differentiate between both


Left portal vein
Pancreas
Splenic vein
Middle hepatic vein
Inferior vena cava
Right psoas muscle

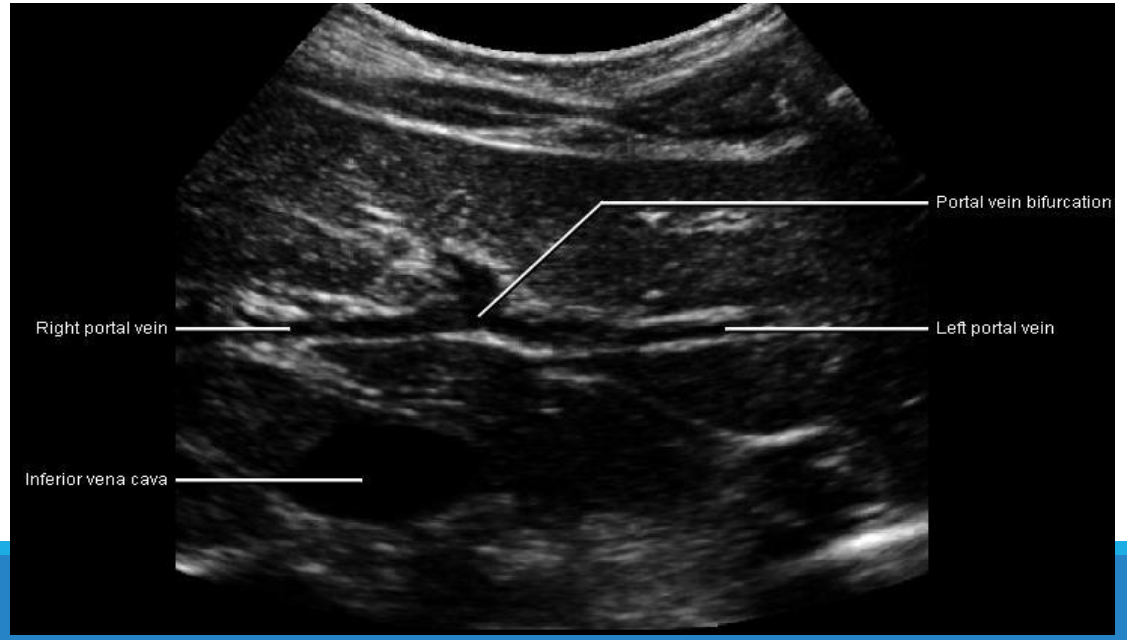

Subcutaneous fat
Right rectus abdominis muscle
Segment 4a
Segment 2
Left hepatic vein
Segment 8
Middle hepatic vein
Hepatic vein confluence/IVC
Segment 7
Right hepatic vein
Right hemidiaphragm

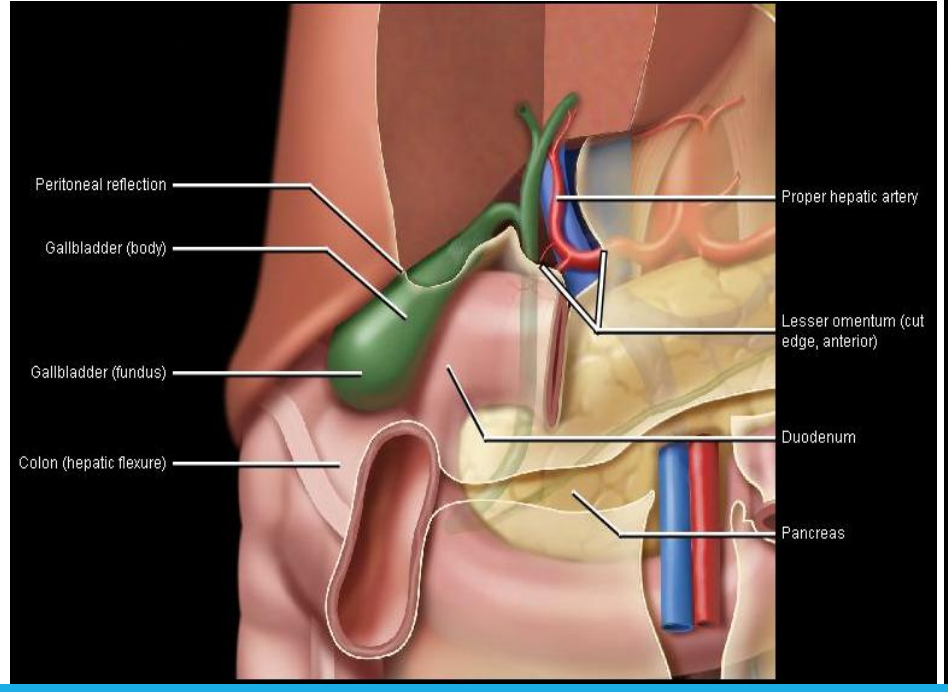

Subcutaneous fat
Right rectus abdominis muscle
Hepatic artery (seen end on)
Main portal vein
Common bile duct
Right lobe of liver
Inferior vena cava
Right portal vein
Crus of right hemidiaphragm
Right hepatic vein
Right kidney

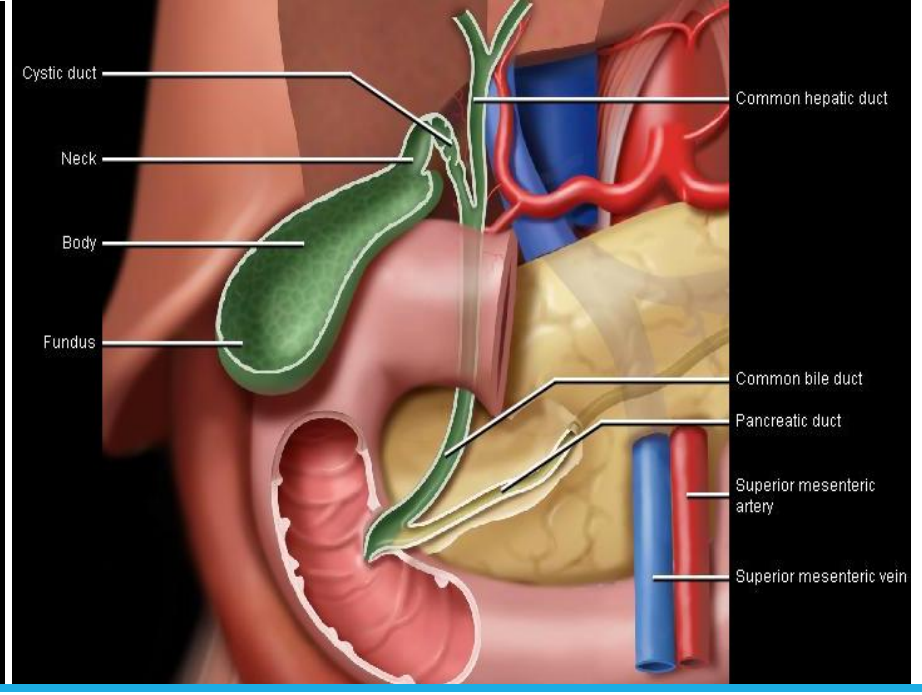




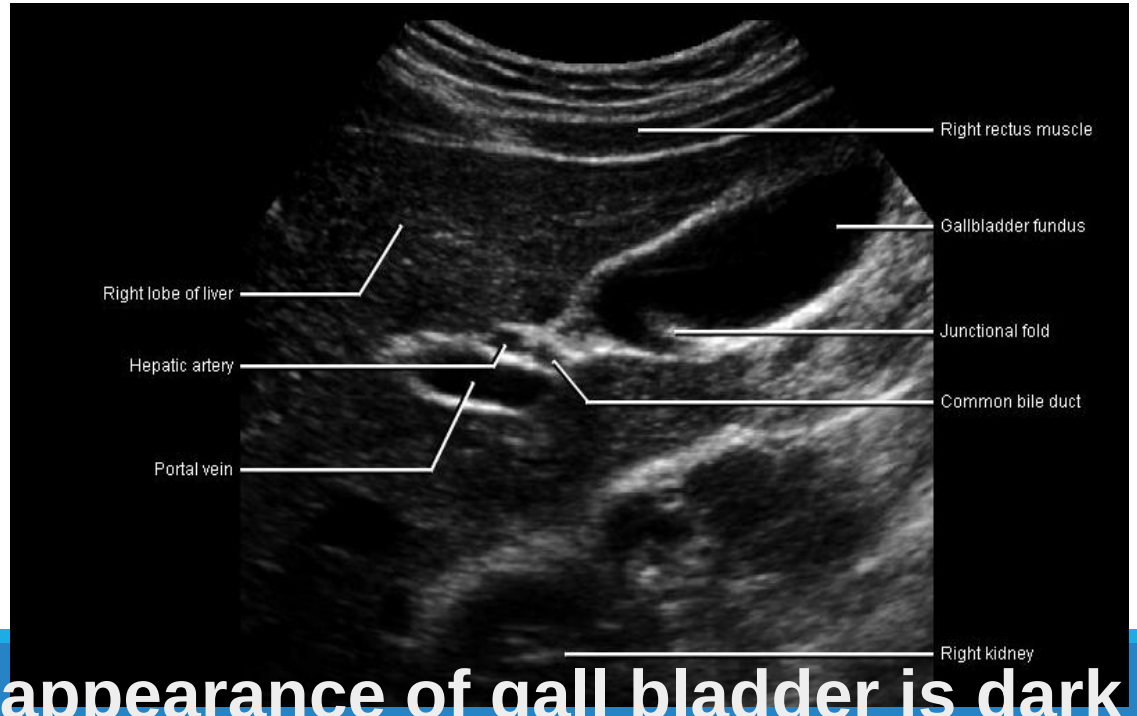
The portal vein is a landmark for the hepatic artery and the common bile duct, when we want to see the hepatic artery or the common bile duct we put a colour (to show blood flow) in the portal vein since it is the largest among them.







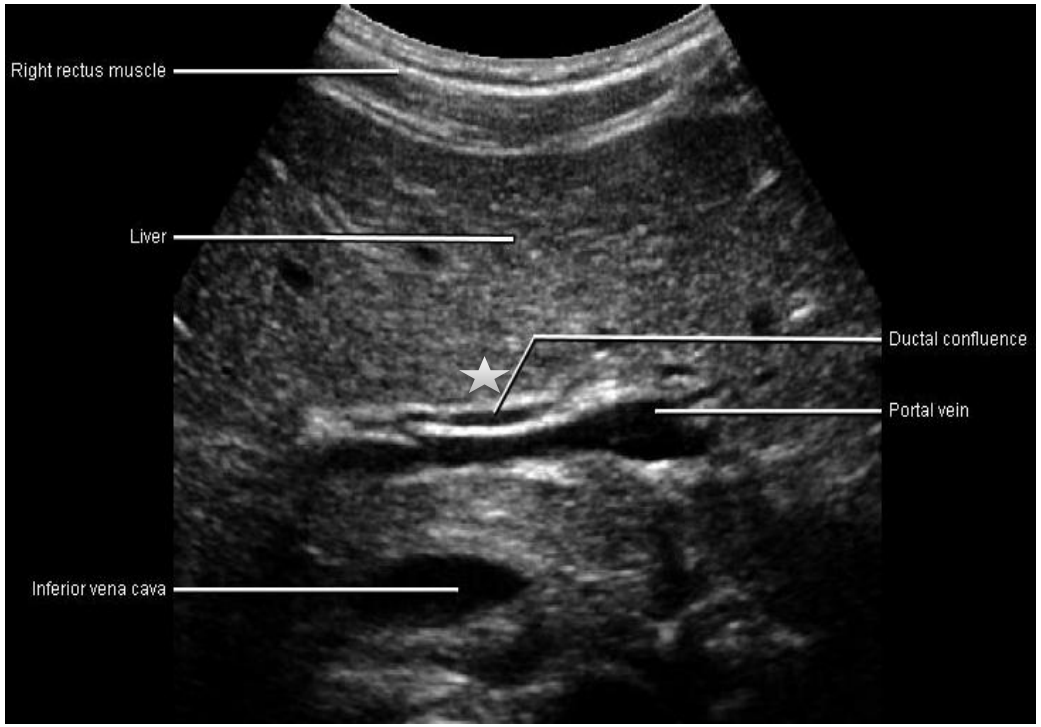
Junctional fold: an echogenic line inside the gallbladder which can be seen normally in some cases.

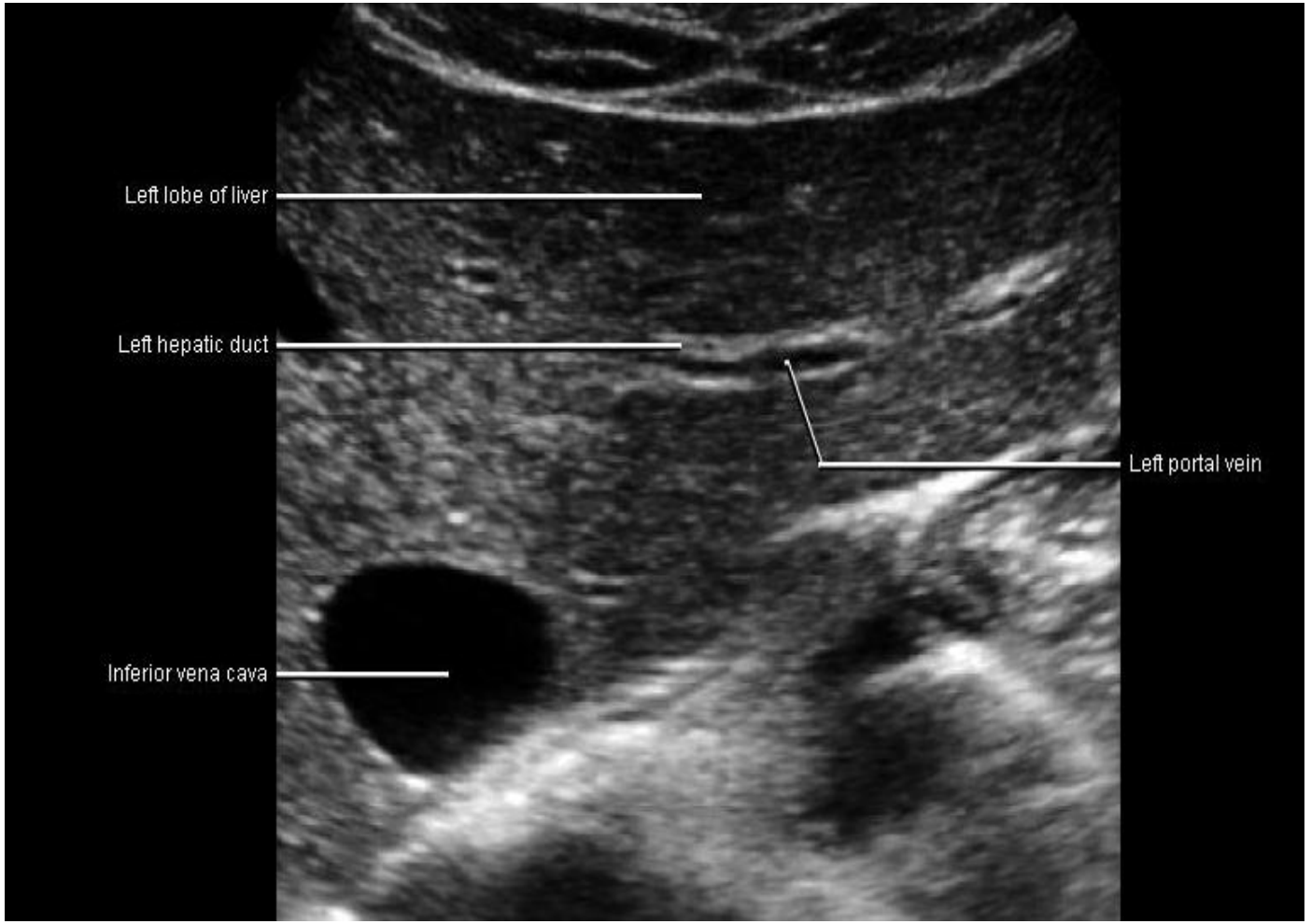


we have to look to the wall of the gallbladder it is fibrous and bright normal is up to 3 mm if it is more than 4 mm consider abnormal . thickness of the gall bladder very important it indicates Cholecystitis

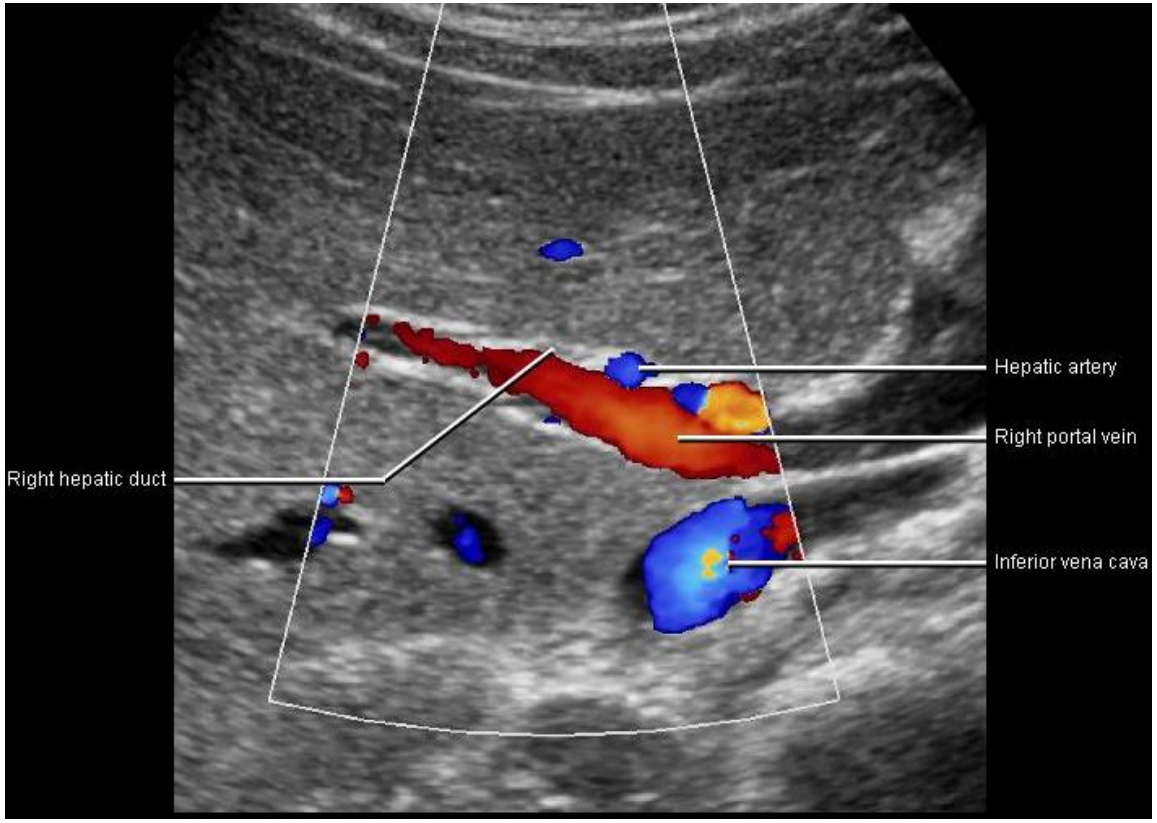
and it is important to see the surrounded area should be liver tissue no edema or fluid

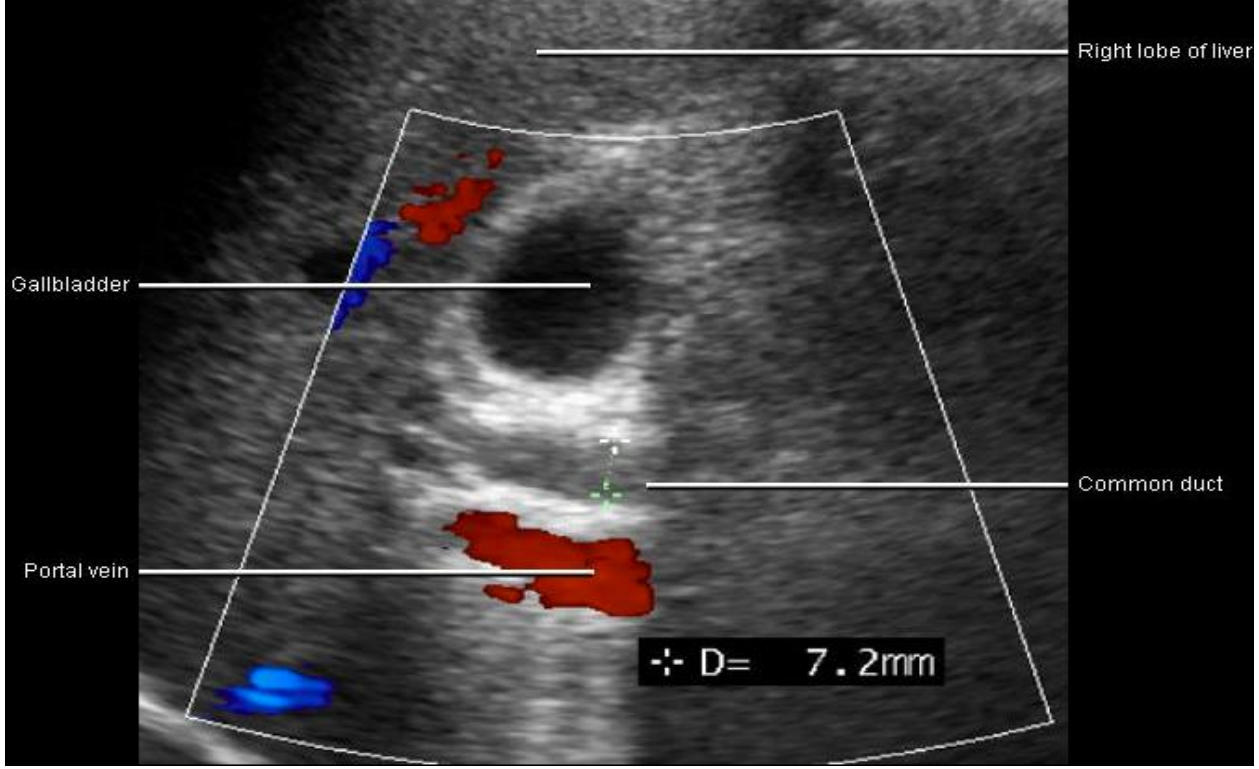
Normal appearance of gall bladder is dark due to fluid filling it





❖(to know the common bile duct the land mark is portal vein so it locate anterior to it)





- **Gallbladder is dark because it fill with fluid and you have to see whether something inside the fluid (mass ,polyp, stones .normal thick of bile duct is up to 4 - 5 mm sometime in elderly patient or post cholecystectomy. If there's any "pathology" like obstruction, the common bile duct could appear even bigger than the portal vein reach 7 mm ,but if it exceed 7 mm consider abnormal (such as who underwent endoscopy).**
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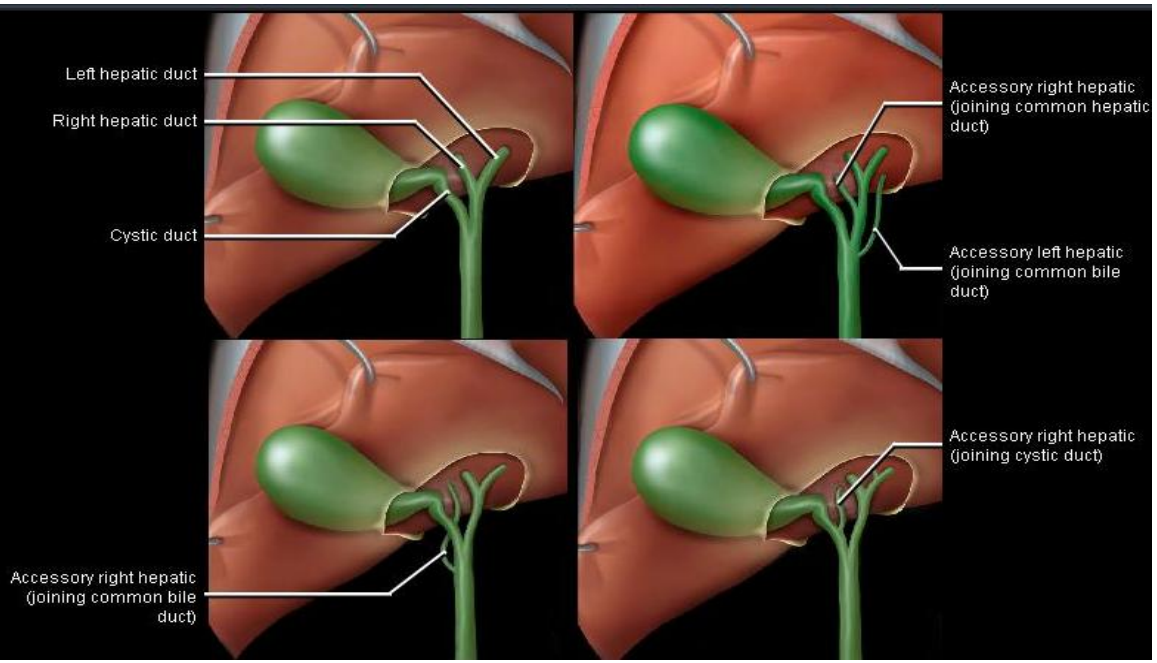
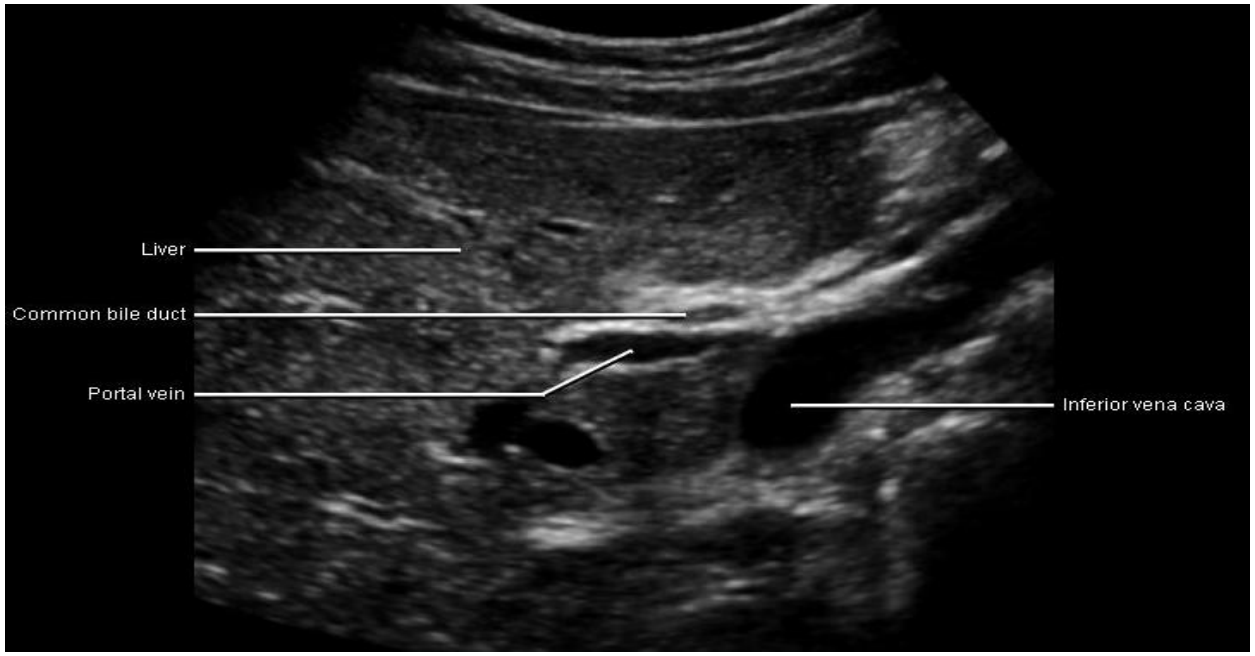




Gallbladder: anechoic structure (sac) with a bright wall .
Cystic duct: drains into the common bile duct .
Portal vein: posterior to common bile duct and hepatic artery .
The best modality to see billiary stone is ultrasound

CT- scan

What is CT Scanning

CT scanning—sometimes called CAT scanning—is a noninvasive, painless medical test that helps physicians diagnose and treat medical conditions.

CT imaging uses special x-ray equipment to produce multiple images or pictures of the inside of the body and a computer to join them together in cross-sectional views of the area being studied. The images can then be examined on a computer monitor or printed.

CT scans of internal organs, bone, soft tissue and blood vessels provide greater clarity than conventional x-ray exams.

Advantages:

Available.
Short scan time.
Much more soft tissue and bone details.
Excellent in diagnosing extra-luminal lesions.
Excellent in diagnosing the cause of bowel obstruction.

Disadvantages:

Radiation.
Some times need intra venous contrast (renal disease).
Relatively expensive.

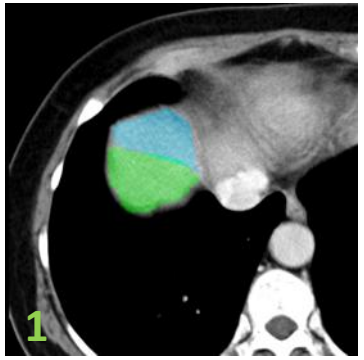
Indications:

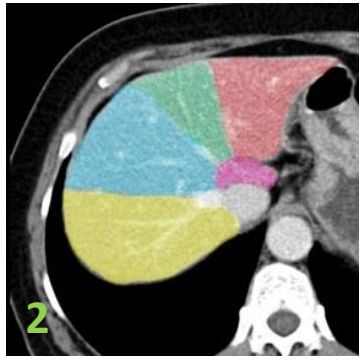
Abdominal pain.
To look for bowel obstruction cause.
To diagnose intra-abdominal masses.
Trauma.

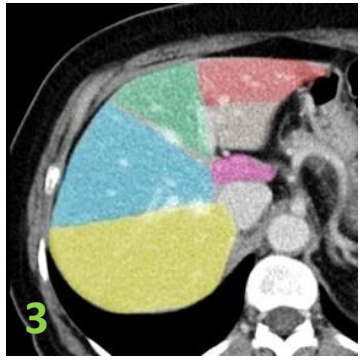
Contraindications:

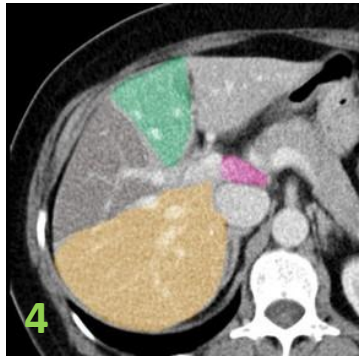
Pregnancy.
No IV contrast in renal failure.
Unstable patients (severe trauma/ICU).

Segmental liver anatomy CT-scan

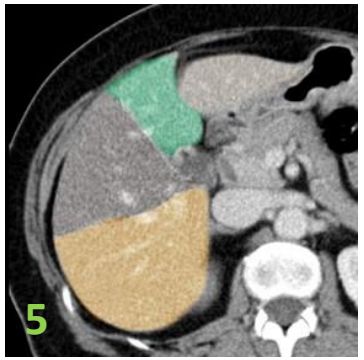


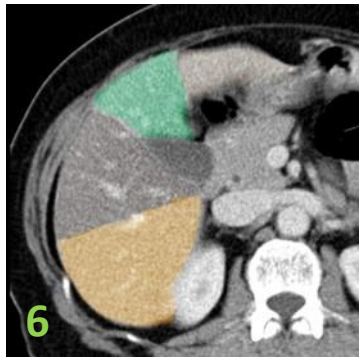


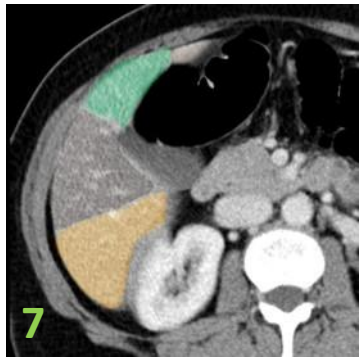




1 to 4 is the level of superior segments and the land mark is IVC.

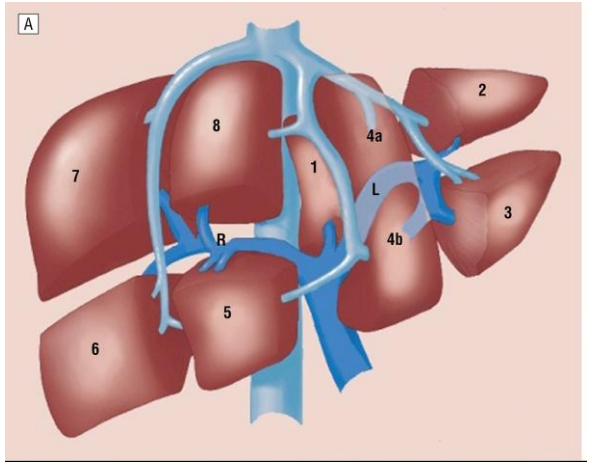


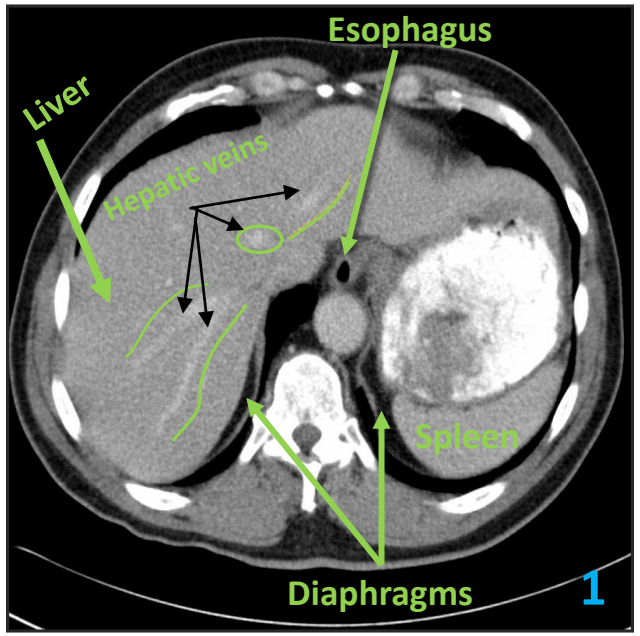


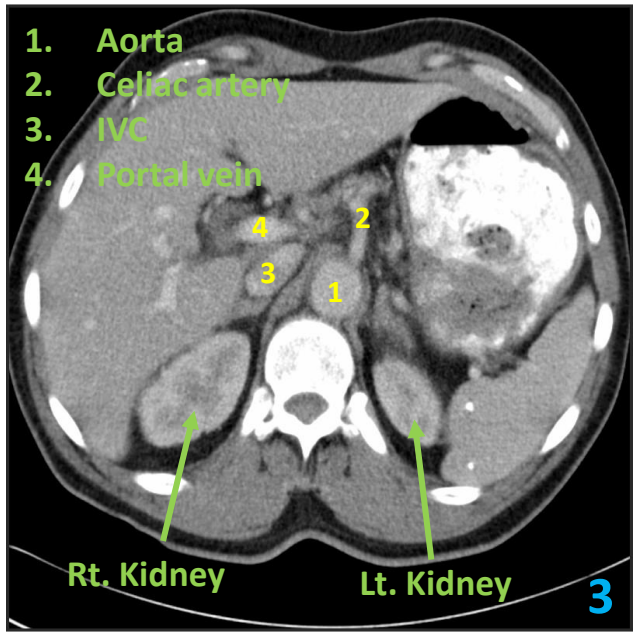


5 to 8 is the level of inferior segments and the land mark is splenic vein.

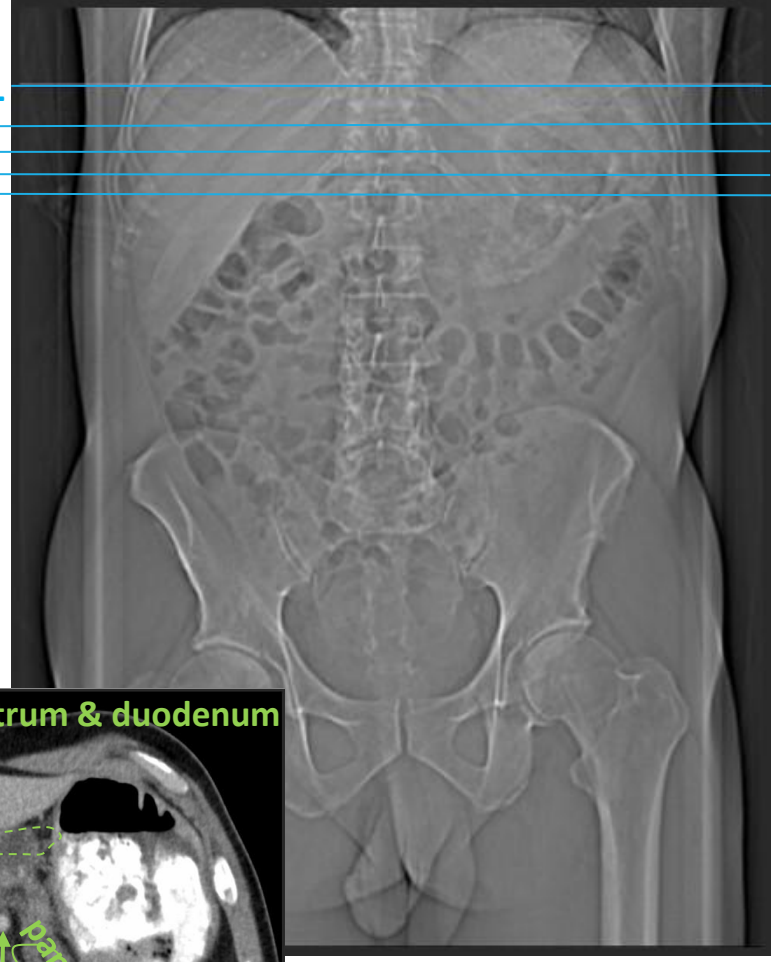
Liver is divided to right and left lobes by a line along the gallbladder and IVC.
Right lobe divided into anterior and posterior segments
Left lobe is divided into lateral and medial segments by ligamentum teres.
Each of the four segments is subdivided into 2 subsegments → 8 segments → 4superior & 4 inferior segments. In addition to central segment.



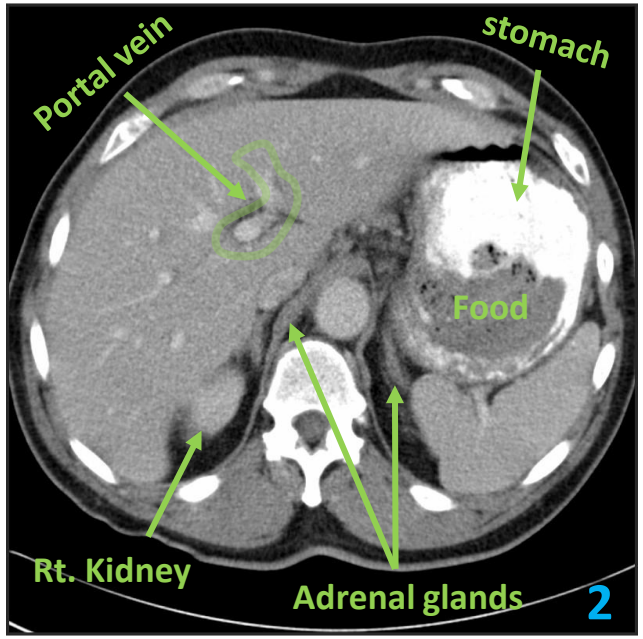


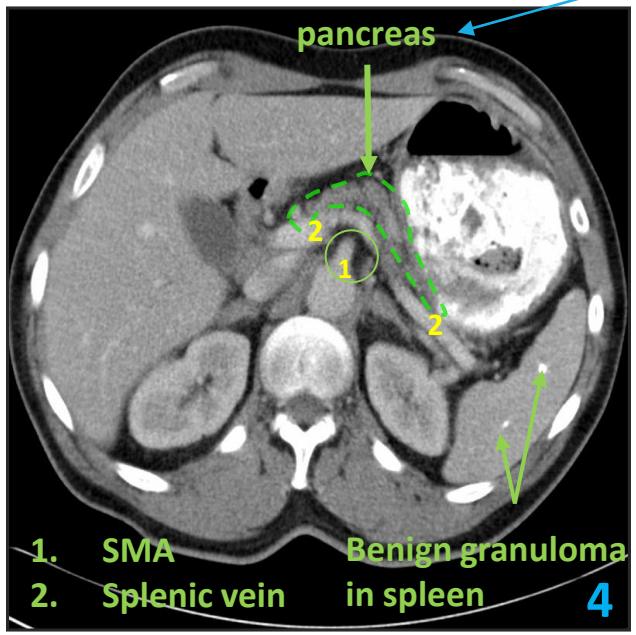


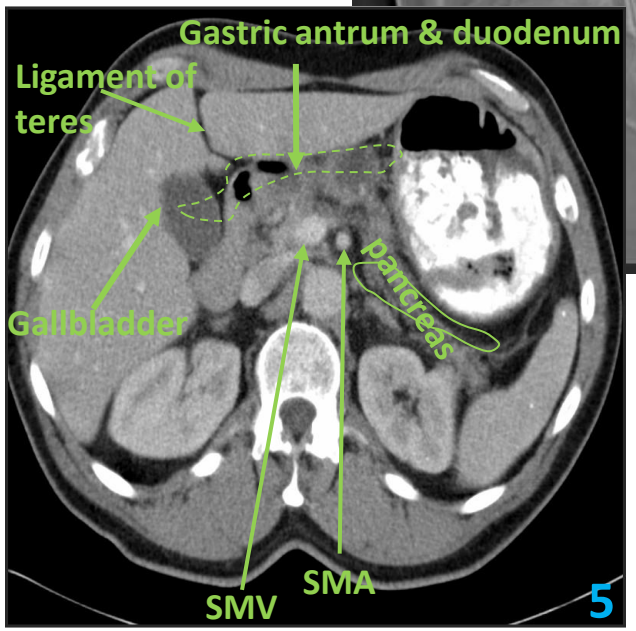
Scan level 1 2 3 4 5



The land mark of pancreas is splenic vein







How to differentiate between hepatic and portal vein in CT ?

- Hepatic vein going to IVC while portal vein coming from hepatic helium going to liver

MRI

What Is MRI ?

. The system includes a magnet, RF coils (Transmitter and receiver), gradient coils, and a computer display unit with digital storage facilities.
. The images displayed may have a low signal intensity, intermediate signal intensity, or high signal intensity.

Advantages:

- Relatively safe in pregnancy (no radiation).
- Give much more soft tissue details.
- Excellent in diagnosing abdominal solid organ lesion: liver, spleen, kidneys.

Disadvantages:

- Expensive.
- Long scanning time.
- Sensitive to motion.

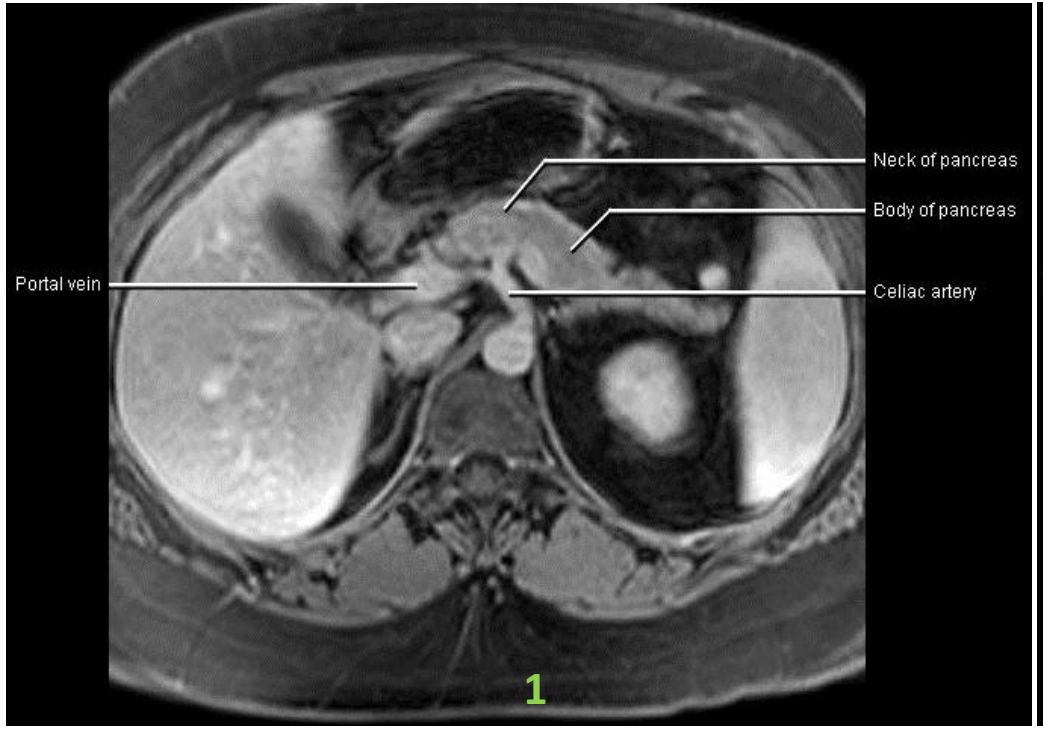
Indications:

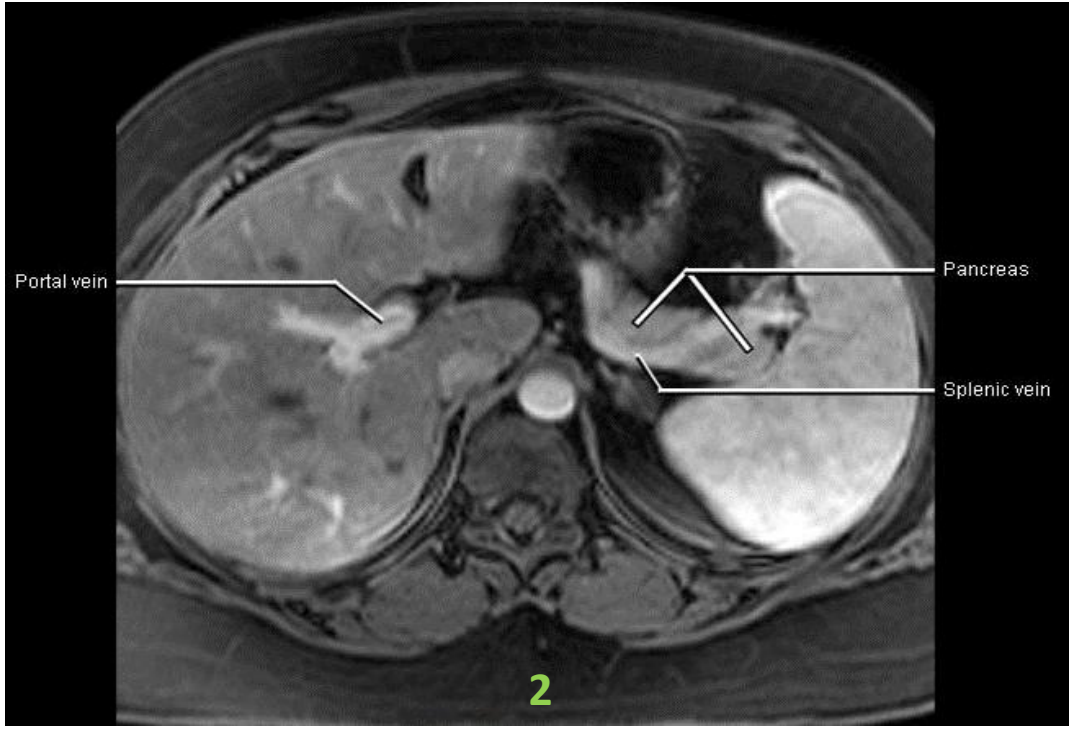
- Abdominal solid organ masses.
- Inflammatory bowel disease.

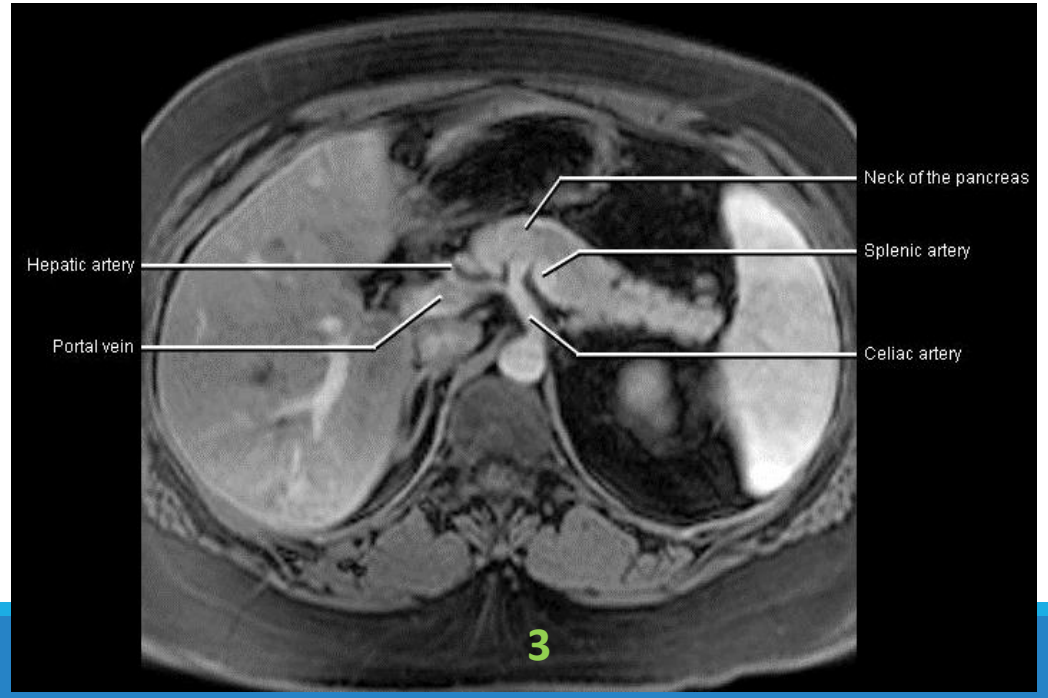
Contraindications:

- uncooperative patients.
- Early pregnancy (relative contraindication).
- No IV contrast renal failure (relative contraindication).

MRI

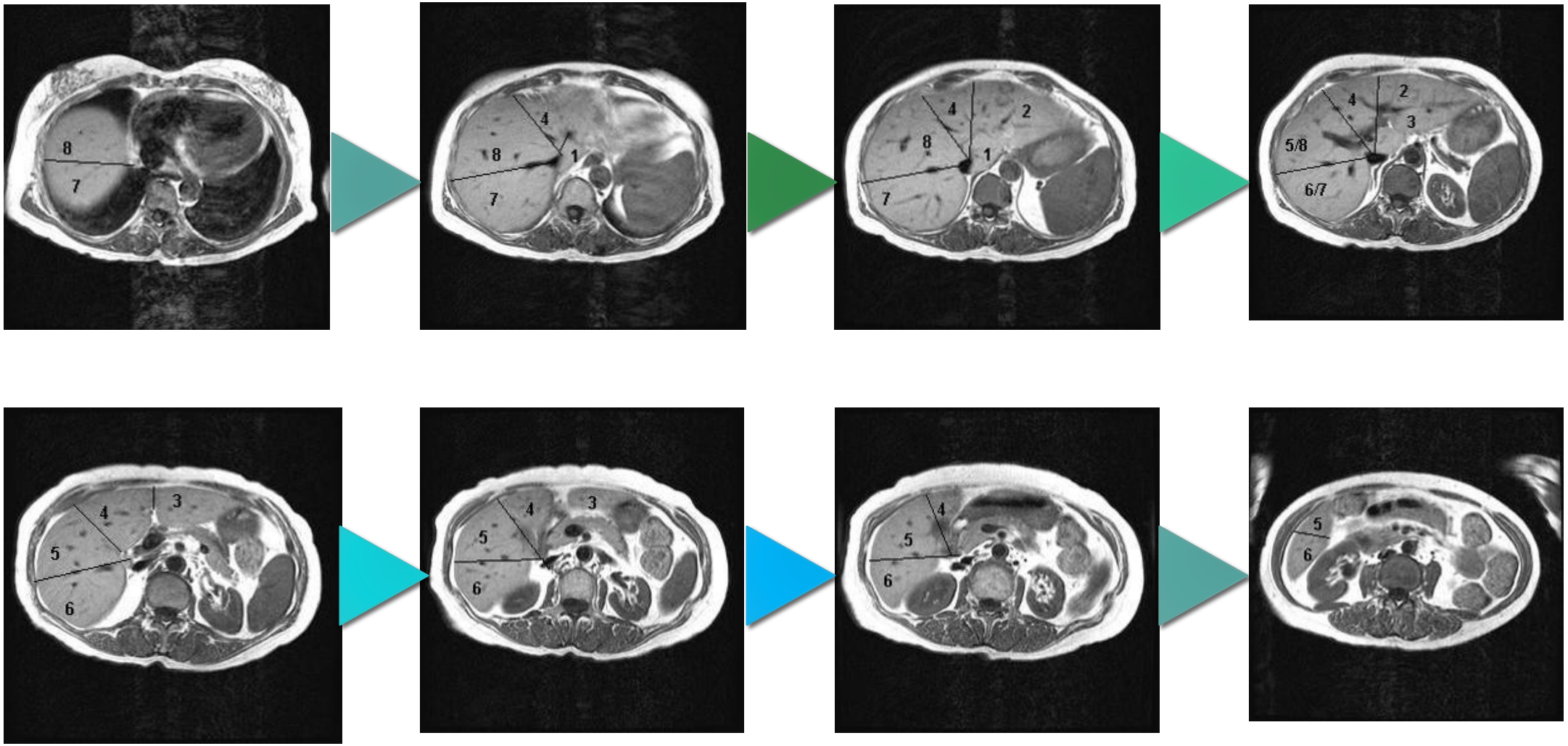

Neck of pancreas
Body of pancreas
Portal vein
Celiac artery
1


Portal vein
Pancreas
Splenic vein
2


Neck of the pancreas
Hepatic artery
Splenic artery
Portal vein
Celiac artery
3


Parcreatic duct
Superior mesenteric vein
Common bile duct
Superior mesenteric artery
Duodenum
Uncinate process
4

Segmental Liver Anatomy- MRI



Biliary Tract Anatomy:

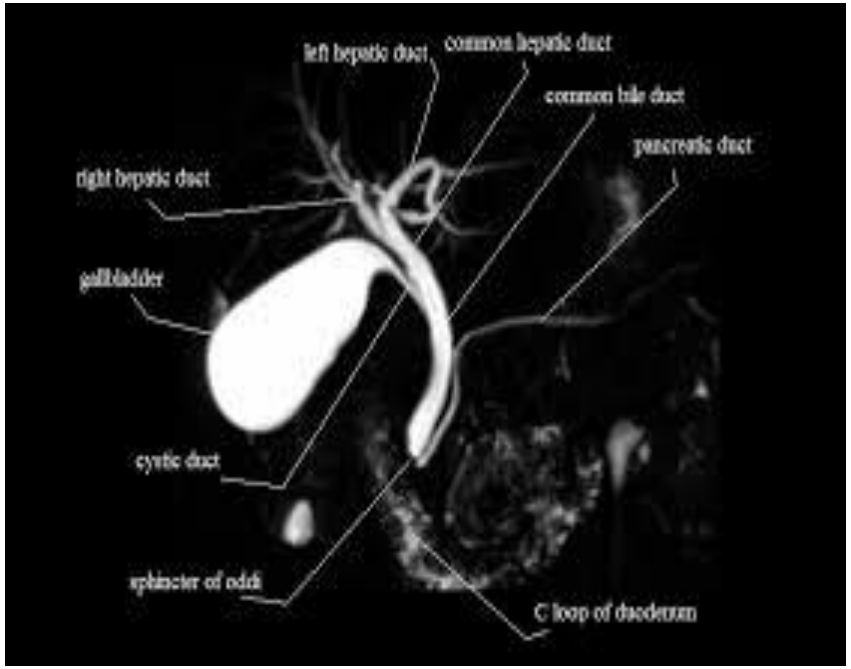
- **The right and left main hepatic ducts fuse at the hilum, anterior to the bifurcation of the portal vein, to form the common hepatic duct. The main bile duct is divided into two segments: the common hepatic duct and common bile duct, divided by the cystic duct insertion.**
- **The left hepatic duct drains 3 segments of the left liver, and the right hepatic duct 4 segments of the right liver. The right hepatic duct arises from the union of two main sectorial ducts: an anterior division draining segments 5 and 8 and a posterior division draining 6 and 7.**
- **The caudate lobe (segment 1) has a variable drainage pattern, but in the majority (78%) drainage is into both main ducts.**
- **The common bile duct passes inferiorly posterior to the first part of the duodenum and pancreatic head. In the majority it then forms a short common channel with the**
- **main pancreatic duct within the wall of the duodenum, termed the ampulla of Vatar.**

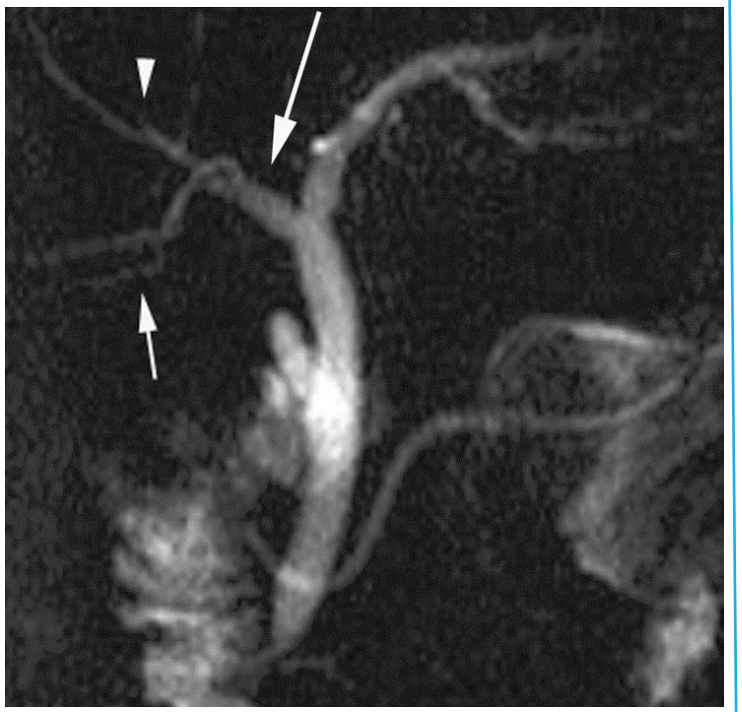
- **The common bile duct:**
  - **length - 5-15cm depending on the level of the cystic duct insertion.**
  - **diameter - up to 6mm, in elderly 8mm, after cholecystectomy up to 10mm.**

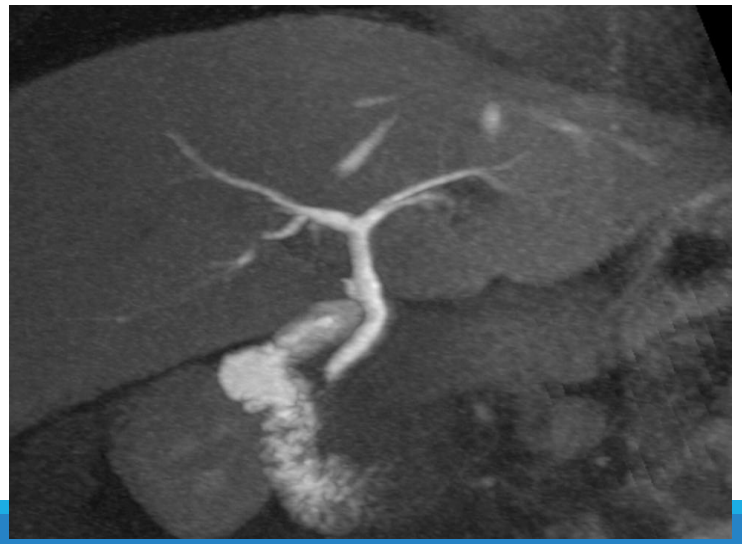
- **Gallbladder - a bile reservoir, lies in the cystic fossa**
- **The cystic duct - length 2-4cm, diameter 1-5mm, joins the common hepatic duct in its supra duodenal segment, half the way between the liver hilum and ampulla of Vatar.**

- **(cystic duct):**
  - **US, CT- visible in 50% of cases**
  - **MRCP- almost always visible**

Biliary tree

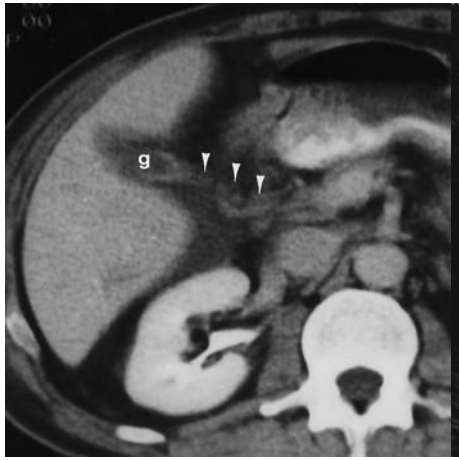


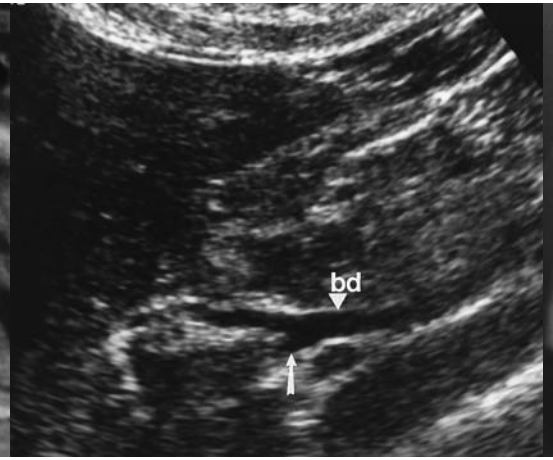


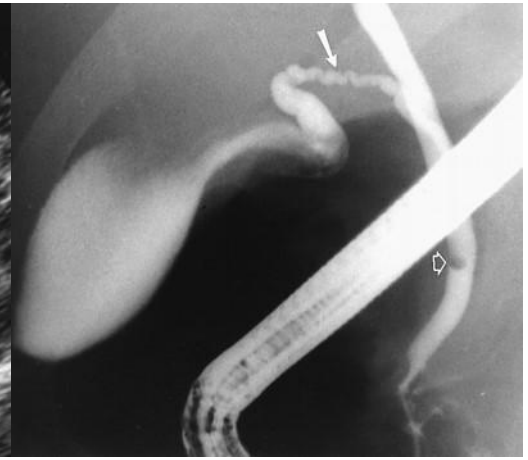


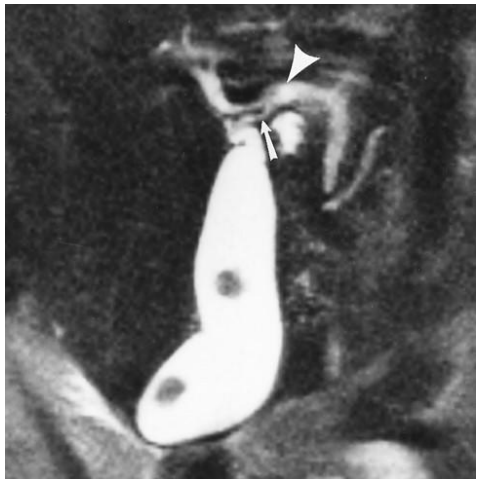
Common bile duct

Cystic Duct

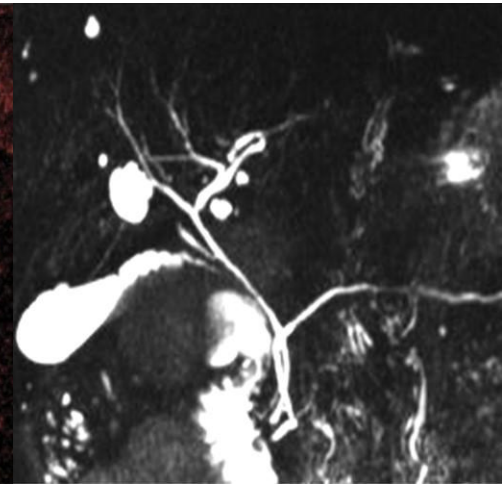


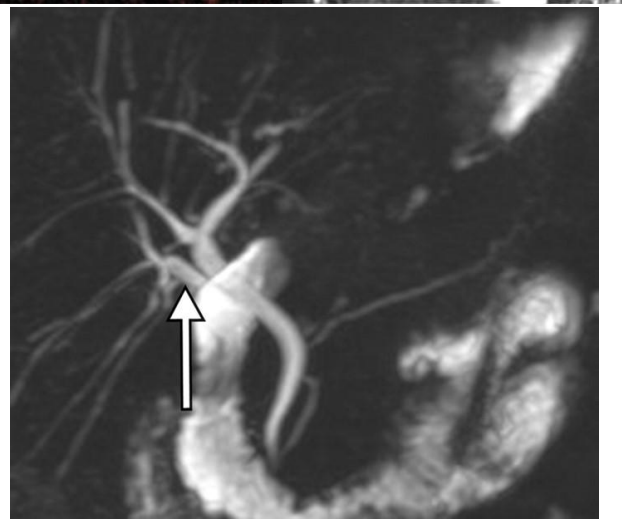






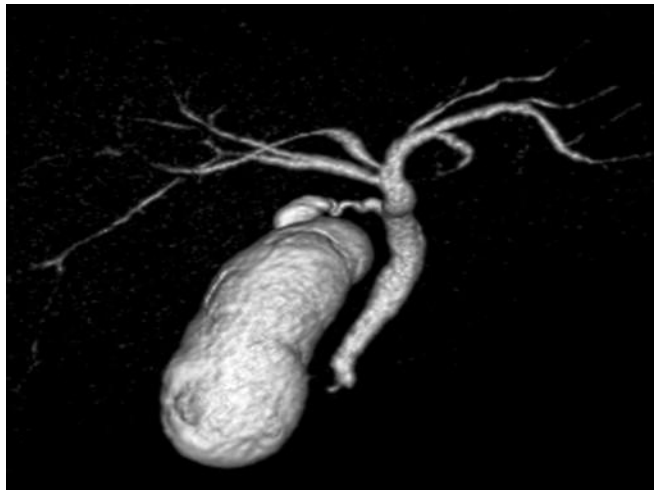
MRCP (magnetic resonance chlangiopancreatography)

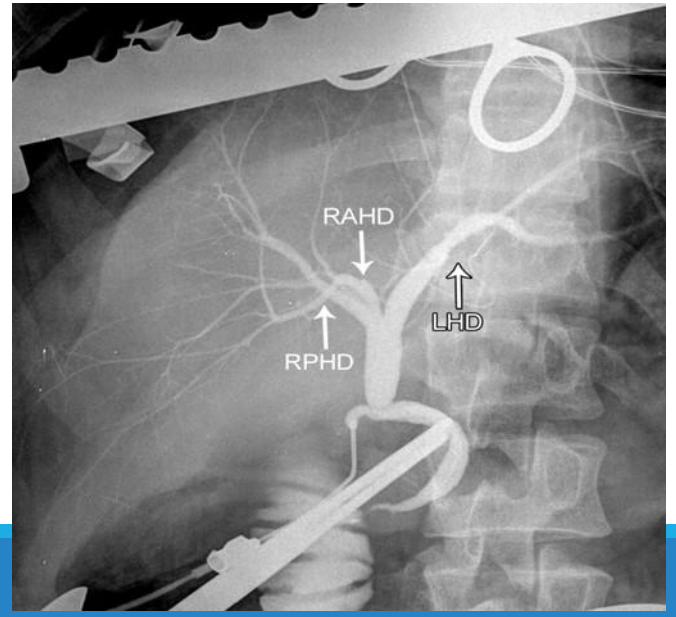




Developmental Anomalies Of Biliary Tract Anatomy

Insertion of right posterior sectoral duct into left hepatic duct

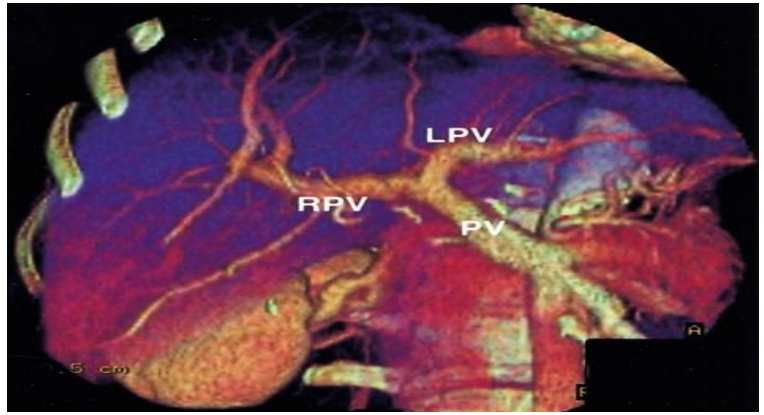


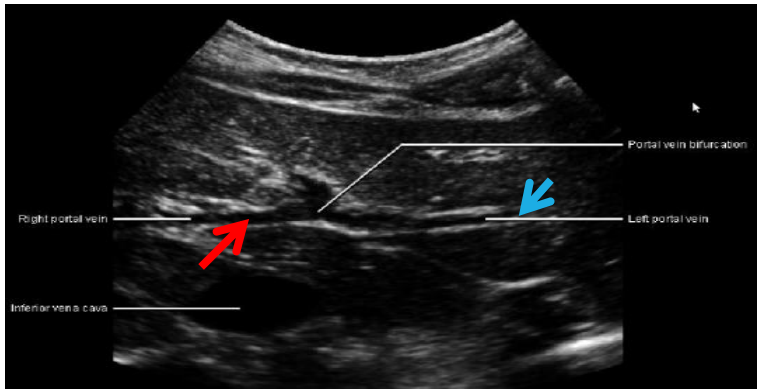


Liver vascular supply

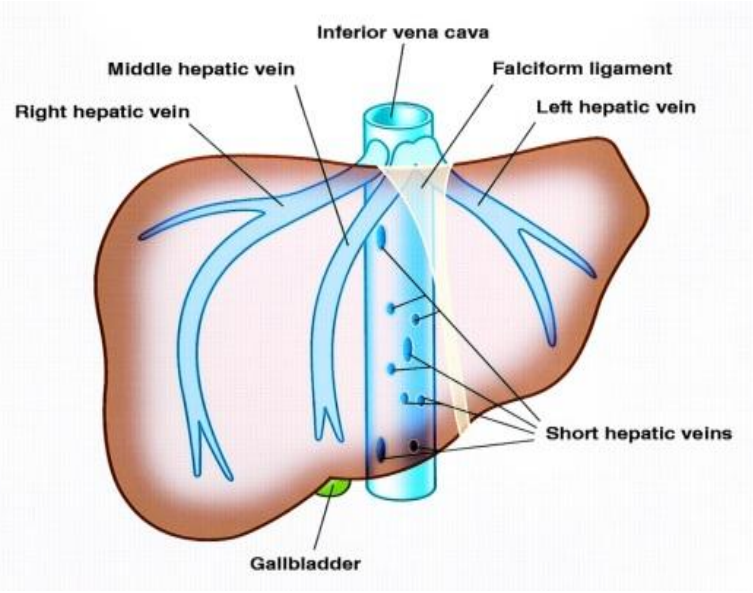
Portal supply

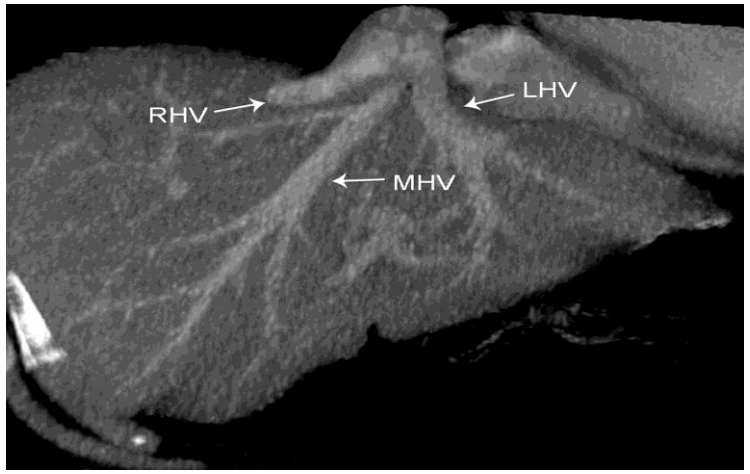
The liver receives app. 2/3 of its blood supply from the portal vein.
Normally the superior mesenteric vein and splenic vein become confluent to form a single portal vein, which courses to the hepatic hilum and divides into the right end left branch.
Portal vein lenght – 6-7cm, diameter 6-13mm





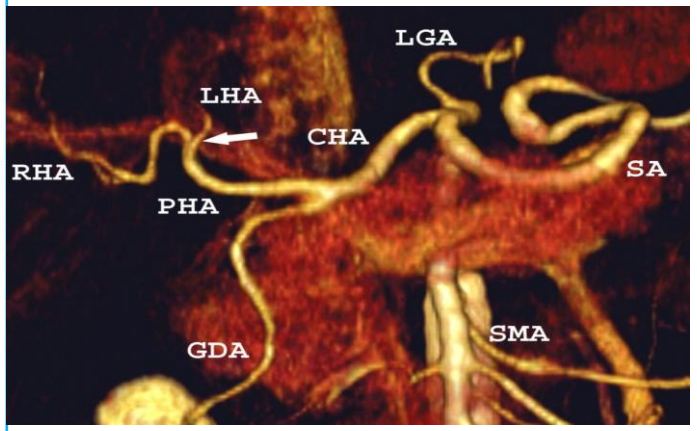
Venous outflow – three major hepatic veins drain into the IVC

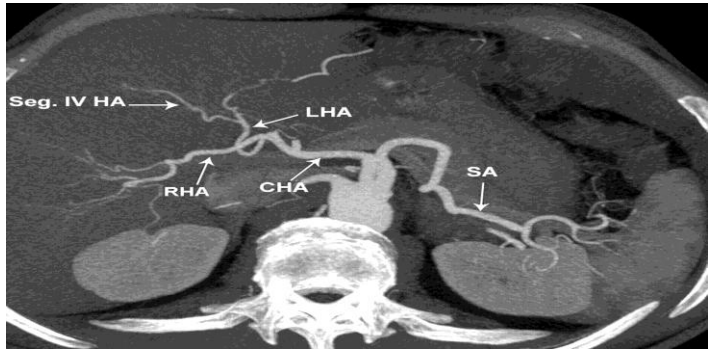




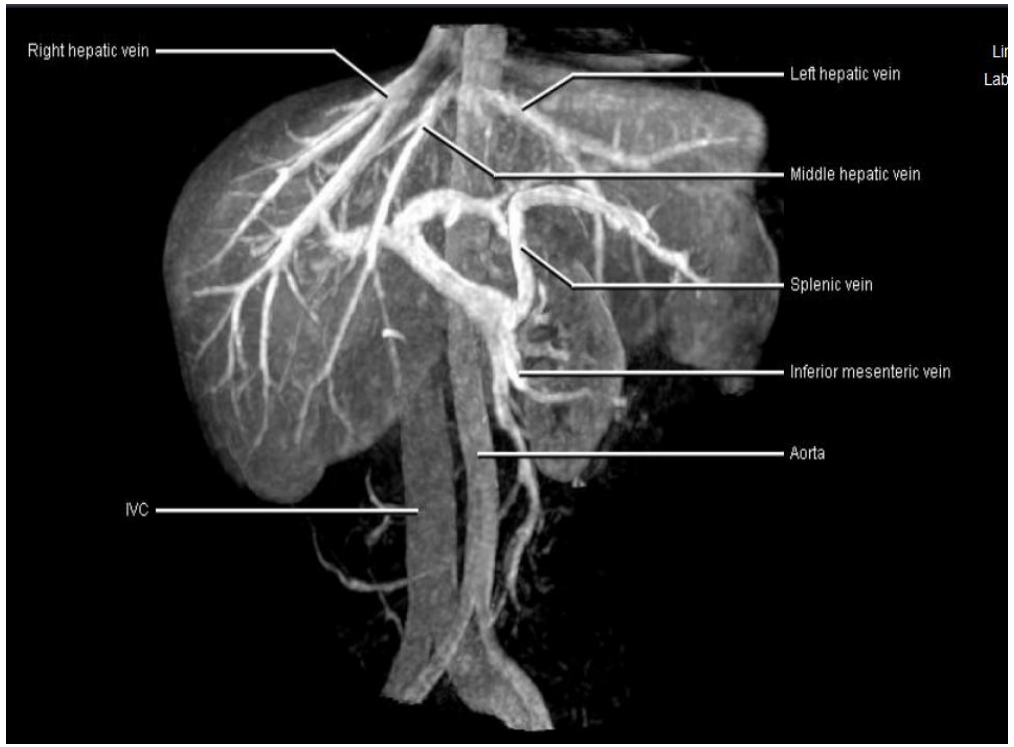
•Arterial supply – hepatic artery proper (20% of blood supply).

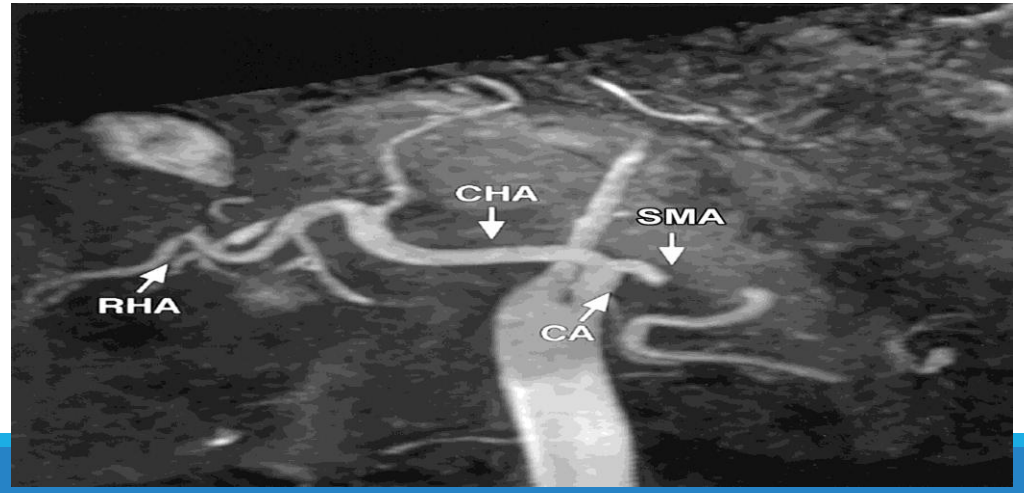
•The usual arterial arrangement is for the common hepatic artery to arise as one of the three major branches of the coeliac trunk. After giving off the gastroduodenal artery , it continues as the main hepatic artery, which in turns divides into the right and left hepatic arteries.

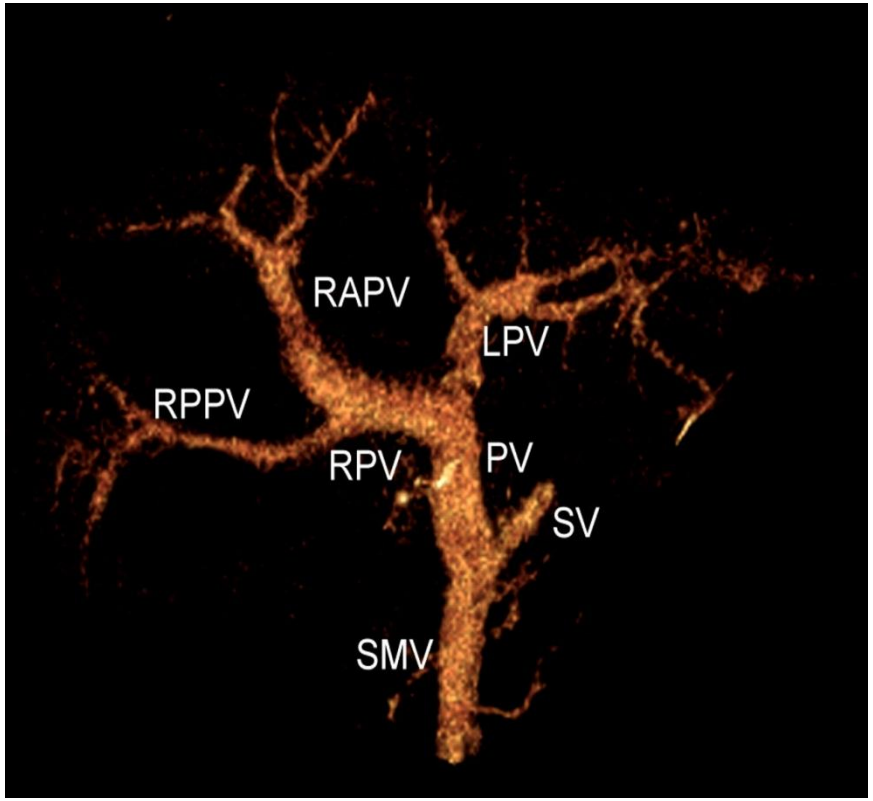




Liver vascular supply





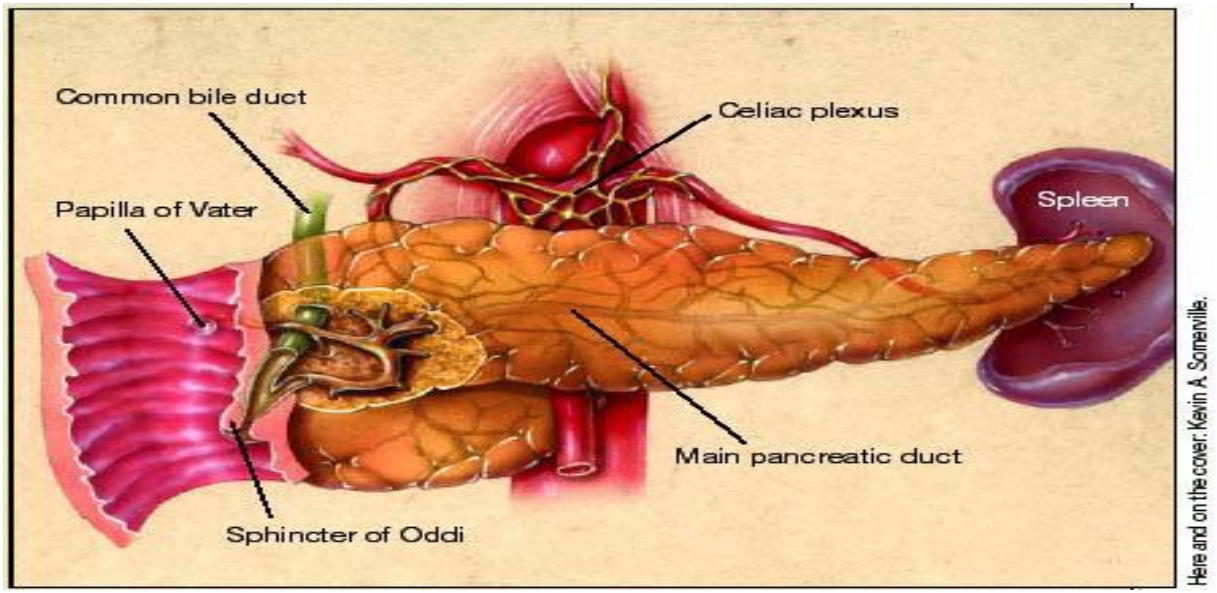


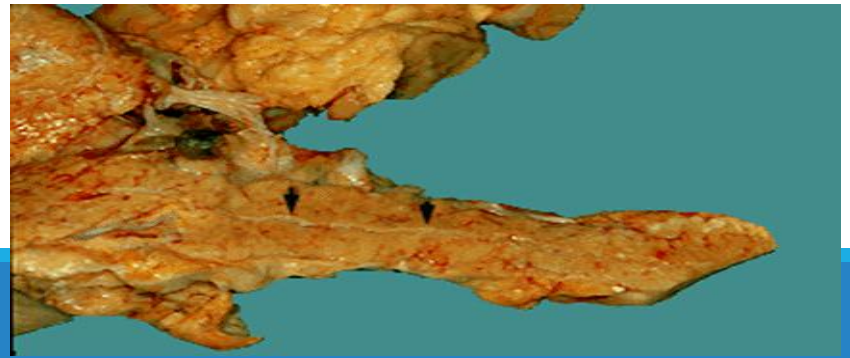
SMV: superior mesenteric vein
PV: portal vein
RPV: right portal vein
LPV: left portal vein
RAPV: right anterior portal vein
RPPV: right posterior portal vein
CHA: common hepatic artery
RHA: right hepatic artery
SMA: Superior mesenteric artery

Normal Anatomy of the Pancreas

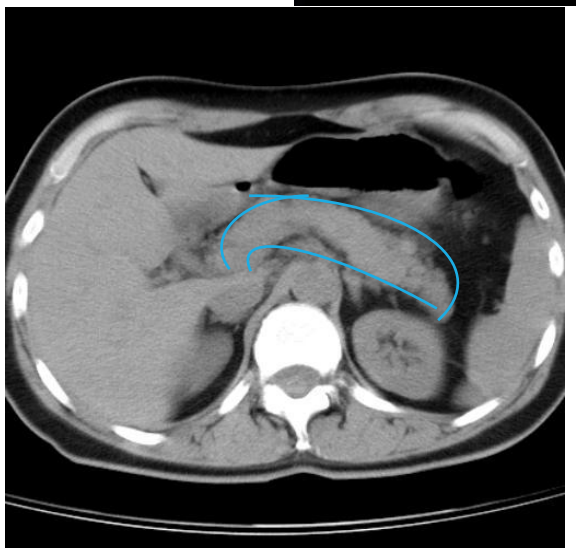
•The pancreas is a retroperitoneal organ and is positioned in the anterior pararenal space. It is posterior to the stomach and lesser sac and anterior to the abdominal aorta and upper lumbar vertebrae.

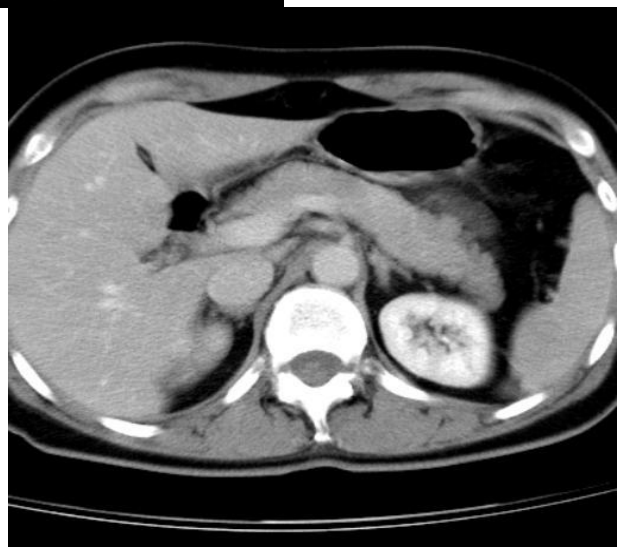
•PANCREAS IS ANTERIOR TOSPLENIC VIEN





Pancreas on CT SCAN:

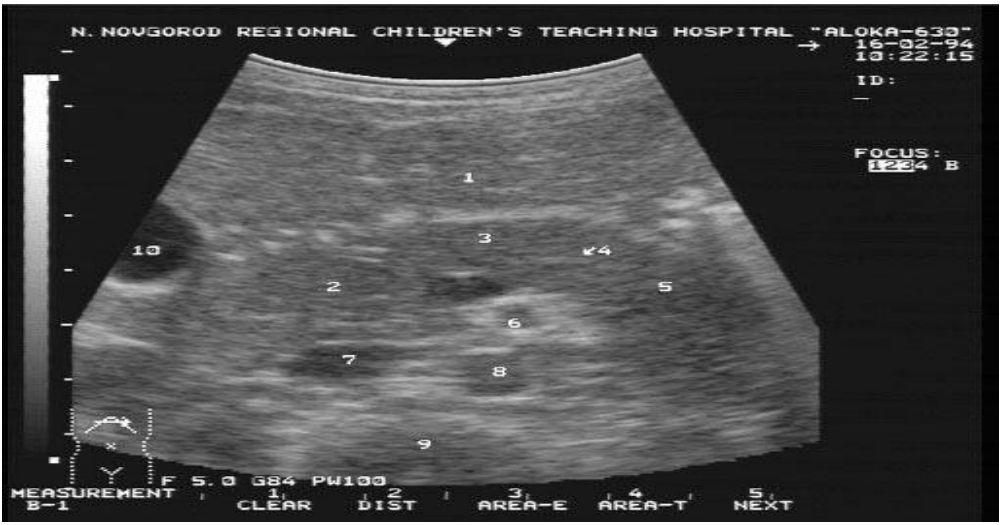




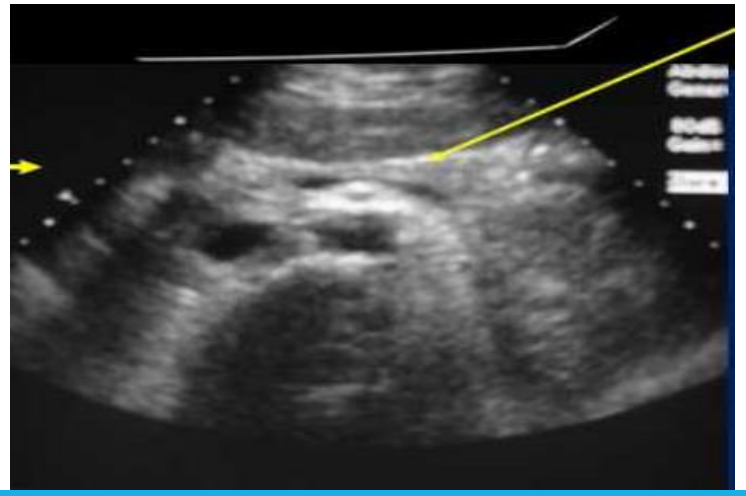
The normal pancreatic parenchyma has CT attenuation values in the range of 30-60 HU. Pancreatic attenuation decreases due to fatty infiltration which occurs normally with aging.

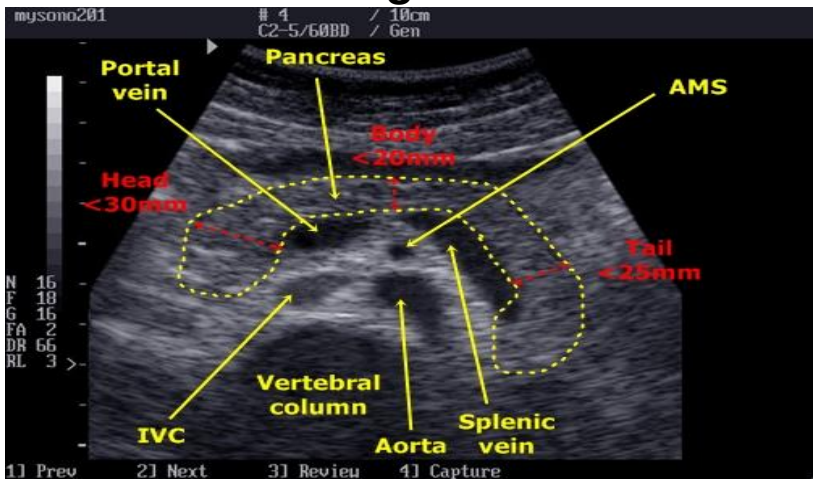
Normal Anatomy of the Pancreas

Pancreas on ultrasound :



The normal pancreas is of similar echogenicity to the liver.



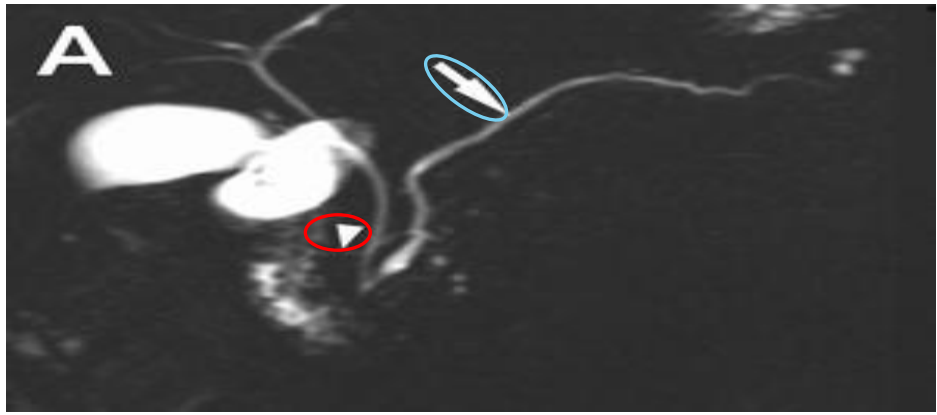


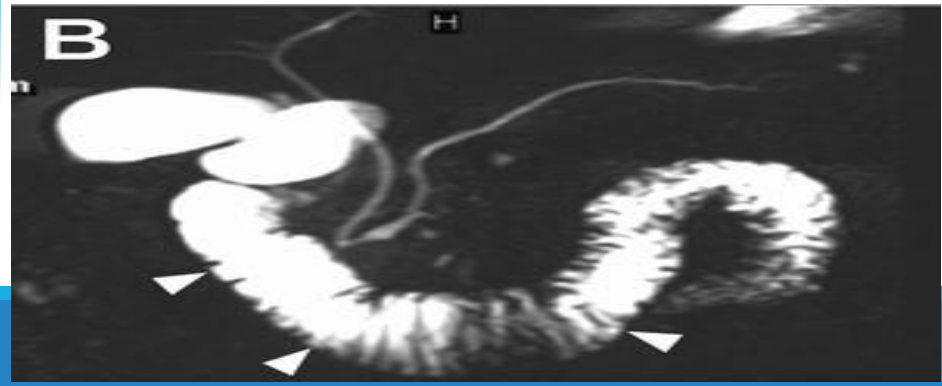
1- liver
2- head of the pancreas
3- pancreatic body
4- Wirsung's duct
5- tail of the pancreas
6- superior mesenteric artery
7- vena cava inferior
8- aorta
9- spine
10- gallbladder

Pancreas on MRCP:

- Normal MRCP performed during **secretin stimulation** shows :

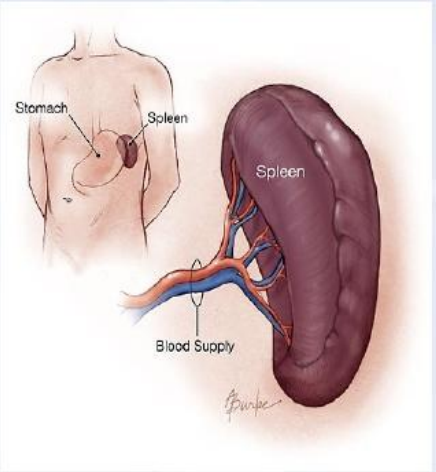
1. slight and temporary increase in the caliber and signal intensity of the main pancreatic duct in (arrowhead in A)
2. Complete filling of the Santorini duct (arrowhead in A)
3. progressive and complete duodenal filling (arrowheads in B)





SPLEEN

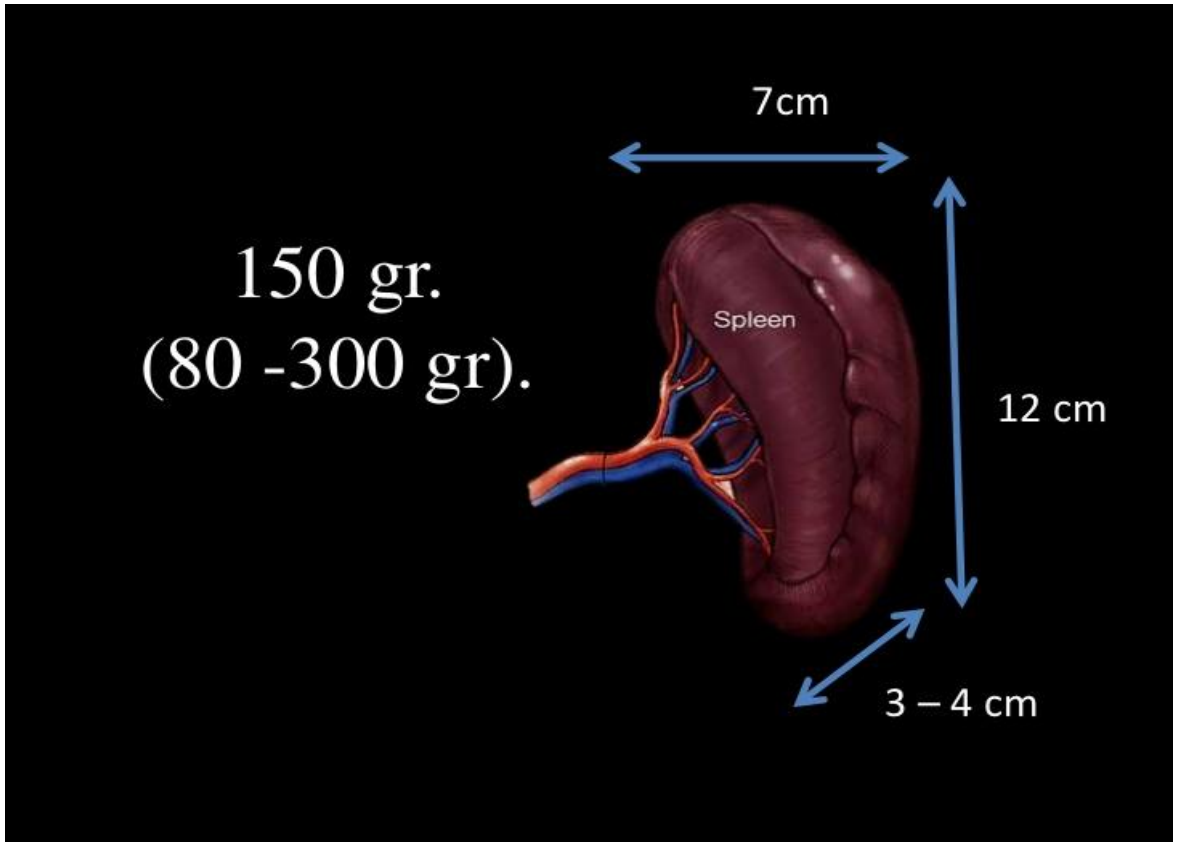
Spleen is.....



part of the lymph system and the immune system.

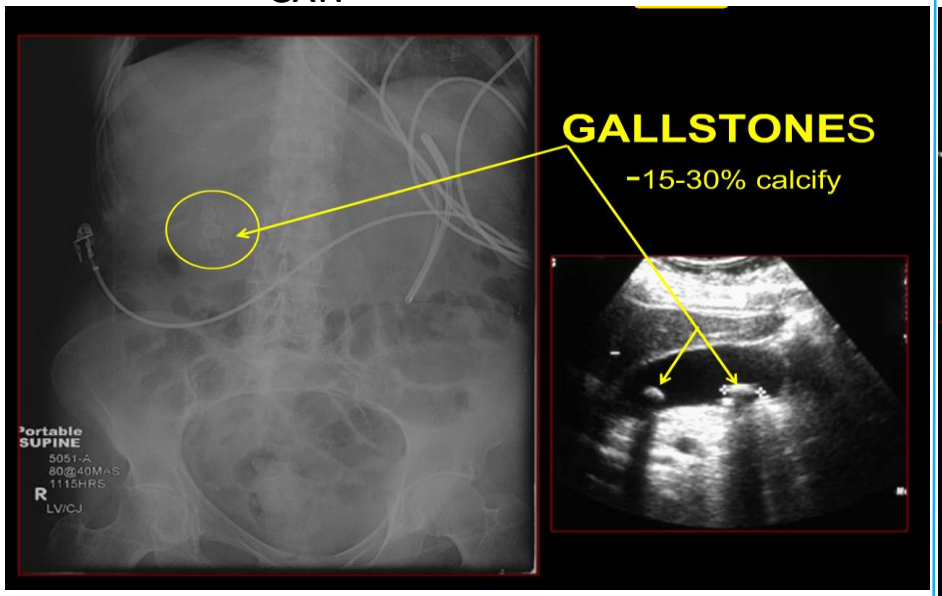
is an organ that creates lymphocytes for the destruction and recycling of old red-blood cells

is also a blood reservoir, supplies the body with blood in emergencies such as a bad cut



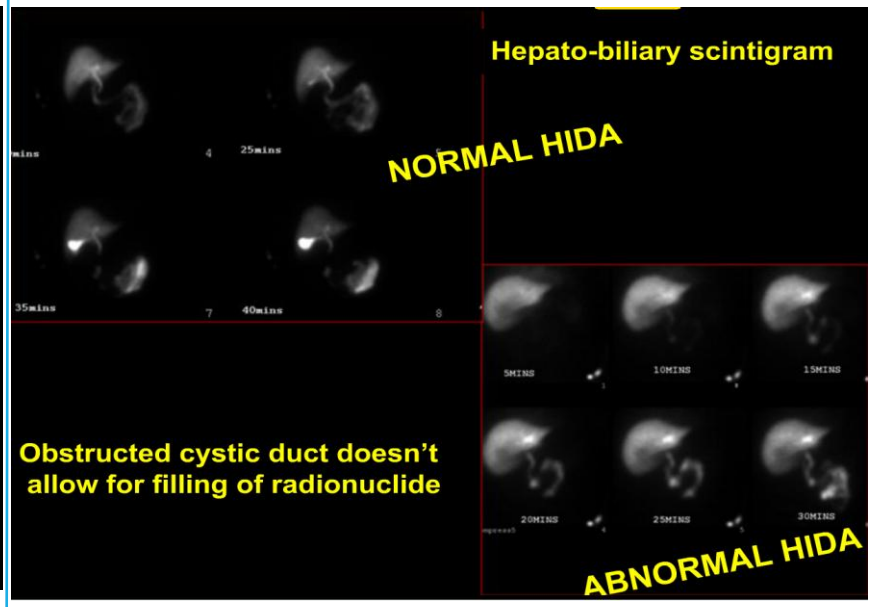
GALLSTONE

CXR

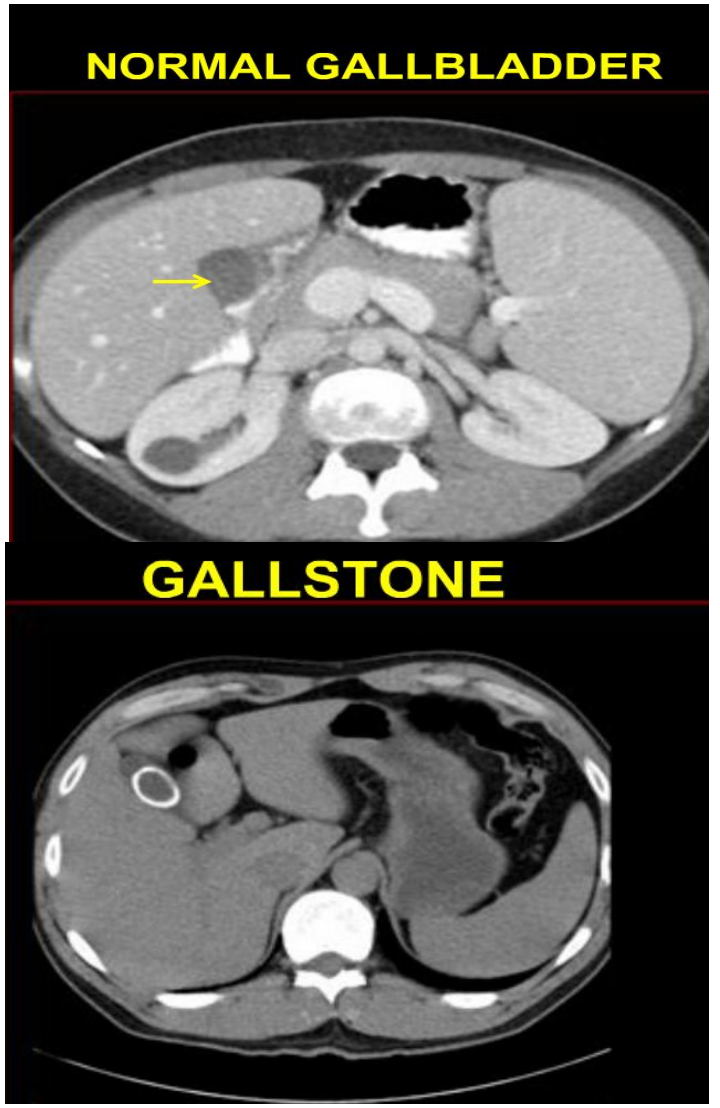


•On CXR (radiobaque shadow on the right side which is stone characterized by is ring like + dark in the centre + bright in the periphery) while in renal stone it will be calcified .
•On US (bright stone with ecoustic shadow)
•If you have similr appearance and you rotate the patient right and left and it is not moving this will be a MASS
• the wall It is important to see whether it is edematous or thickened that will lead to cholycystitis and the wall distention which is normally 10cm in length

HIDA SCAN

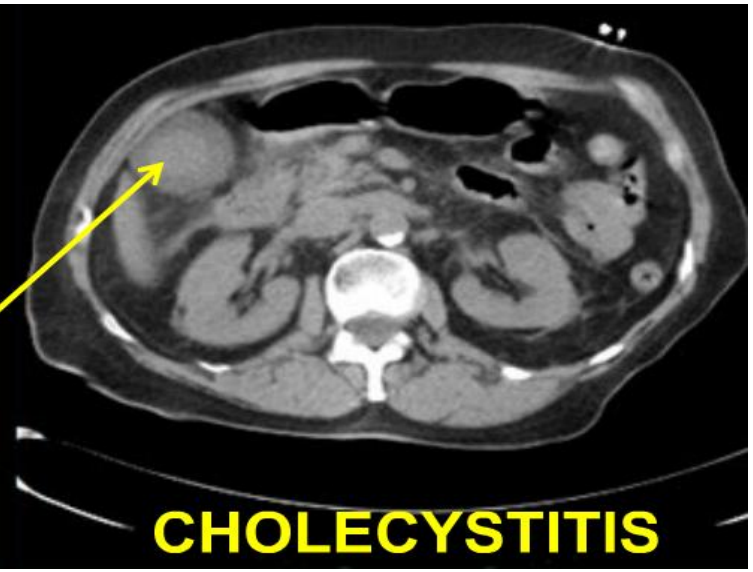


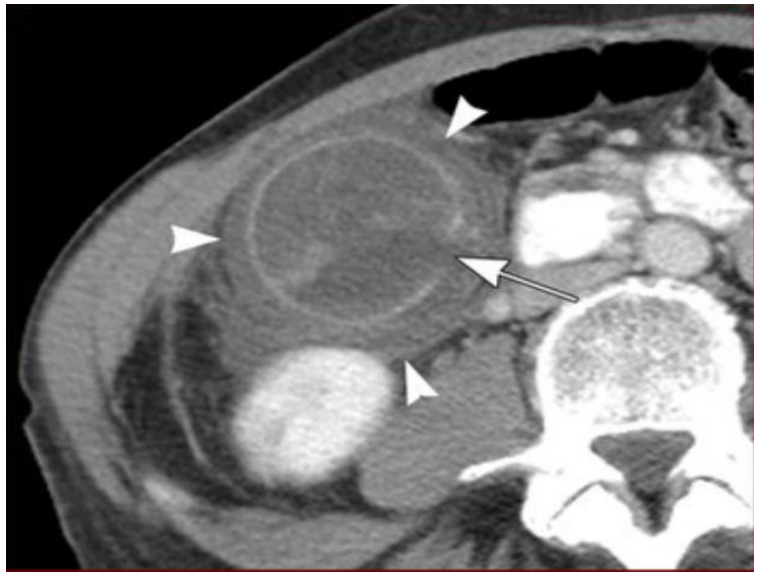
•HIDA SCAN : it is a nuclear scan that a material is injected to a vein and imaging kidney , liver and billiary duct).
•In normal HIDA the gallbladder is opacefied after 3-5 minutes.
•While in abnormal HIDA scan you van not visualize the gallbladder even after 15 minutes which indicate obstruction



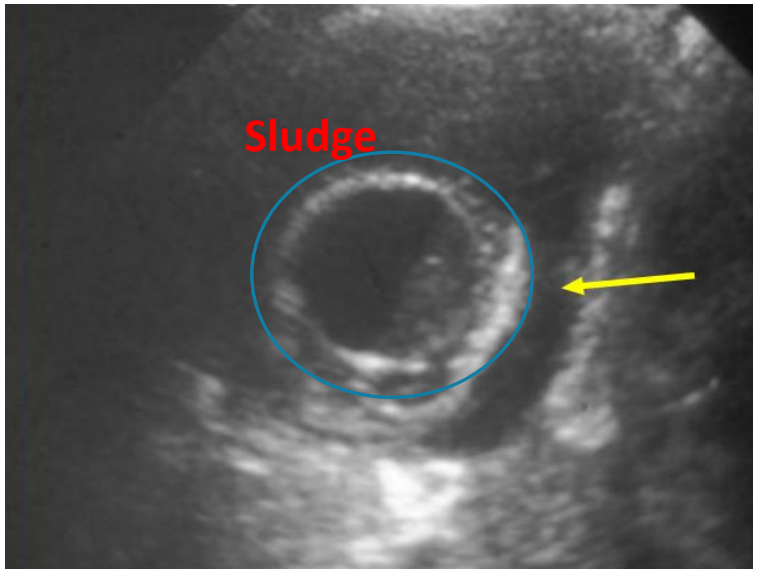
•There is dark ring like which is a gallstone.
•There is no edema and thickened wall to rule out cholecyctitis

cholecyctitis



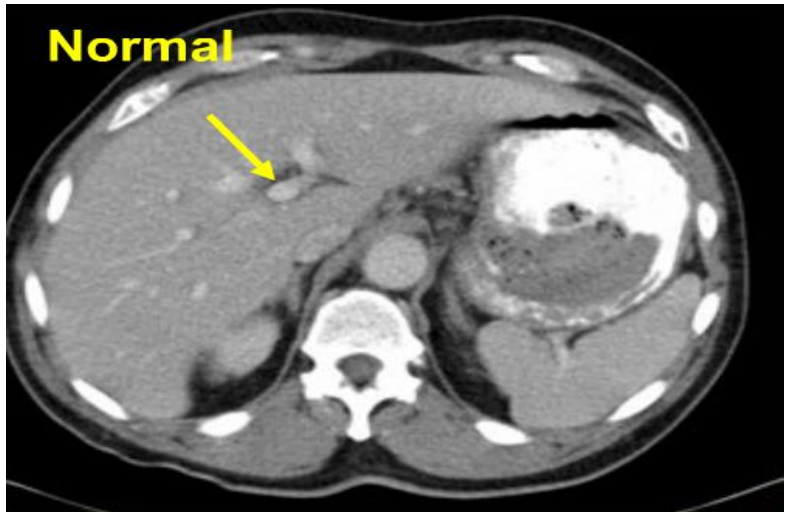


Thickened diffuse edematous gallbladder and fat around the gallbladder wall with cholecyctitis

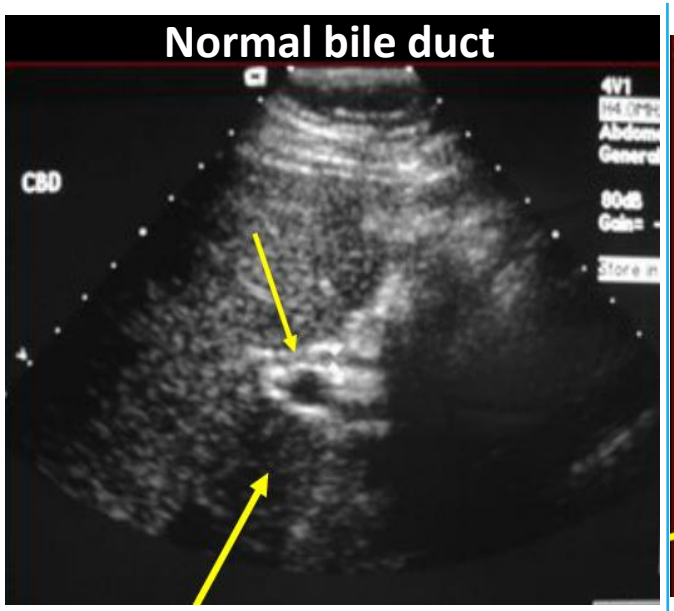


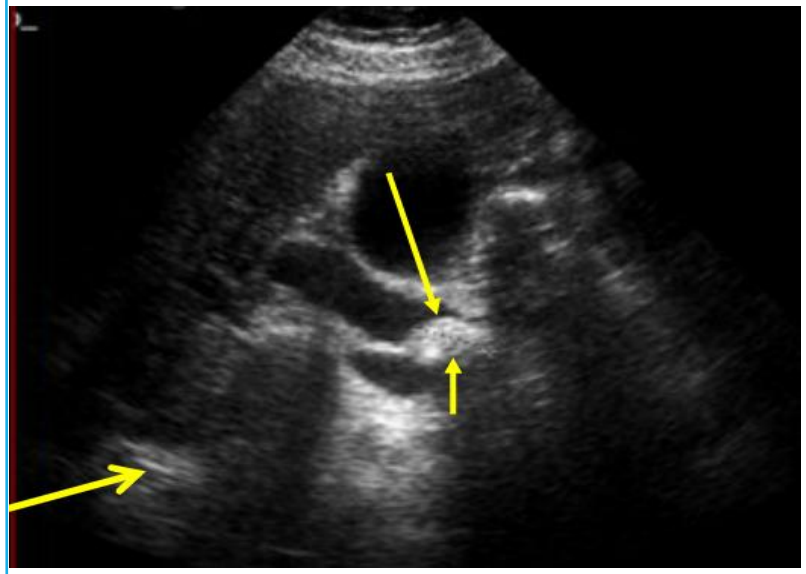
This is an US for cholycyctitis you can see the sludge (fluid –fluid level) and edema around the gallbladder

DILATED BILE DUCT:

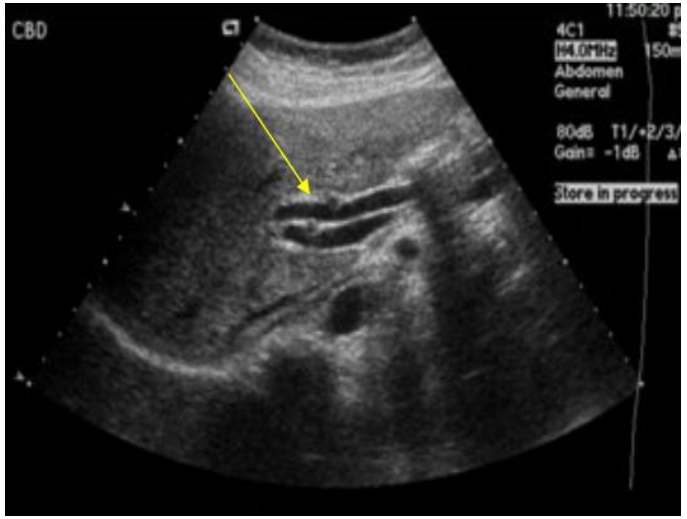


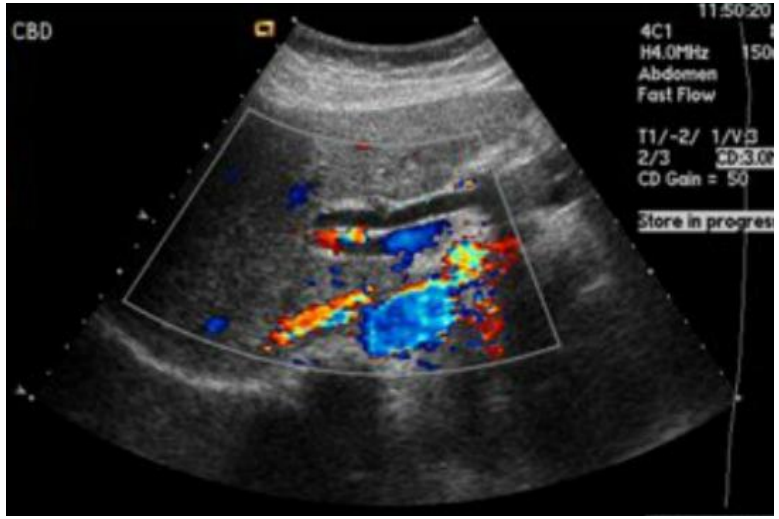
Dilated bile ducts due to obstruction by stone (low density branching structures anterior to portal veins





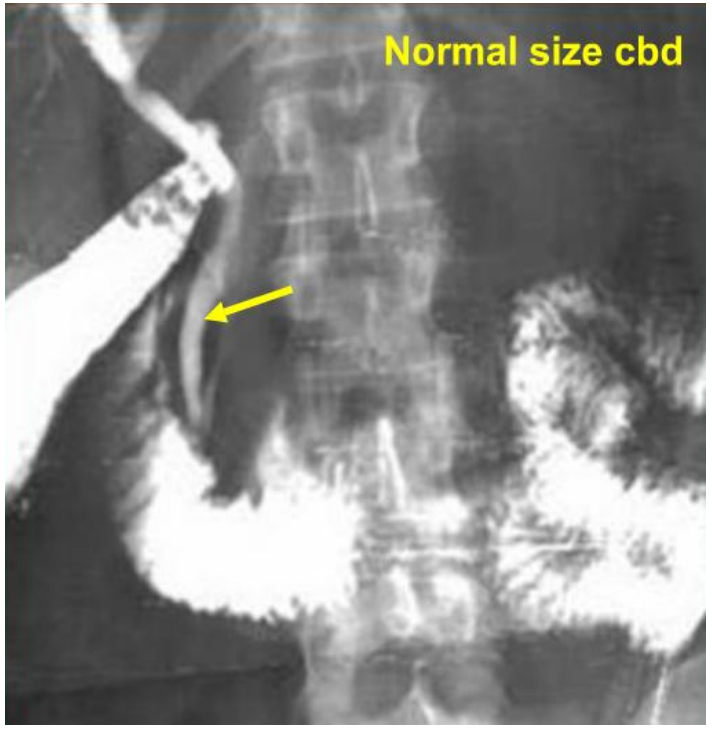
Obstructed duct due to distal calculus

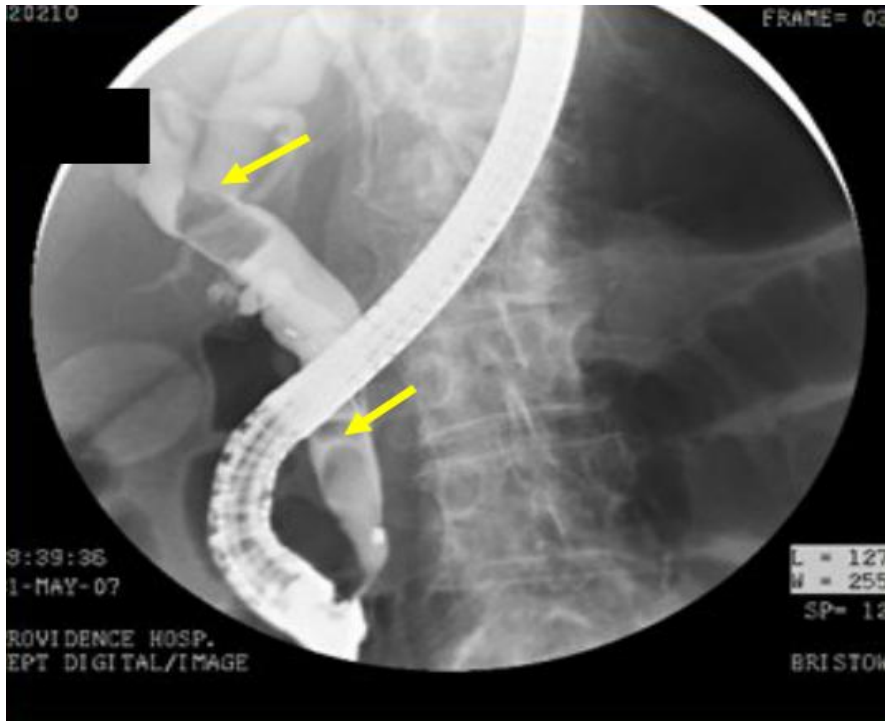




LONGITUDINAL common bile duct will not be visualized by doing Doppler signal in vessel

DILATED BILE DUCT:

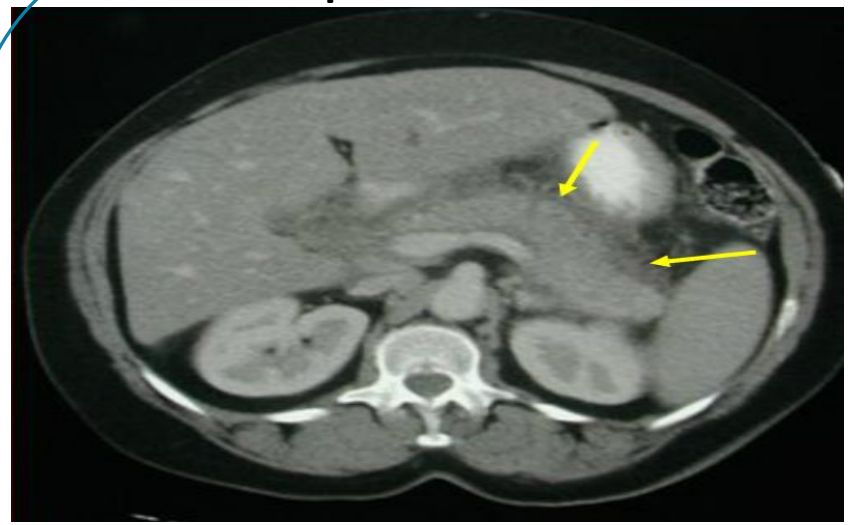




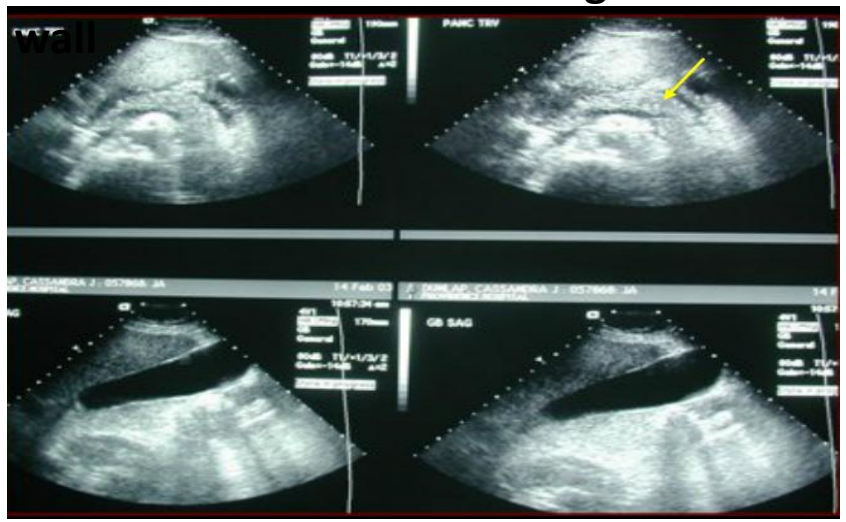
Dilated CBD with multiple filling defect calculi (ERCP)

Pancreatitis

Acute pancreatitis Risk factor (1-Biliary calculi 2-Alcoholism)



diffuse edema + fat stranding +thickened wall

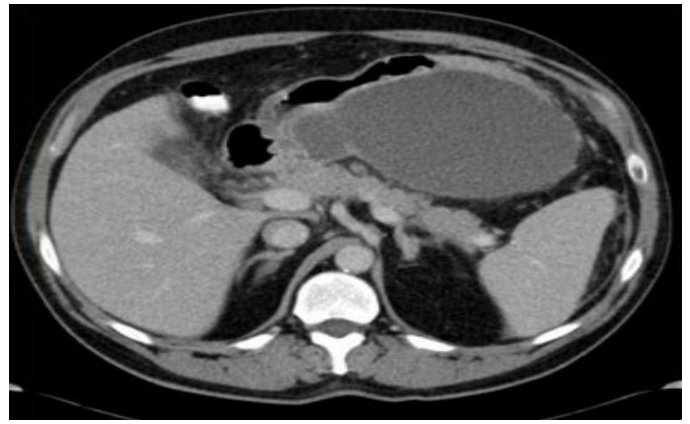


pancreatic duct is dilated and thickened with diffuse edema on US

Complication of acute pancreatits :

- Pain
- Infection
- Hemorrhage – pseudoaneursym
- Pseudocyst

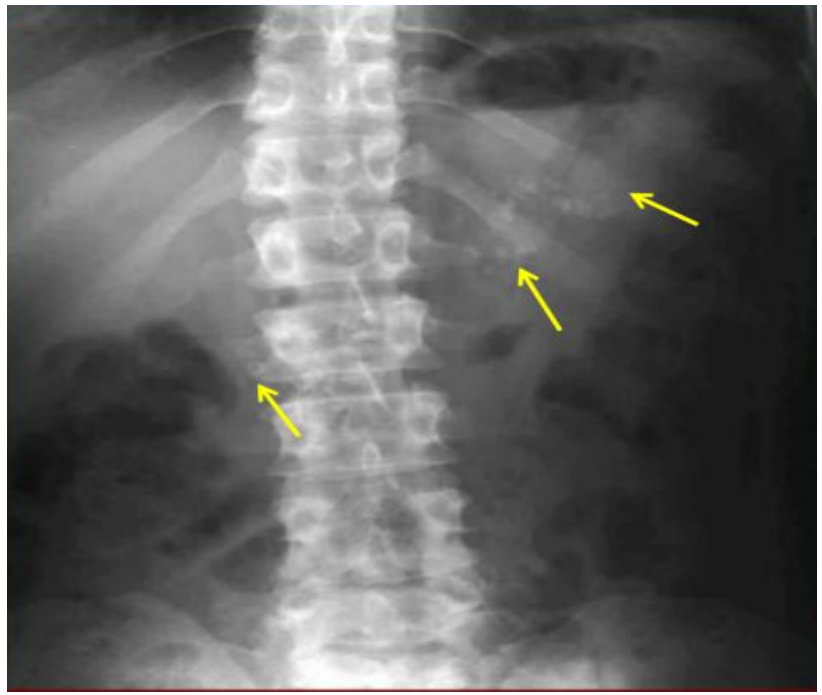
Retrograde fluid collection
Pseudocyst:



Big cyst compressing stomach an push it.
Pancreas is posterior to the stomach

Pancreatitis

Chronic pancreatitis



Calcification and atrophy of the pancreas

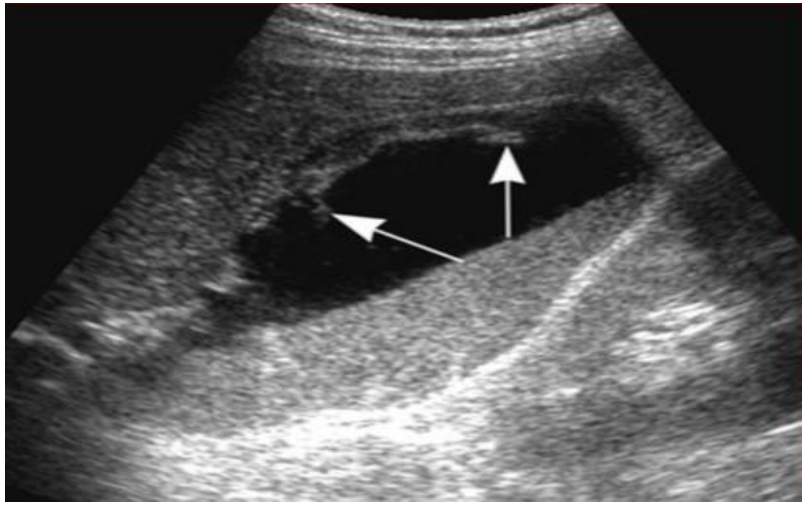
Special cases (very important)

Emphysematous cholecytis

Scenario : patient come complaining of right Upper quadrant pain and he is diabetic you examine the patient by US and you do not see the gall bladder. why? Because it contain gas.

Then do an x-ray you will se see pouch filled with gas on then do CT and the gas is very clear in the picture above

Acalculous cholecystitis

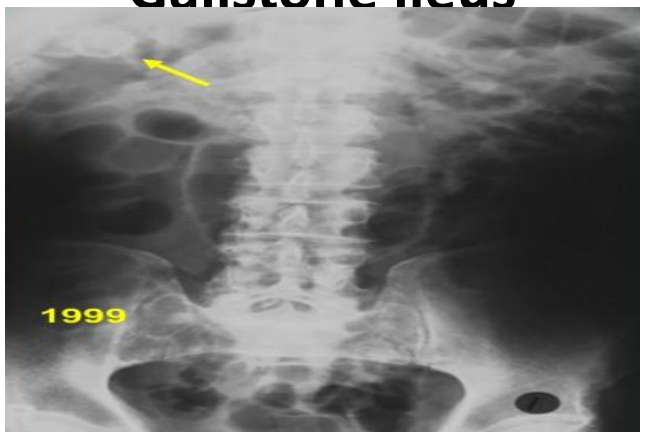


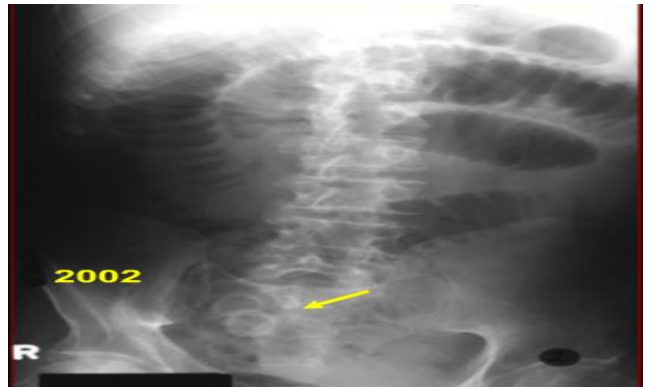
Cholycyctitis without stone

The patient have a history of (fasting/ICU patient) and Elderly you examined him but You did not find the stone and you found thickened + sludge + distended gallbladder

Biliary stasis

Gallstone ileus





•Small bowl obstruction at IC valve due to migration of gallstone.

•After the 4 years of follow up , you examined the patient and you did not find the stone that mean Gallbladder is inflamed and cause fistula between stone and bowel that will lead to obstruction.

Acute RUQ pain:

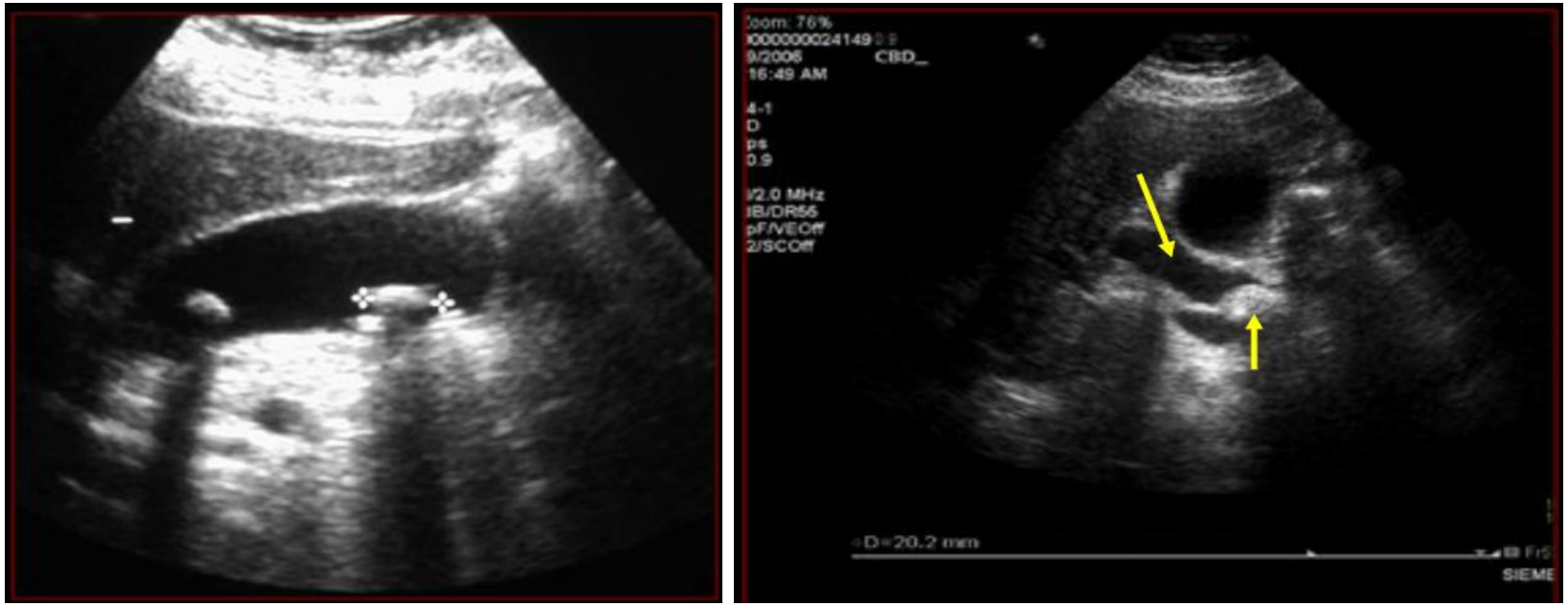
What is the most common cause of RUQ pain? Acute cholecystitis

- **Differential diagnosis:**
  - ✓PUD\ Gastritis\ Reflux
  - ✓Acute Hepatitis \ Pancreatitis
  - ✓Right Sided Pneumonia
  - ✓Choledochlithiasis
  - ✓Liver abscess

- **Imaging Evaluation**
  - ✓Ultrasound -1st (is the best modality to investigate patient with RUQ pain).
  - ✓CT\HIDA – 2nd
  - ✓ERCP\MRCP – 3rd

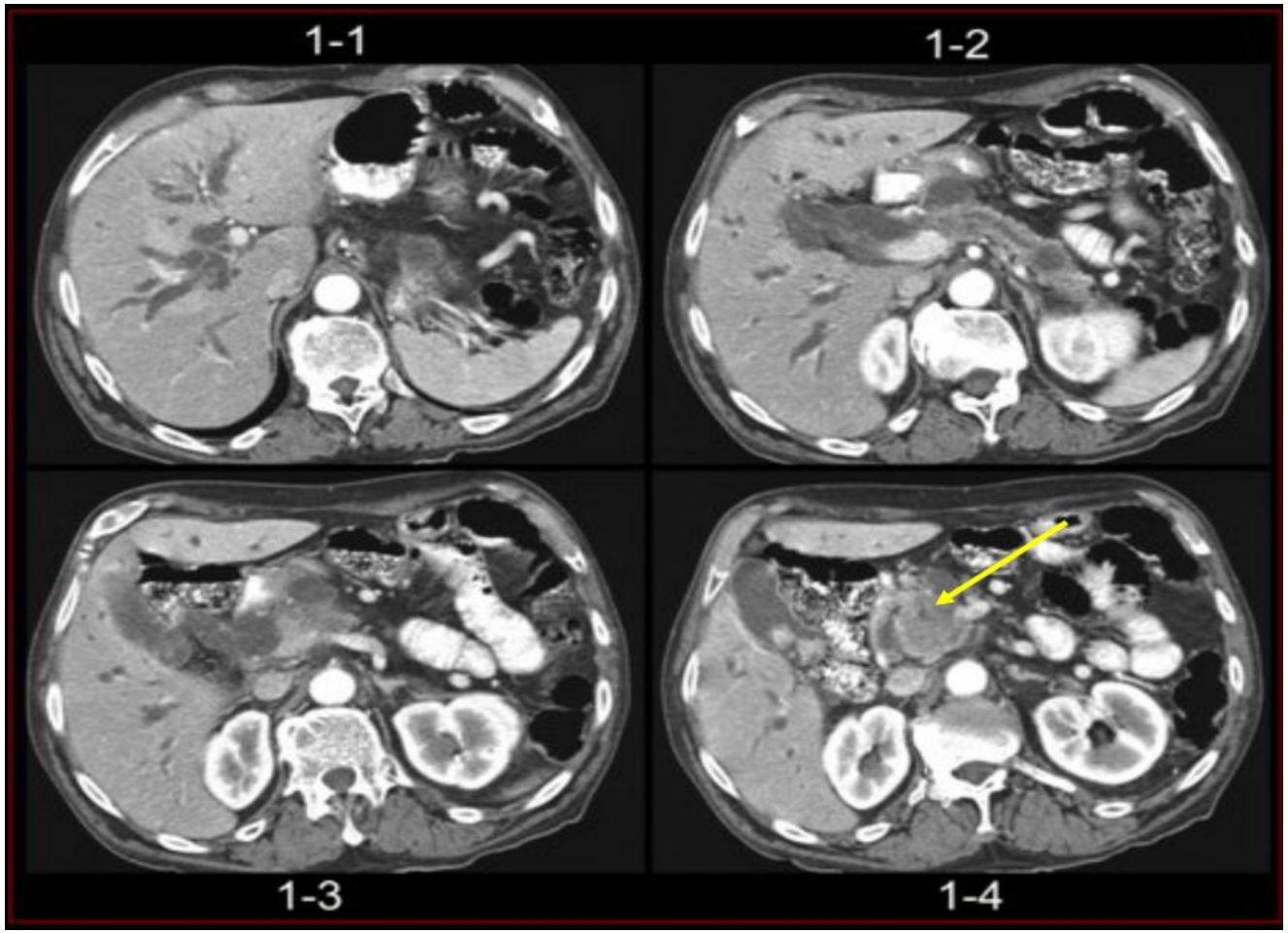
Ultrasound(US):

- **Sensitive and specific for demonstrating**
  - ✓Gallstone ((if you think of gallbladder go the US)
  - ✓Biliary Dilatation
  - ✓Features of inflammatory disease



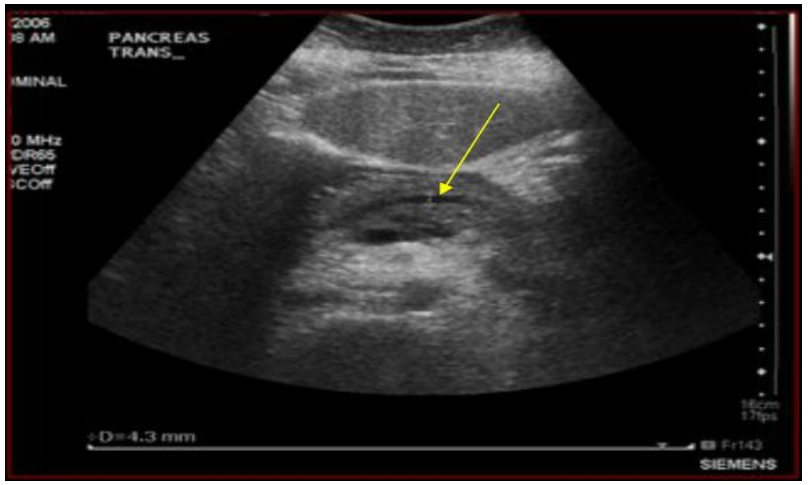
Cholelithiasis and obstructed duct due to distil calculus

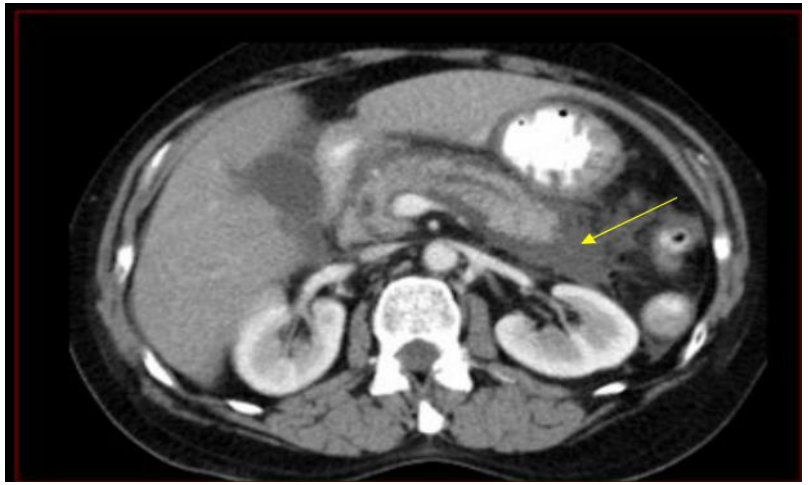
Pancreatic cancer (Obstructive jaundice)



There is a mass (yellow shadow) in the pancreatic duct that will cause obstruction and jaundice. There is billiary dilation and the bile duct is lined with portal vein

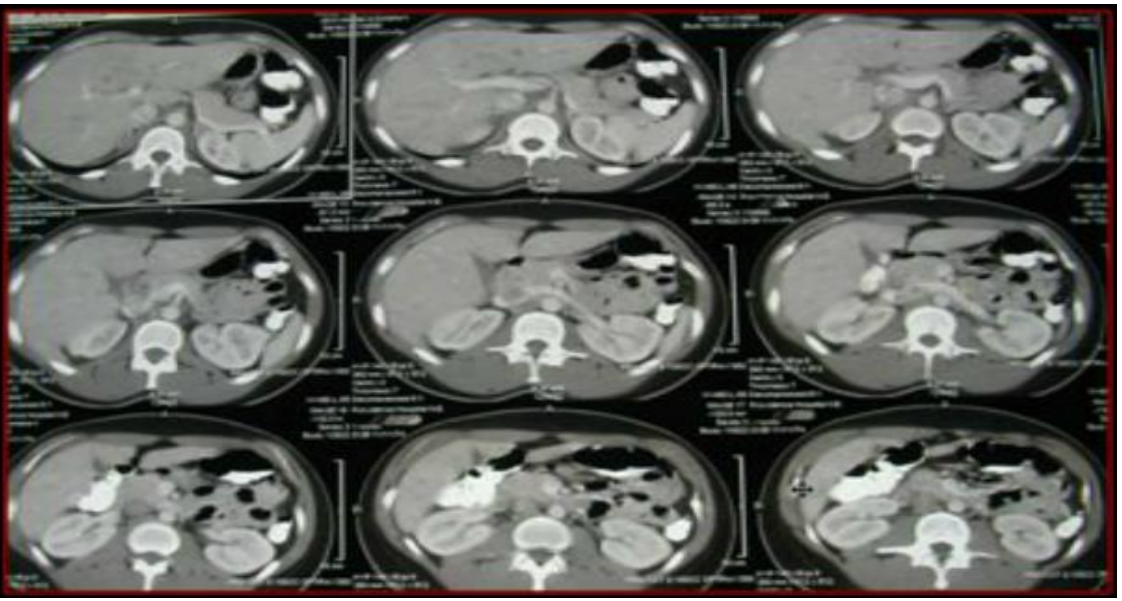
Elevated Amylase
Pancreatitis edema and dilated pancreatic duct



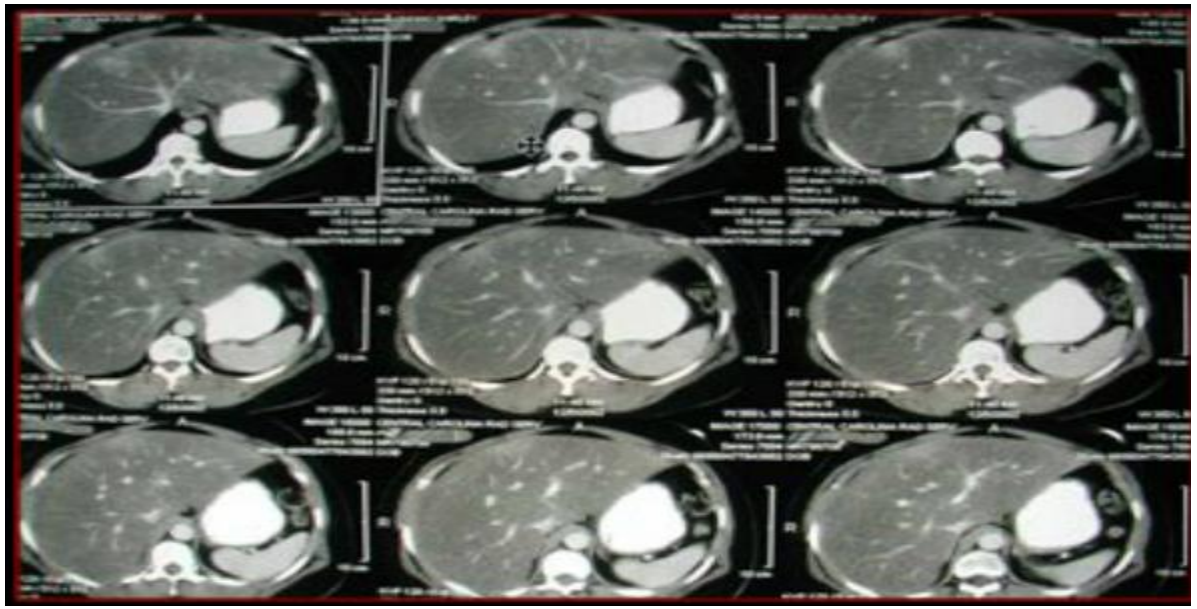


Hepatic dysfunctions
SGOT \ SGPT

Normal liver

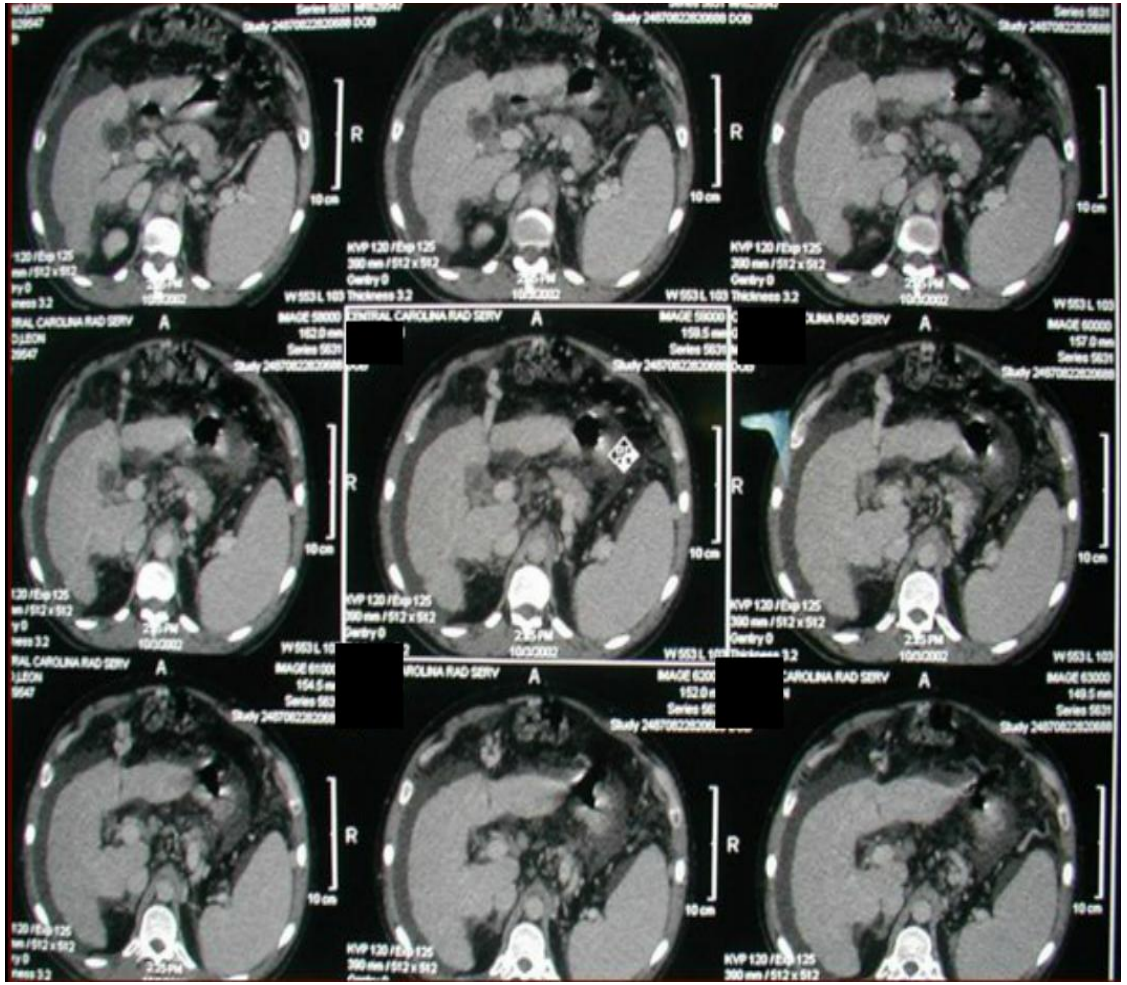


Fatty infiltrations



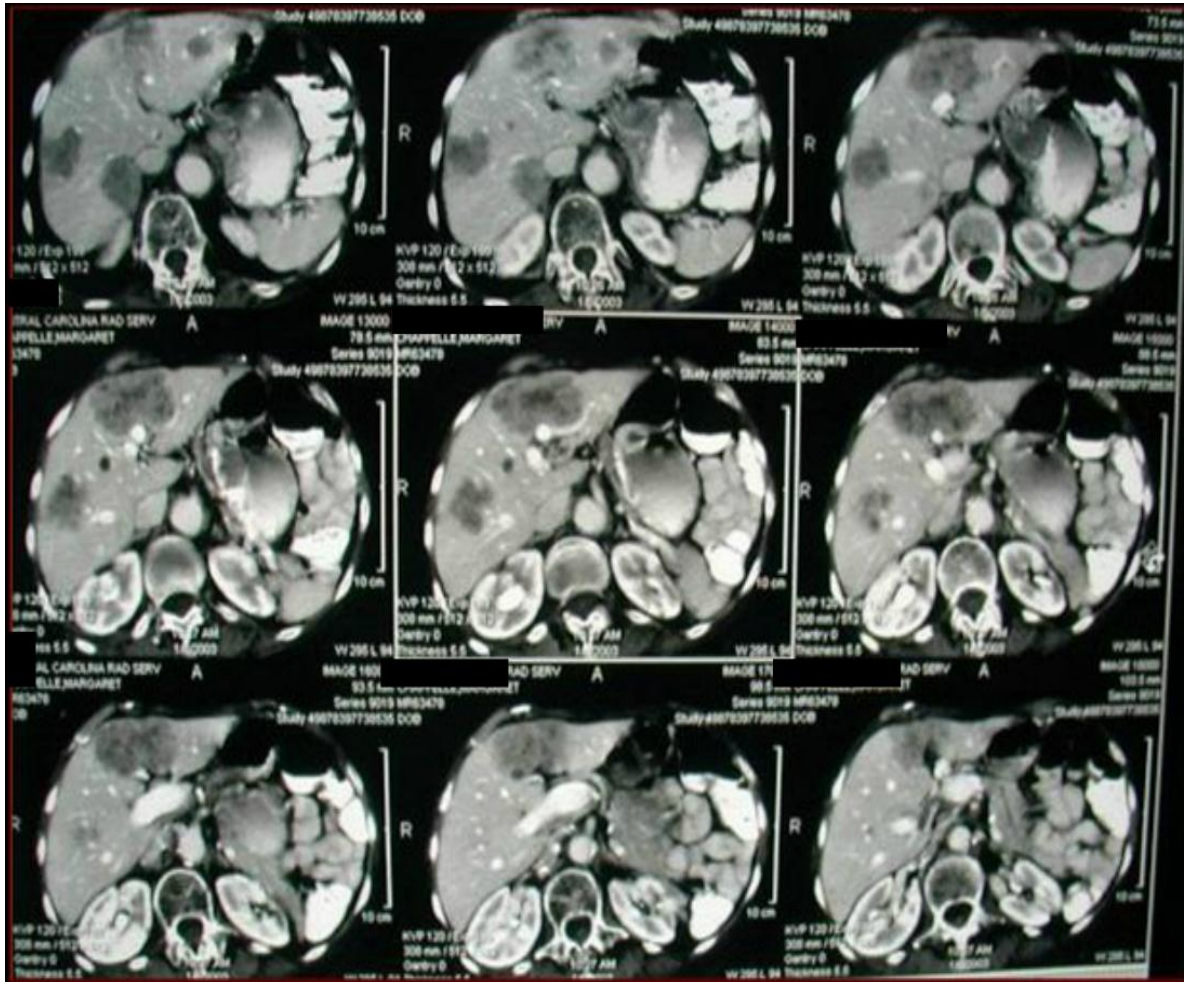
The liver is more dark that mean there is a fat in CT scan

Cirrhosis



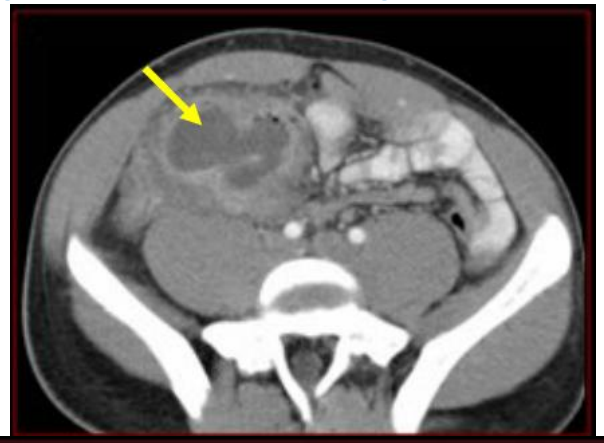
Irregular wall + shrinkage of liver + ascites + subvarices

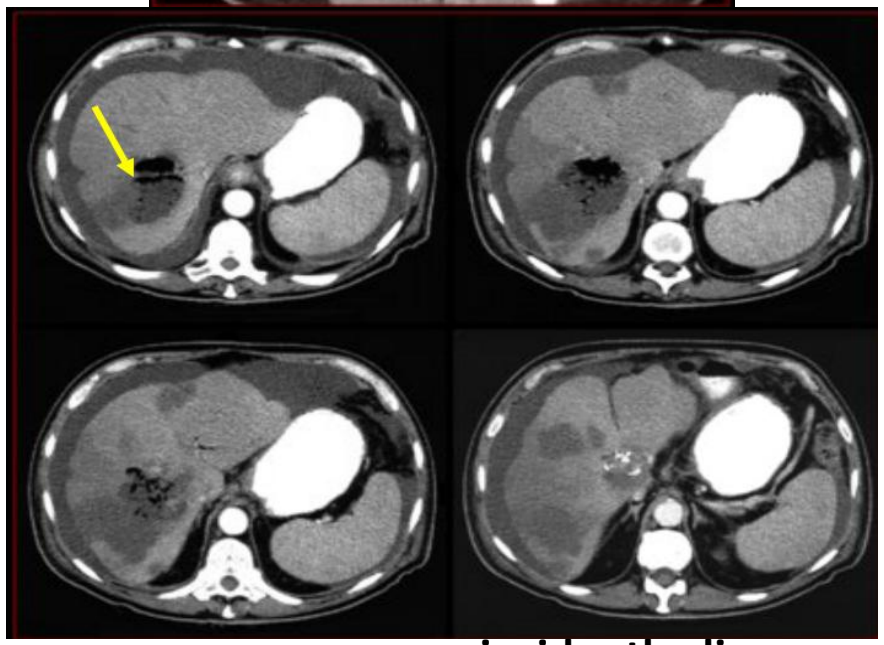
Metastatic Disease



Multiple masses in the CT scan indicating metastatic disease

Appendicitis and hepatic abscess





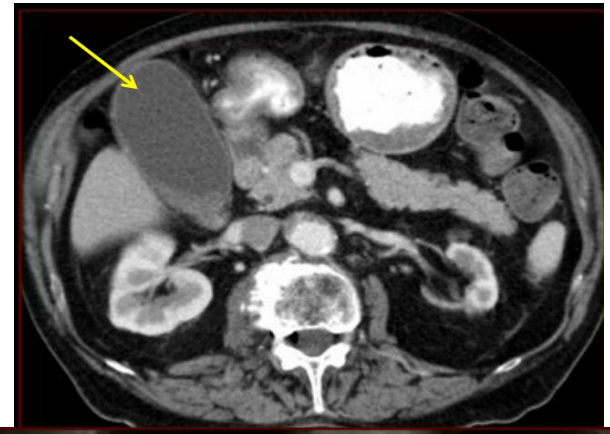
Some grey or some gases insider the liver →

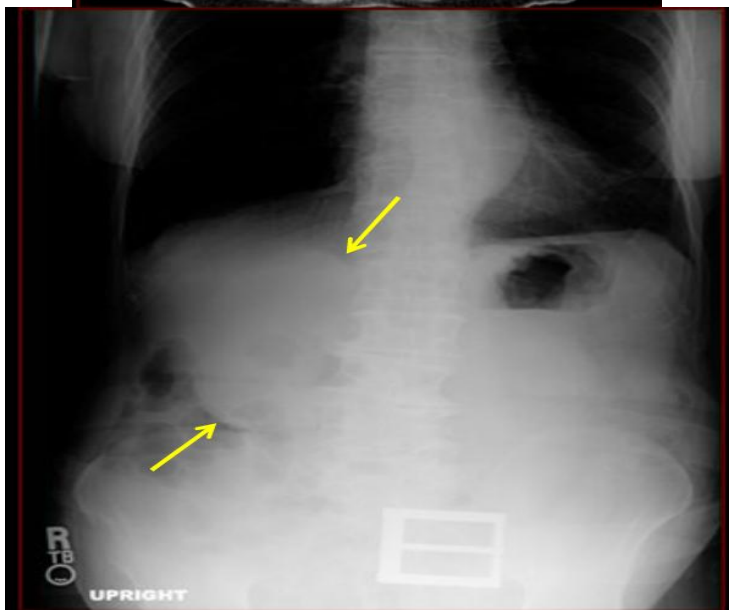
Liver abscess could be due to:

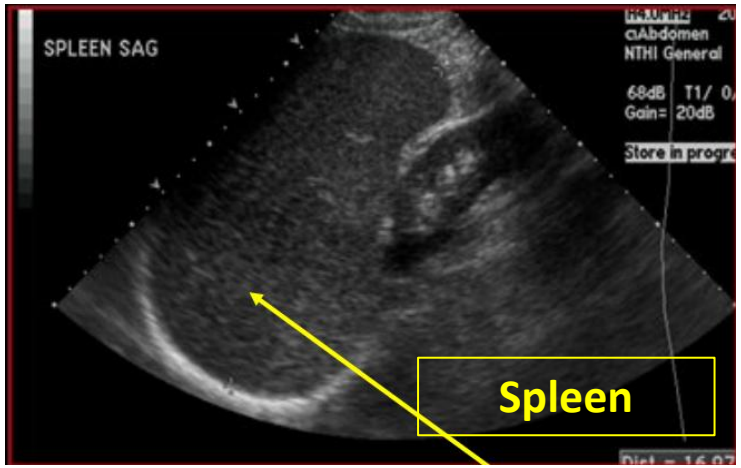
1- ascending cholangitis or 2-appendicular abscess

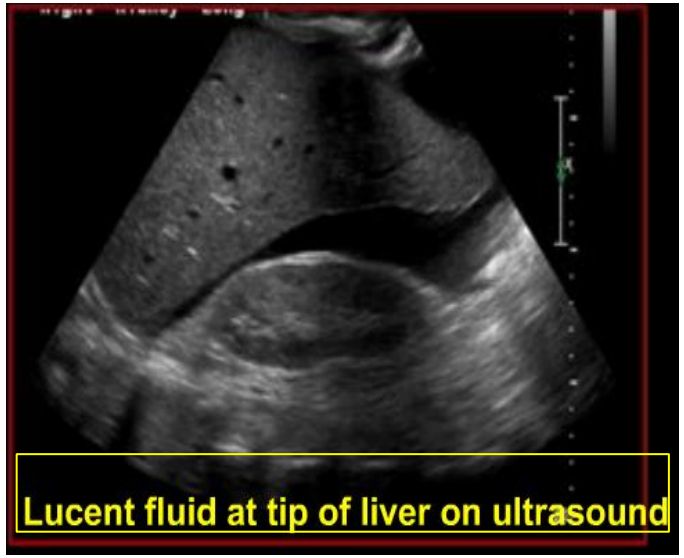
Palpable mass

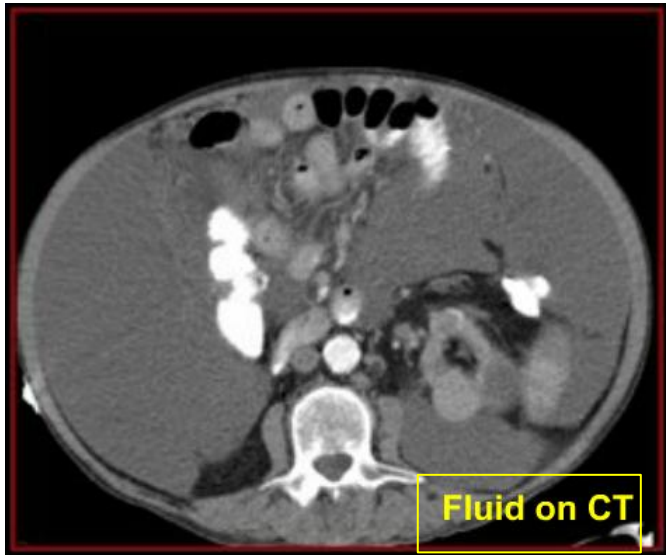
Palpable Gallbladder

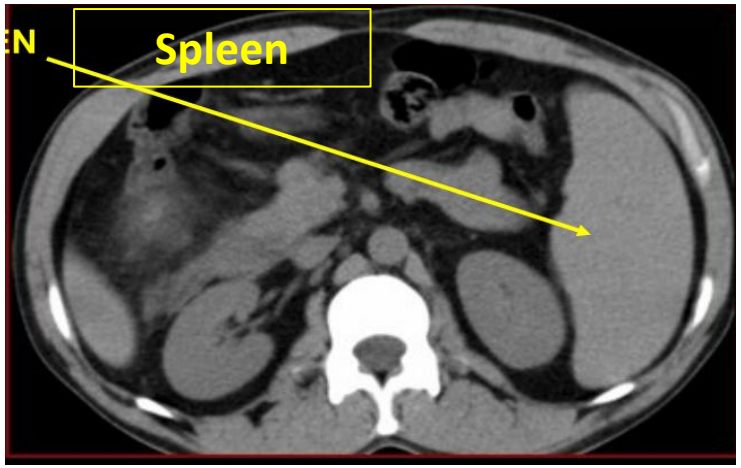


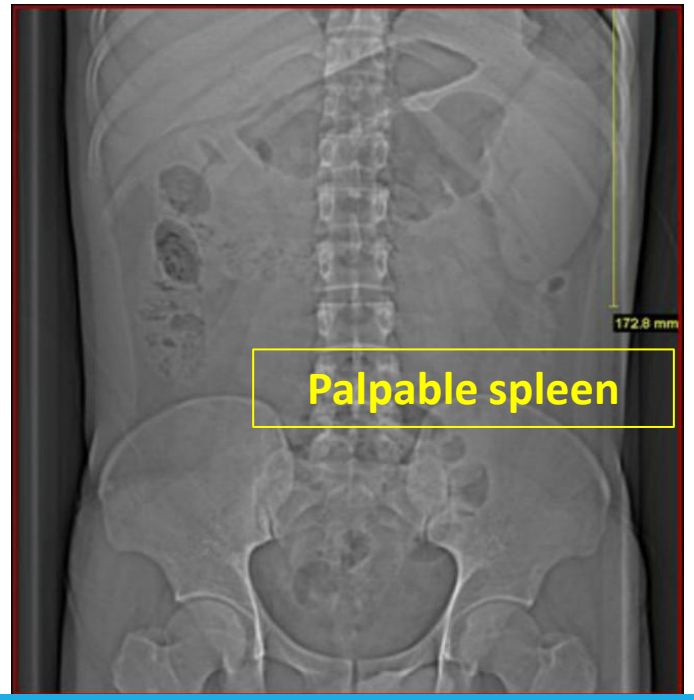


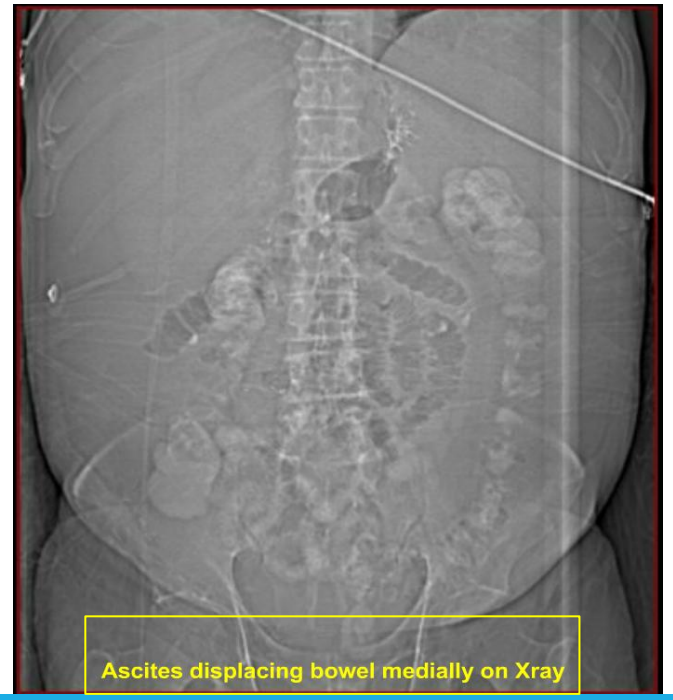

SPLEEN SAG
cAbdomen
NTHI General
68dB
Gain= 20dB
Spleen


Lucent fluid at tip of liver on ultrasound


Fluid on CT

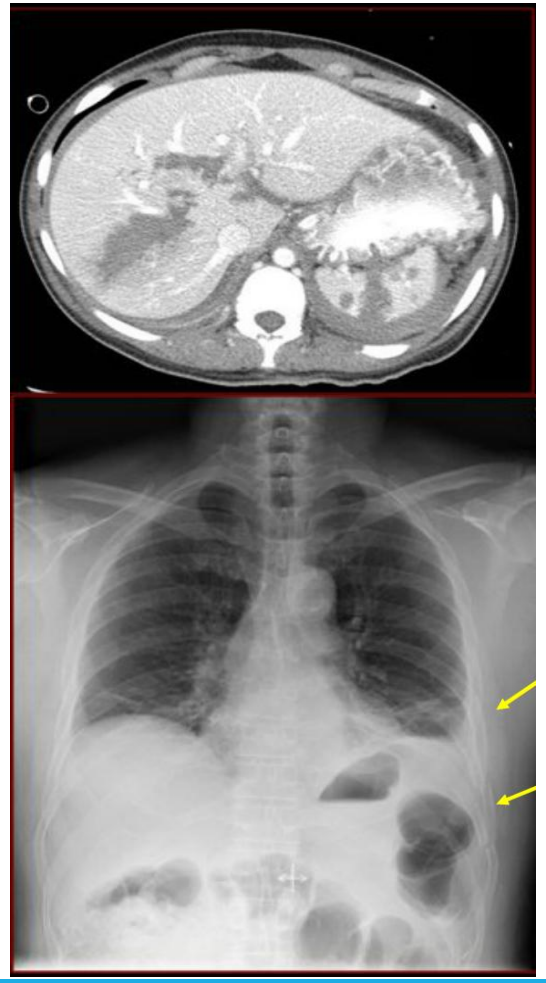

Spleen


172.8 mm
Palpable spleen

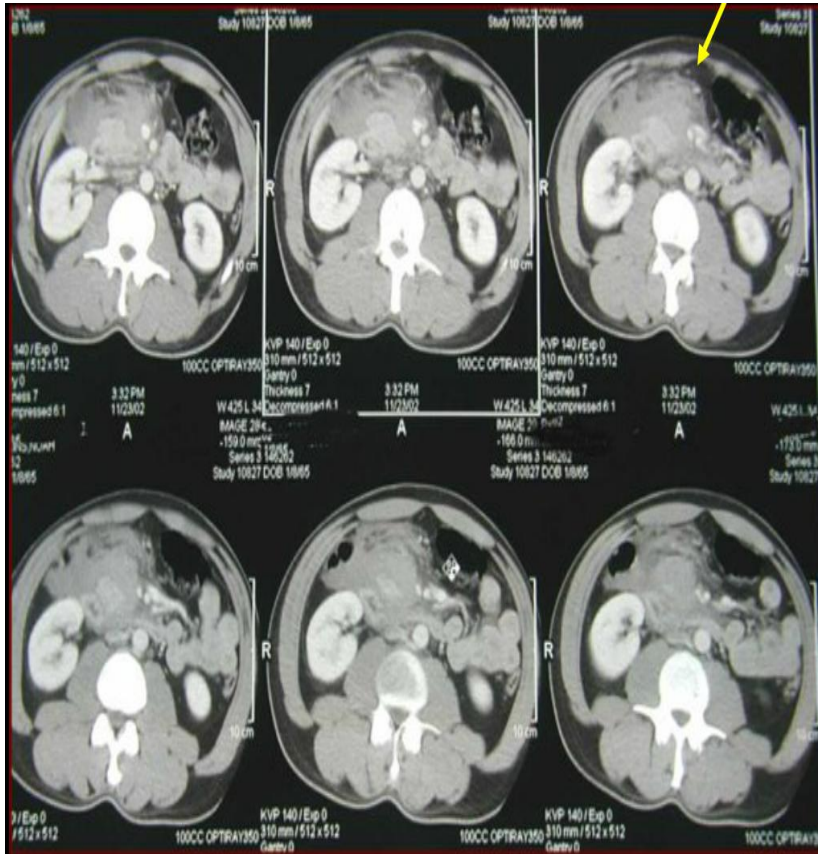

Ascites displacing bowel medially on Xray

Trauma

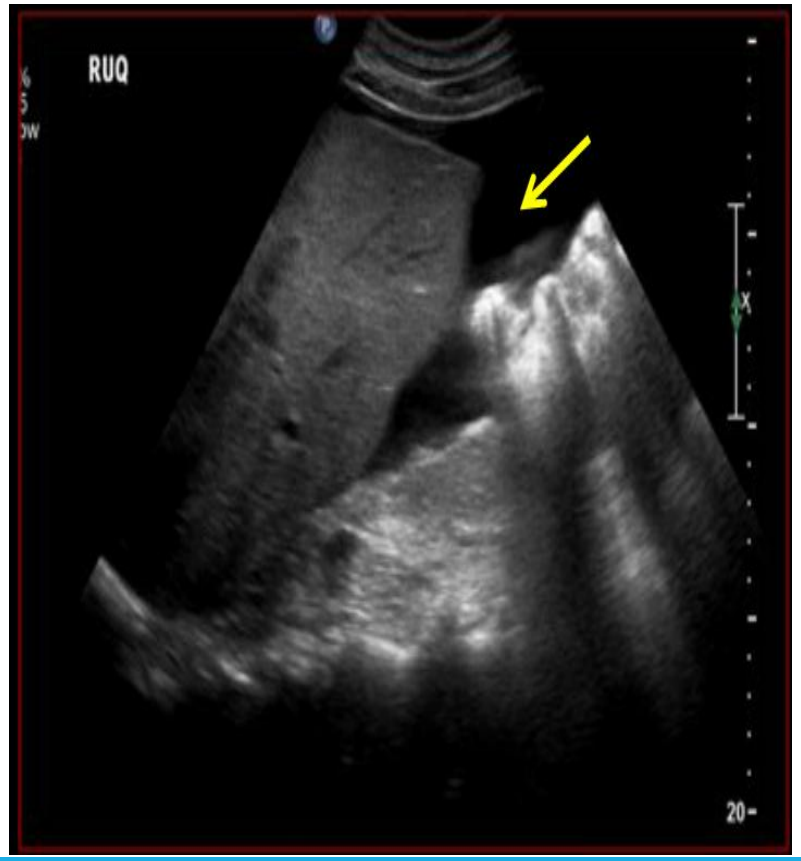
Hepatic / splenic laceration



Post traumatic Pancreatitis
Seat – belt injury

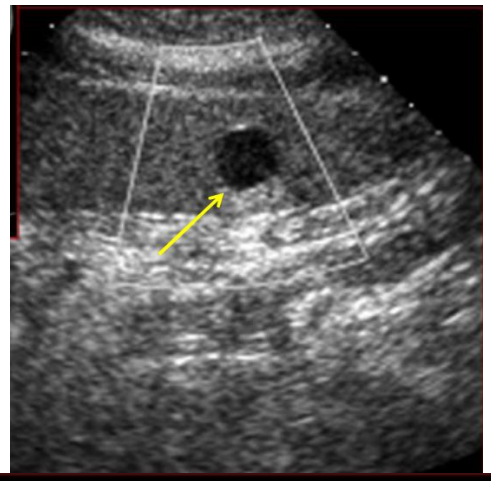


F.A.S.T Scan
Focused assessment with sonography for trauma
Ultrasound survey for free peritoneal fluid

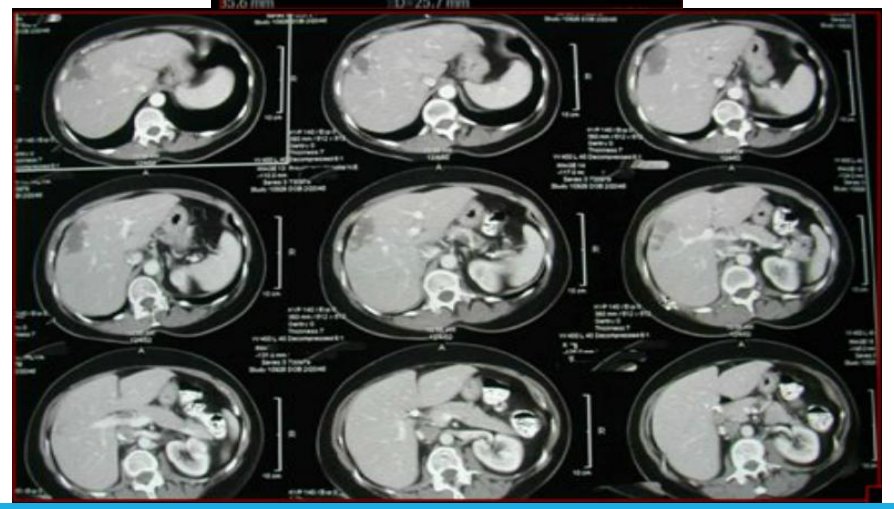


Incidental finding

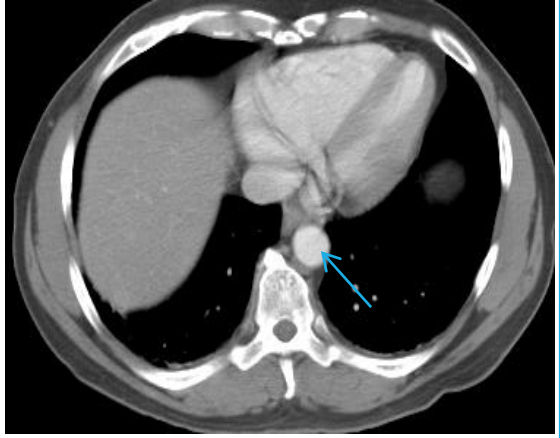
Hepatic cyst

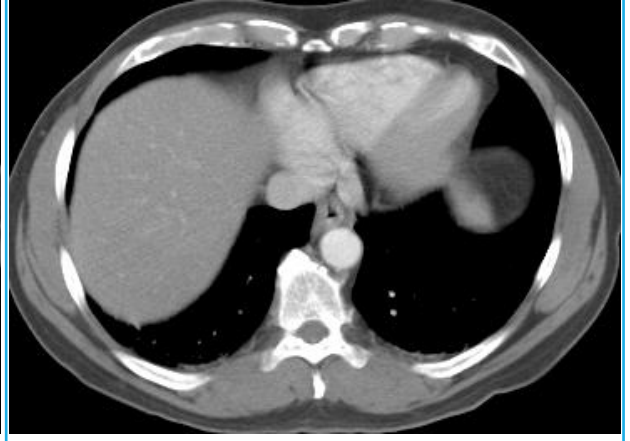


Hemangioma
Benign hepatic lesion



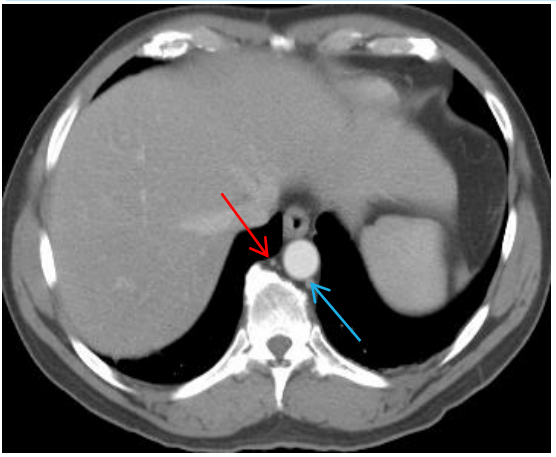
Cholelithiasis
Incidence is 10% of general population

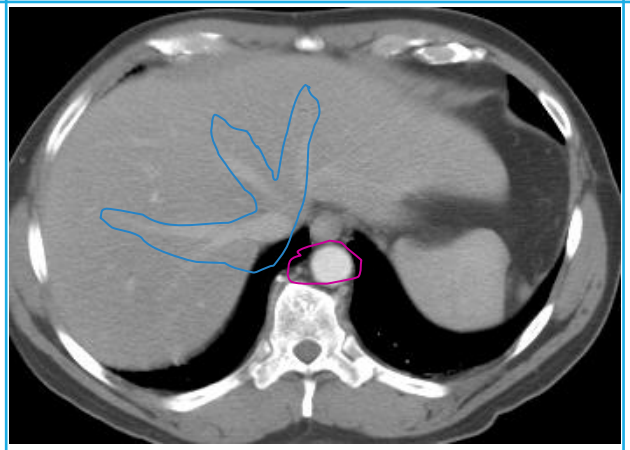


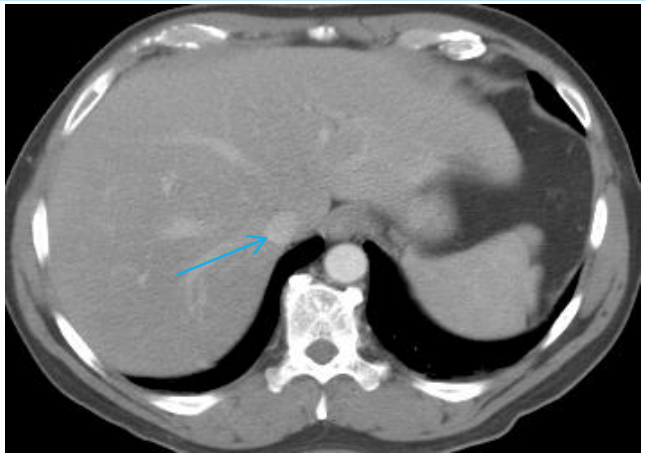


→ AORTA

•Follow the IV contrast filled Aorta as we descend caudally. Branches and points of interest will be noted.





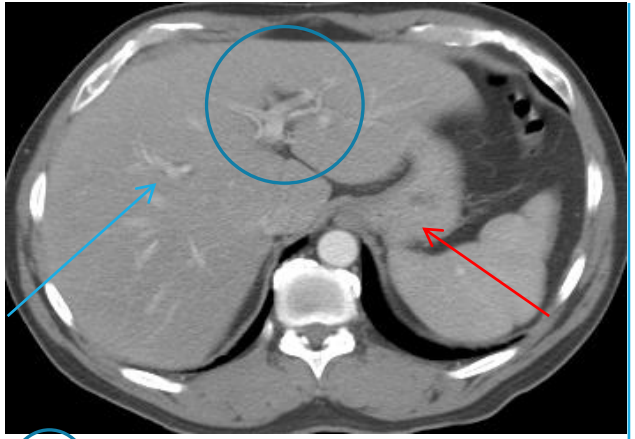


→ **Azygous Vein.**

→ **Hemiazygous Vein**

This is an excellent image of the right, middle and left hepatic veins draining into the Inferior Vena Cava. Don't confuse this structure with the IVC, this is the esophagus at the level of the Lower esophageal sphincter,

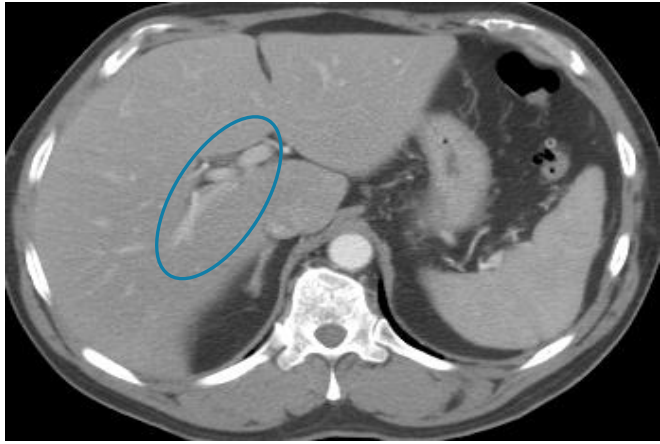
The outline of the Inferior Vena Cava is more distinct in this image.



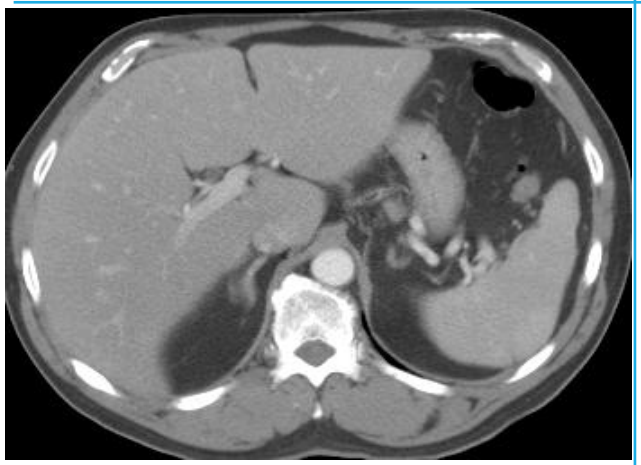
Portal Vein Branching into the Liver

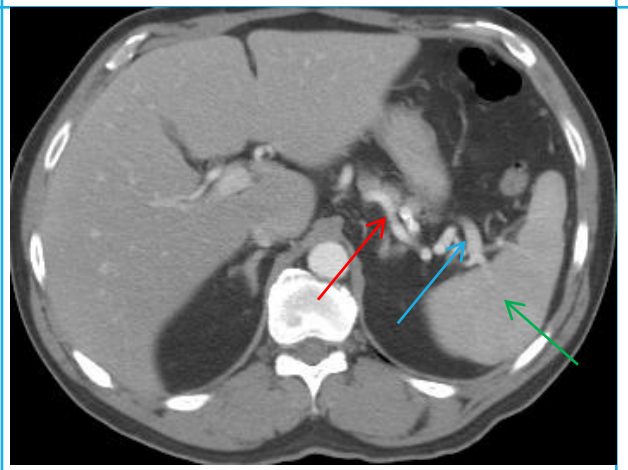
Liver

Stomach



More portal vein branching into the liver lobes

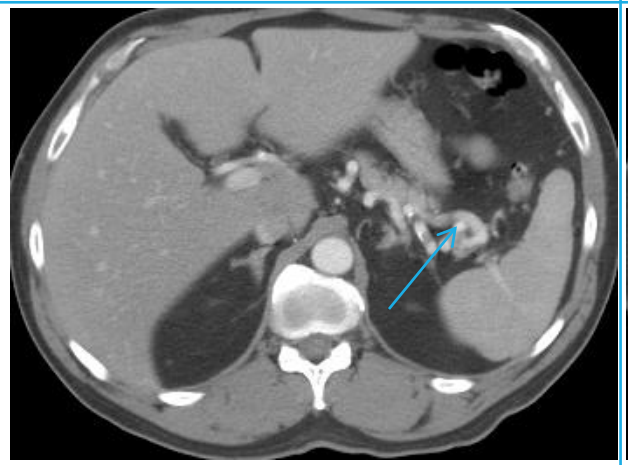




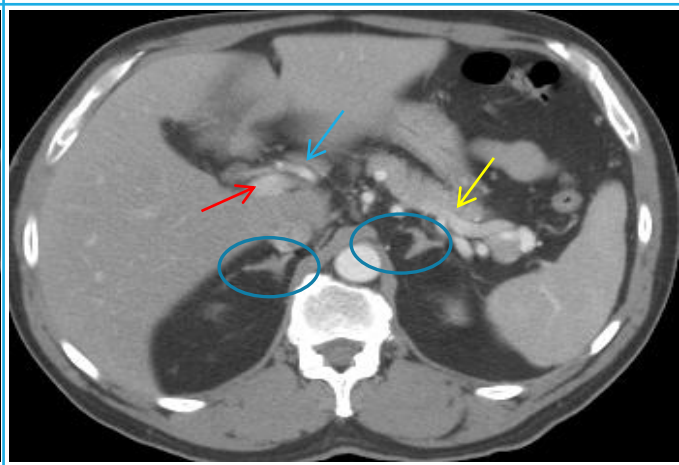
Splenic Artery

Splenic Vein

Spleen



Splenic Vein

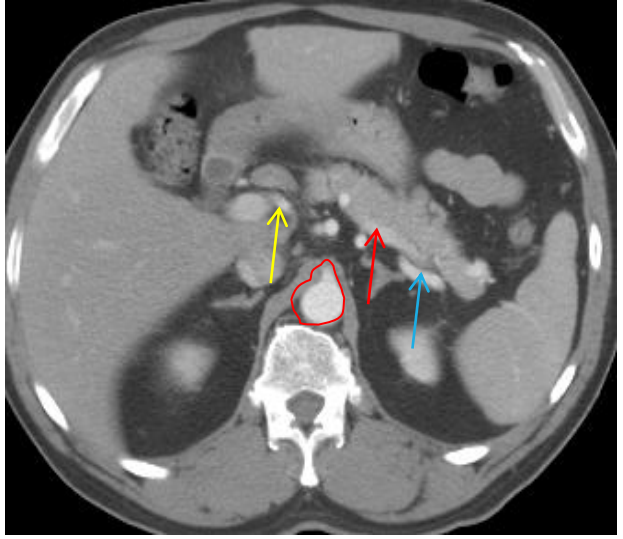


Adrenal Glands

Portal vein

Splenic Vein

Proper Hepatic Artery

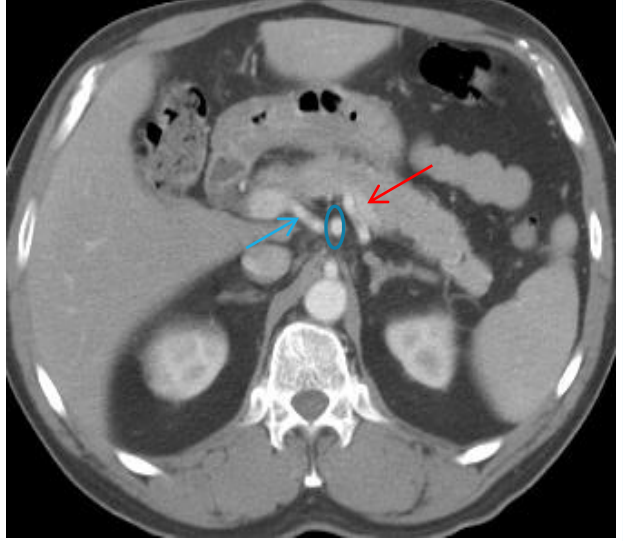


Celiac artery starting to branch from the Aorta

Hepatic Artery

Splenic artery

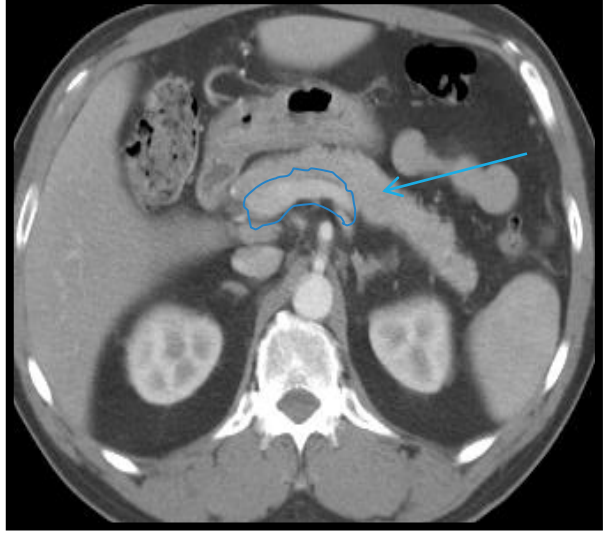
Splenic vein



splenic artery

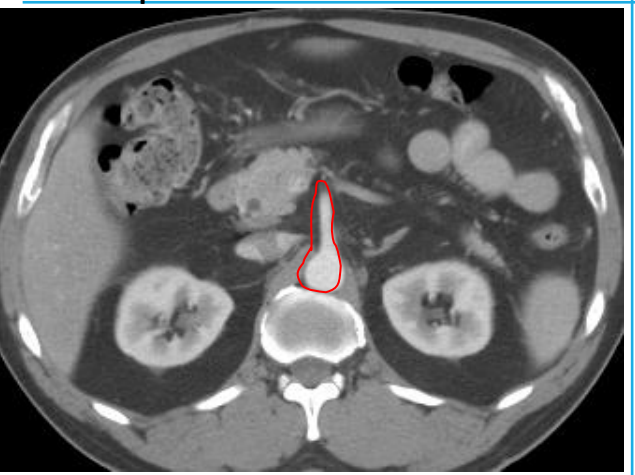
Hepatic Artery

Splenic Vein

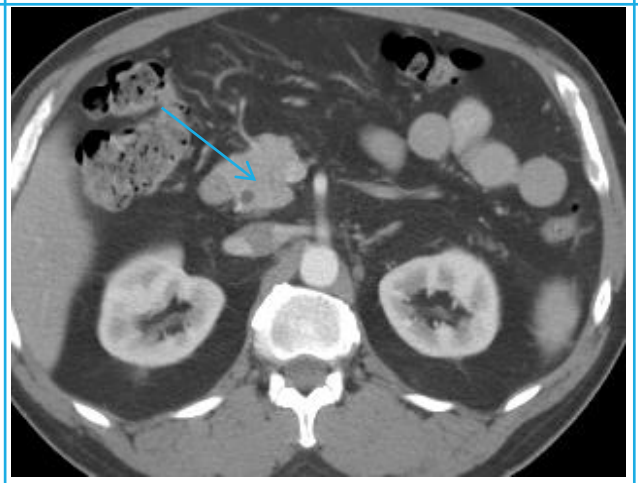


Splenic Vein is emptying into the portal vein

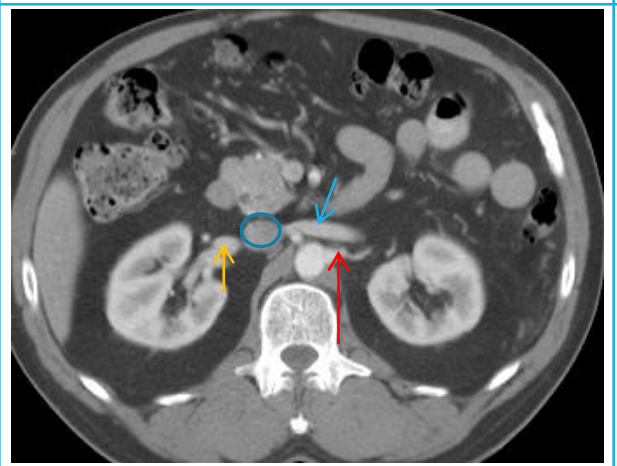
Pancreas



Superior Mesenteric Artery



Pancreas

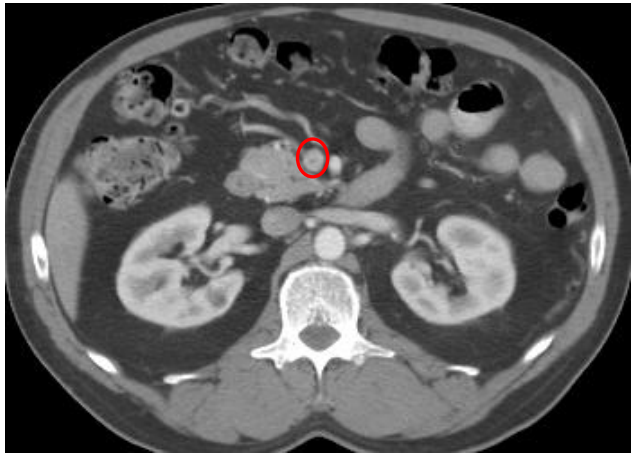


Inferior Vena Cava

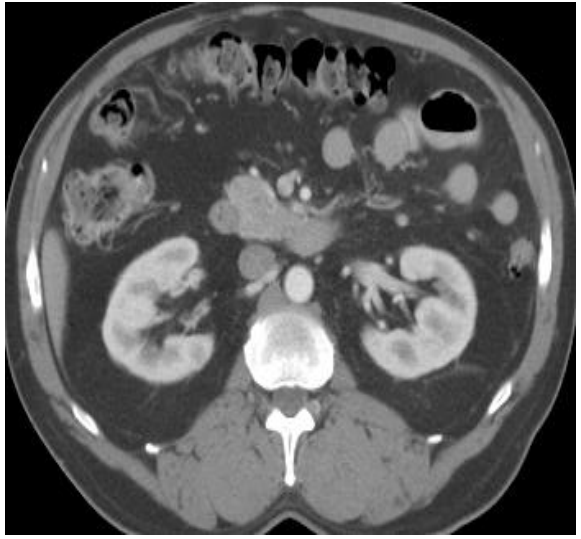
right renal vein

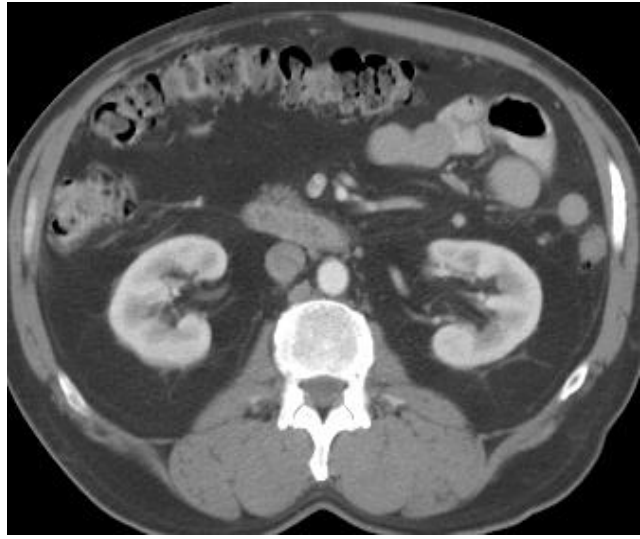
left renal vein

left renal artery



Superior Mesenteric Vein

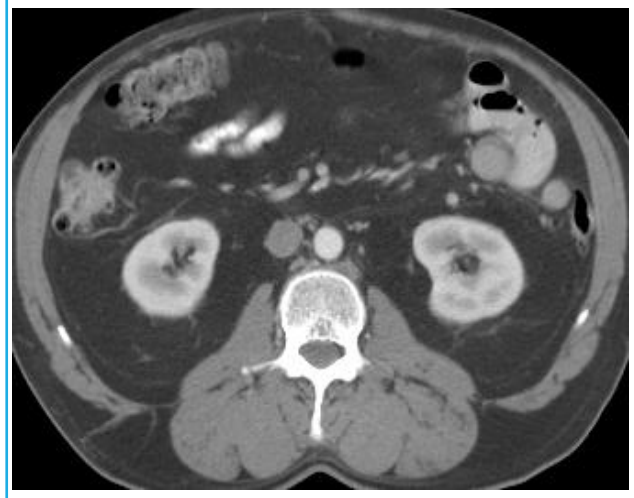


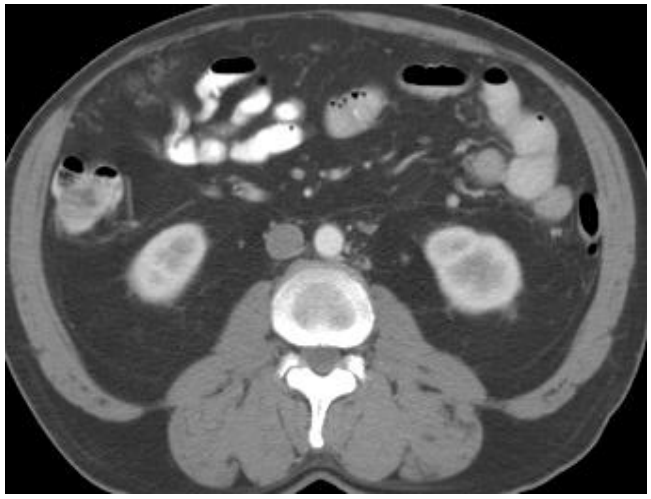


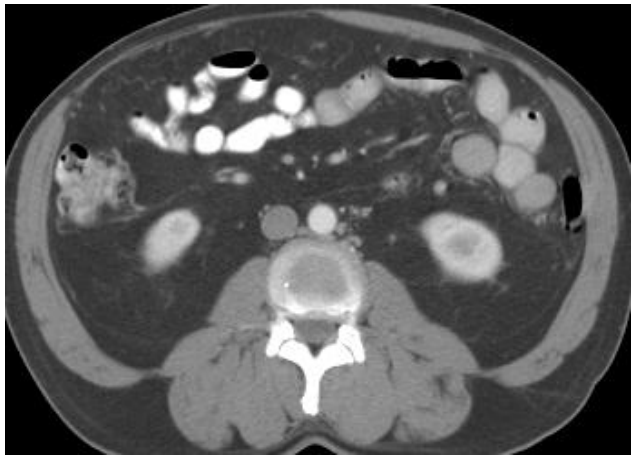
If you follow Superior Mesenteric Vein, it joins the Splenic Vein to form the Portal Vein

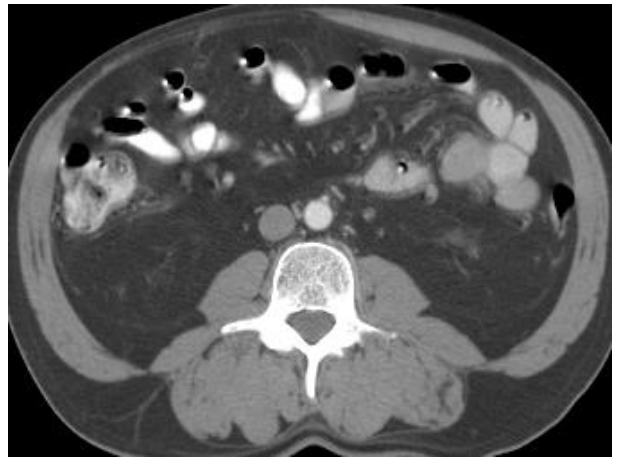
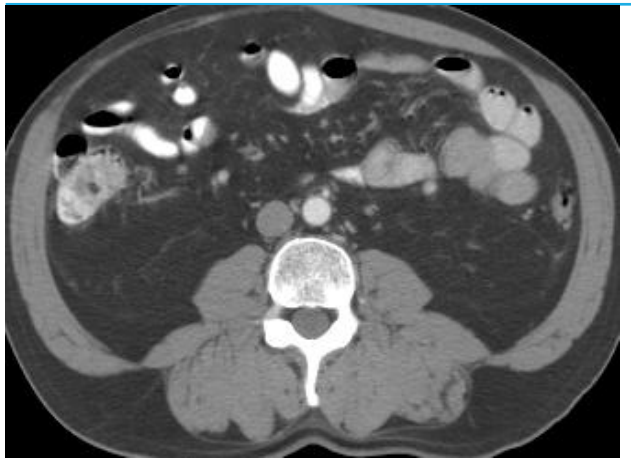
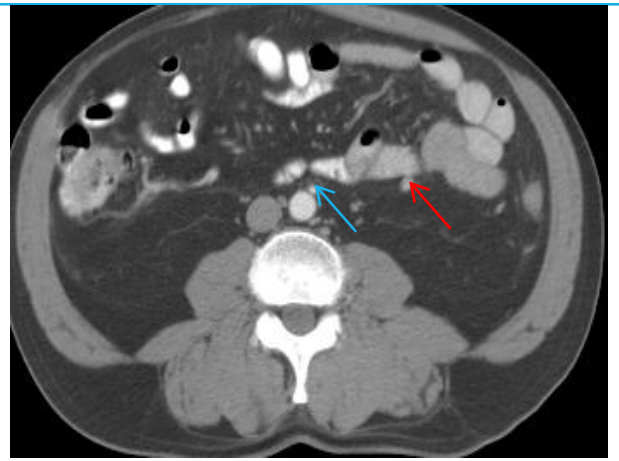
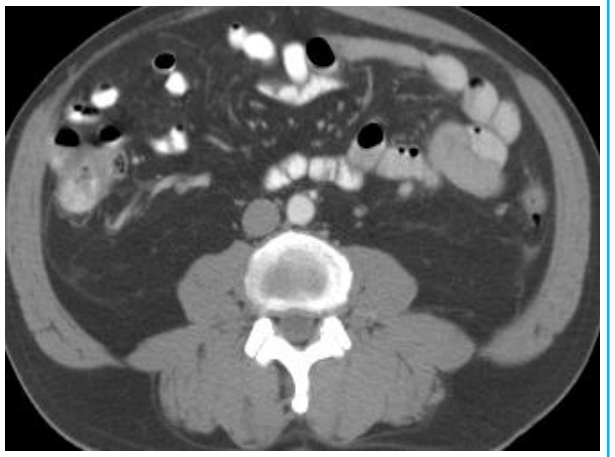
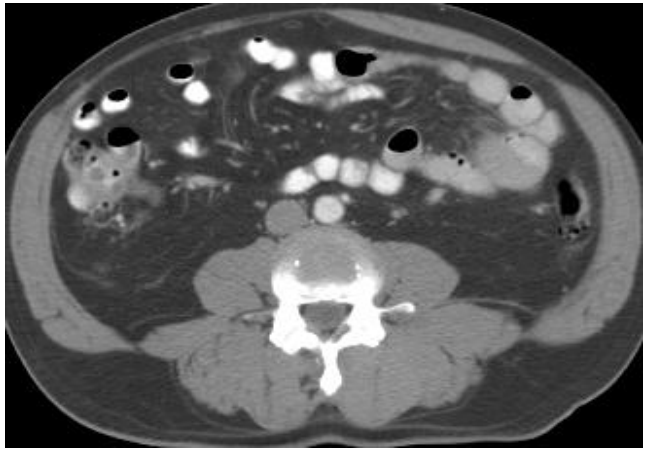
Transverse Colon

Small Bowell

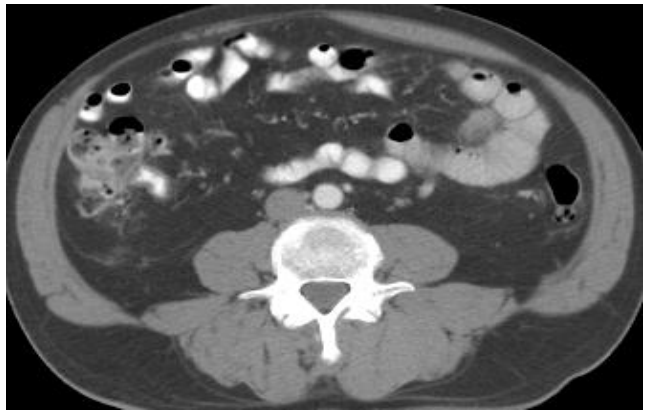
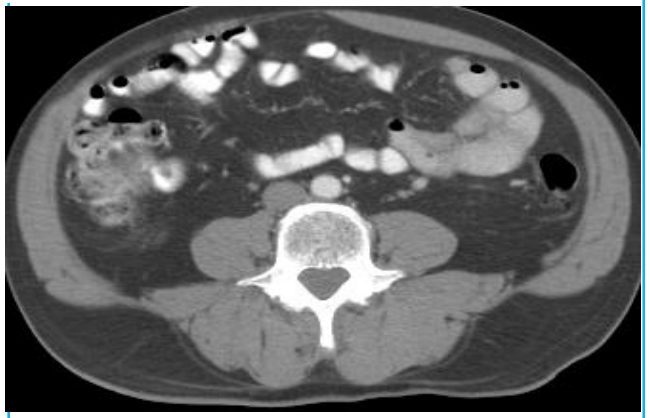


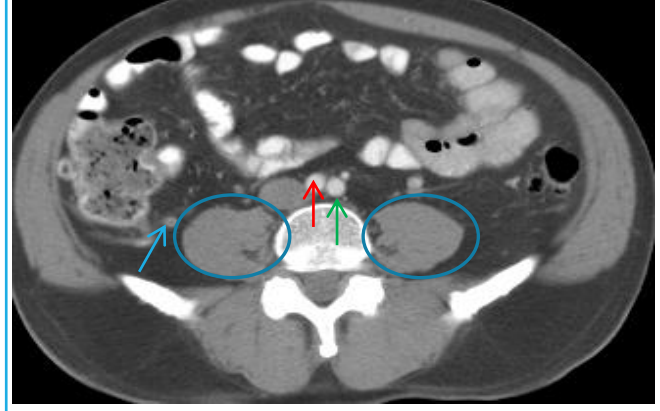
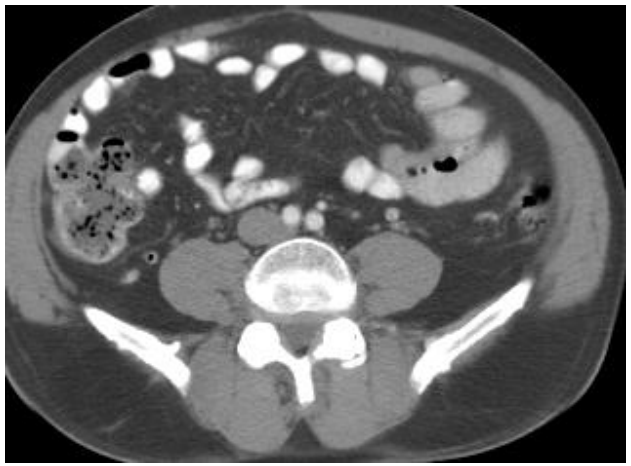
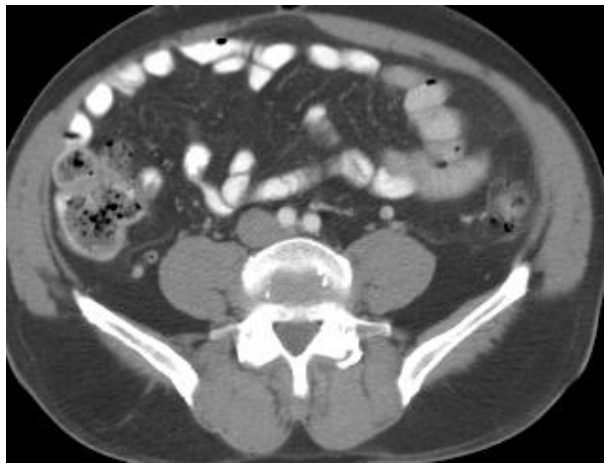
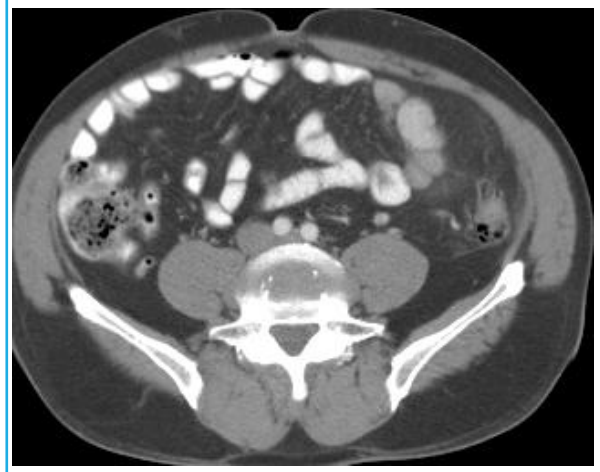
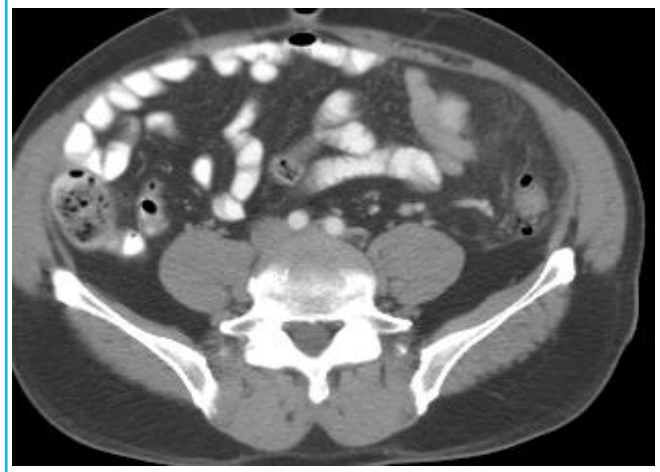




- inferior mesenteric artery emerging from aorta
- Inferior mesenteric vein extends cephalad to join superior mesenteric vein


Appendix
Aorta
common illiac arteries





Thank You!

We hope you found this helpful and informative.

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