

# Radiology of hepatobiliary diseases

## Lecture 13

### Objectives

" اللهم لا سهل إلا ما جعلته سهلا وأنت تجعل الحزن إذا شئت سهلا "

#### Color Index:

Main text Males slides Female slides Dr's notes Important Golden note Extra

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Editing File

45 year-old female with RUQ pain radiating to right shoulder and aggravated by fatty meals associated with vomiting.

## » What is the most likely diagnosis?

Gallstone +/- inflammation (cholecystitis)

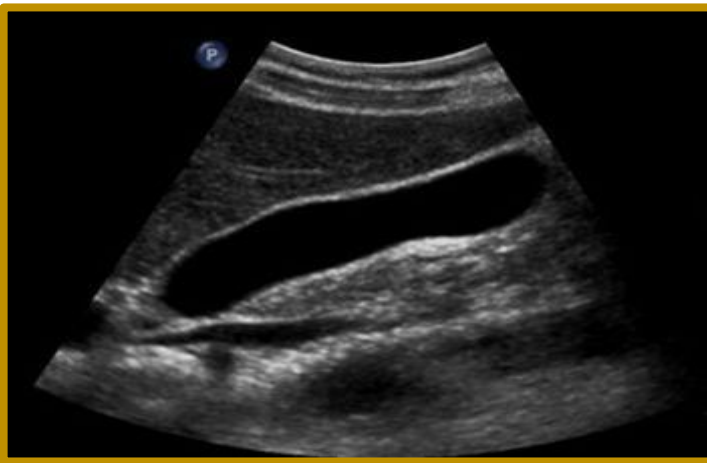
## » What is the best radiology modality to start with?

Ultrasound.

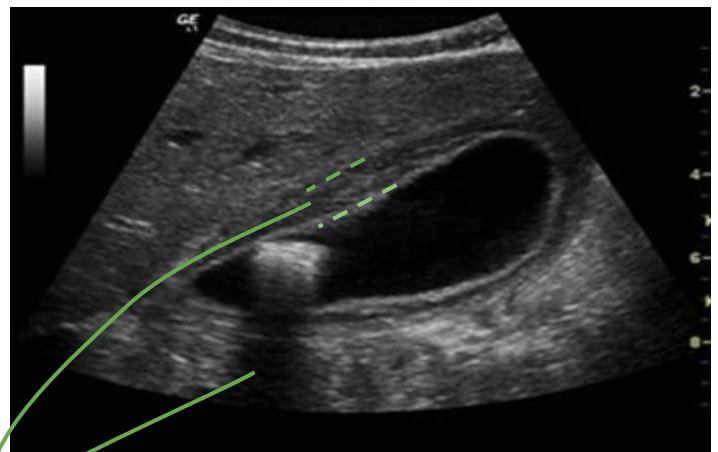
Why not CT? It can't detect fat

Why not MRI? Too complicated

Why not X-ray? It's not good at picking up gallstones. You can only see less than 10%, so you will miss 90%. It doesn't provide enough information about the gallbladder. You can't see inflammation.



Normal Gallbladder



Abnormal Gallbladder  
(Acute calculous cholecystitis)

## » What is abnormal?

- Hyperechoic structure inside the gallbladder
- Posterior **acoustic shadow**
- Thickening of the wall
- Distended gallbladder because of obstruction.
- **442:** clinically: positive Murphy's sign

Murphy's sign is a clinical finding used to diagnose cholecystitis. It involves palpating the right upper quadrant of the abdomen while the patient takes a deep breath. If the patient experiences pain or tenderness and halts their inspiration upon palpation, it is considered a positive Murphy's sign

## » Acute cholecystitis features in ultrasound:

- Gallbladder wall thickening (more than 3mm)
- Gallbladder distension
- Surrounding fluid
- Gallstone (calculous cholecystitis) without stone (Acalculous cholecystitis)
- 442: hyperemia
- **How do you know it's a stone?**
  - We have white structure "hyperechoic" with shadow (classic gallstone).

## » What is the difference between the two images?



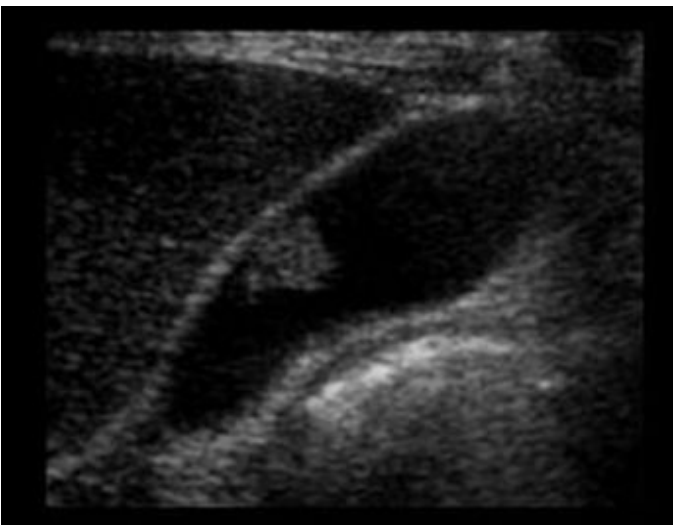
### Stone **WITHOUT** inflammation

- The stone is within the body of gallbladder.
- The Wall is normal.
- There is no inflammation.
- Usually asymptomatic



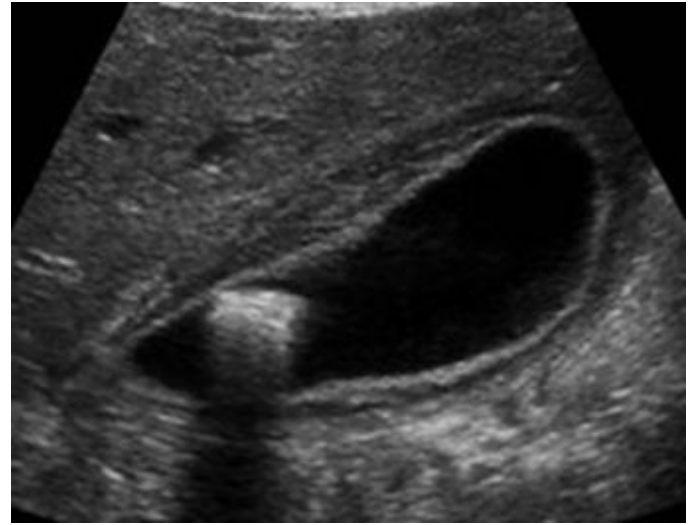
### Stone **WITH** inflammation

- The Stone is in the neck.
- The Wall is thickened.
- There is inflammation.



### **WITHOUT** acoustic shadow (GB **polyp**)

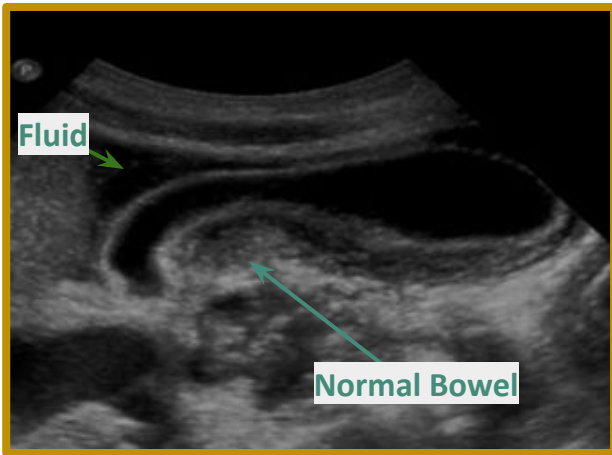
- Greyish structure
- No posterior shadow.
- There is no inflammation.
- It is a mass “gallbladder Polyp”.
- Could be benign or malignant.
- 442:hypoechoic structure
- 442:attached to the wall



### **WITH** acoustic shadow (GB **stone**)

- Calculous shadow with inflammation

The key to differentiate between a polyp and stone is the acoustic shadow



## Acalculous cholecystitis

- The inflammation without stone called (Acalculous cholecystitis)
- It has some fluid around.
- 442:Tx by relieving the distention with tube



## Calculous cholecystitis

- Inflammation with stone
  - 442:Treated by cholecystectomy
- 442: it's important to differentiate between them to choose the right treatment option

**Acalculous cholecystitis** less common & usually happens with very sick patients. Patients in the ICU are at higher risk because they are getting their nutrients either through NGT or IV and this won't stimulate GB to contract so it will be distended because of the accumulated bile and fluid (442:good media for infection) and that will cause inflammation.

## ➤ Different gallstones on US: 442: the key is the posterior shadow



Multiple tiny stones  
Big shadow

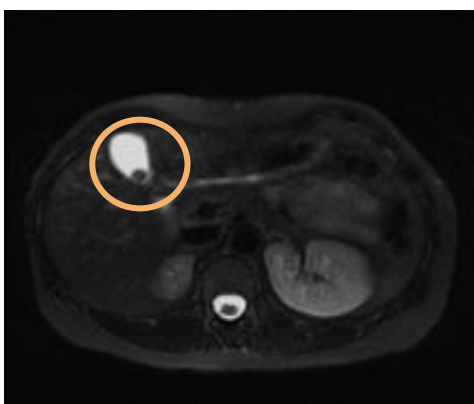


2 stones (2 shadows)  
**Gallbladder stones with no features of cholecystitis**

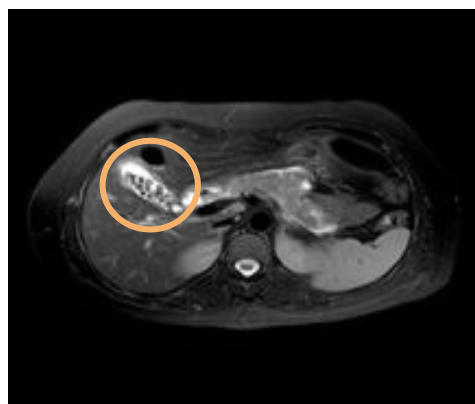


1 stone (1 shadow)

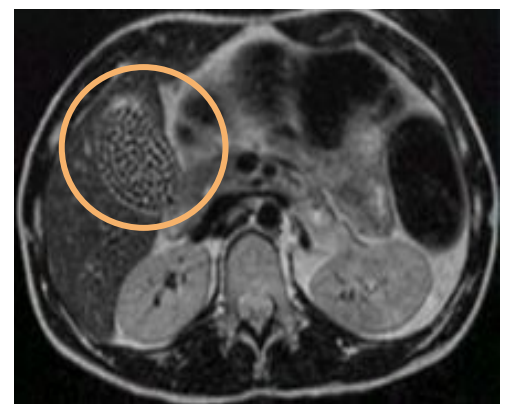
## ➤ Gallstones on MRI: 442:If US was not helpful next step is MRI, we do not do CT



1 stone, Usually gallbladder appear white/hyperintense



Multiple stones, Stones appear black/hypointense



Multiple stones replacing the whole gallbladder

60 year old male with chronic alcoholic consumption & complaining of fatigue, disorientation and abdominal distention.

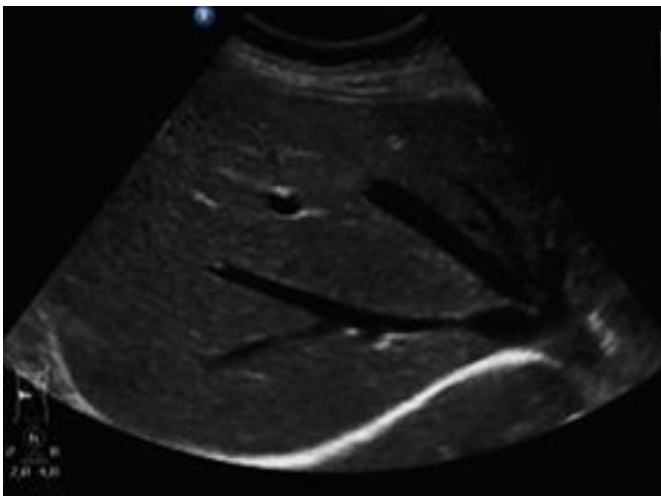
## »» What do you think this patient has?

- Chronic liver disease (Liver cirrhosis) due to hepatitis

## »» What radiology modality you will start with?

- Ultrasound. Aim is to confirm if the liver is normal or abnormal  
X-ray is not good for liver and soft tissue

## »» what is abnormal



**Normal Liver**

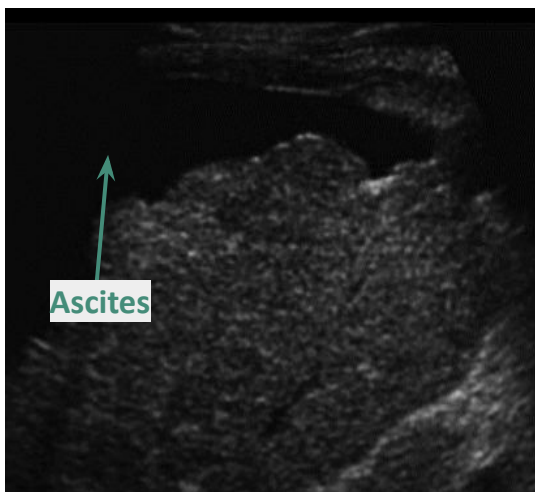
- Smooth surface
- Hypoechoic
- Normally we can't see the whole liver in one image



**Liver cirrhosis**

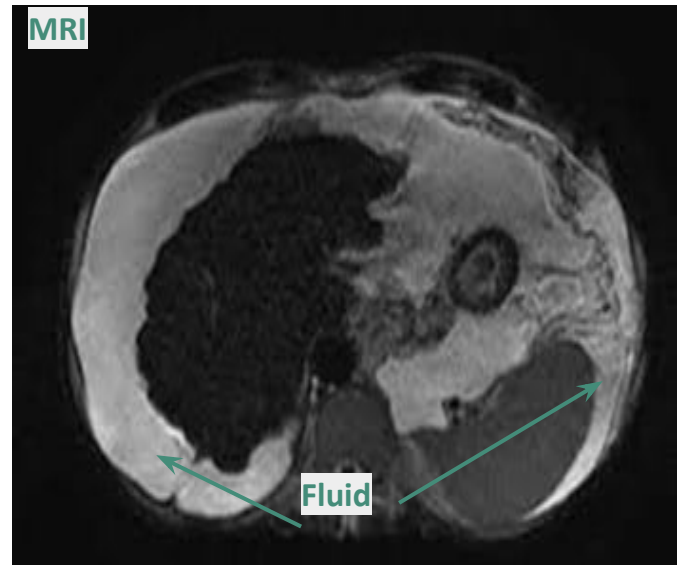
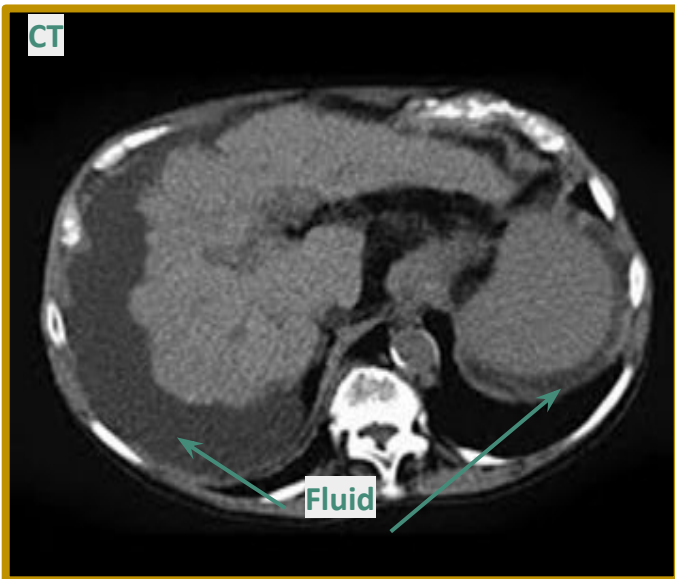
- Nodular liver surface.
- Shrunken size as part of the image contain no liver
- Hyperechoic parenchyma due to fibrosis
- -/+Ascites (fluid)
- In liver cirrhosis, we must look for masses

### Other examples of cirrhosis:



Coarse/heterogeneous appearance

## » Cirrhosis on CT scan and MRI:



### Liver cirrhosis with ascites

shrunken liver with irregular surface  
surrounded by fluid

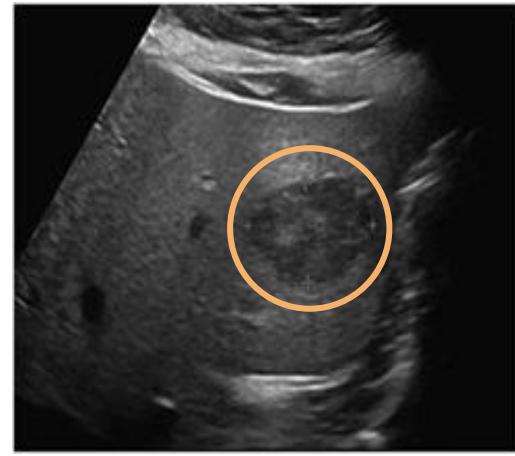
442: in liver cirrhosis there is spleen enlargement & fluid around  
live because of portal hypertension.



wow, such empty

## » US for chronic hepatitis B virus patient. What is your diagnosis?

- Hypoechoic mass within the liver. US excluded cirrhosis but we can't tell if the mass is benign or malignant.



## » What is DDX?

### a) Benign:

- 1- Hemangioma.
- 2- Adenoma.
- 3- Focal nodular hyperplasia.
- 4- cysts e.g., hydatid cyst

### b) Malignant:

- 1- Hepatocellular carcinoma.
- 2- Metastasis e.g., cholangiocarcinoma

### • How to tell if it's benign or malignant?

DO CT scan or **MRI with intravenous contrast.**

[442: why CT or MRI? To characterize liver lesion \(benign,malignant...\)](#)

## » What do we mean by triphasic?

### Scanning liver with IV contrast in three different phases:

**442: multiple images to look for the pattern of enhancement**

- Phase 1 (**arterial**): when IV contrast in arteries → 30 to 40 seconds after IV contrast injection

We wait 30-40 sec because first we'll give a contrast to a peripheral vein then it'll go to right side of the heart → pulmonary circulation → left side of the heart → systemic circulation through the aorta → organs

- Phase 2 (**portal-venous**): when IV contrast in veins → 60 to 70 seconds after IV contrast injection.

- Phase 3 (**delayed or equilibrium**): after 3 to 5 minutes after IV contrast injection to give more time for mass to wash out the contrast.

- **Normal liver** parenchyma is 80% supplied by the **portal vein** and only 20% by the hepatic artery, so liver will be **enhanced in the portal venous phase.**
- However, all **liver tumors** gets 100% of their blood supply from the **hepatic artery**, so the tumor will be enhanced in the **arterial phase.**

# Case 3

- Triphasic liver CT scan helps in differentiating between liver lesions (benign vs. malignant) based on **enhancement pattern**
  - **Benign:** BLACK(no enhancement) in phase 1 / WHITE in phase 3 (e.g. **hemangioma** → most common benign tumor of the liver).
  - **Malignant:** WHITE (enhancement) in phase 1 / BLACK (no enhancement) in phase 3 (e.g. **HCC** → most common malignant tumor of the liver which is **hypervascular** and take the contrast in a very early stage!).

## » 437 notes

We do 3 phases because:

1. To differentiate the tumor (e.g. HCC appears in arterial phase and doesn't appear in portal).
2. In equilibrium phase the malignant tumor may be seen as a cyst.
3. When we want to do only one phase we prefer portal phase because the whole liver will uptake the contrast.

## » What is the difference between both cases?

### a. Hepatocellular carcinoma



White → uptaking contrast



Lesion Similar to liver



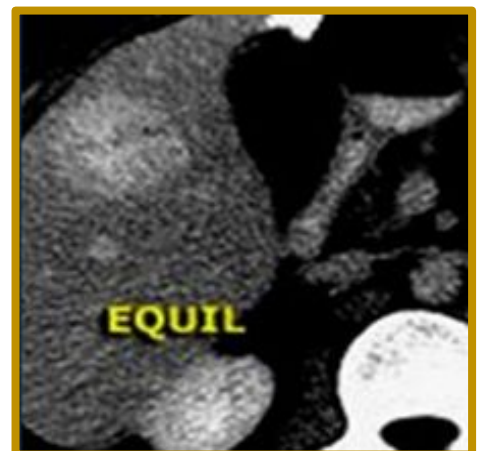
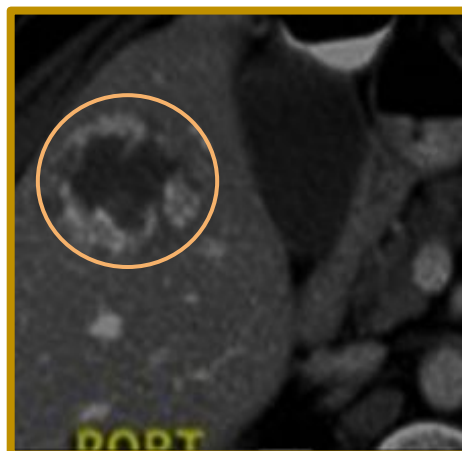
Black lesion (early washout from the lesion)

442: enhancement in arterial phase

### b. Hemangioma: blood accumulate very slowly (slower than the liver)



Slow accumulation of contrast only the peripheral of the lesion



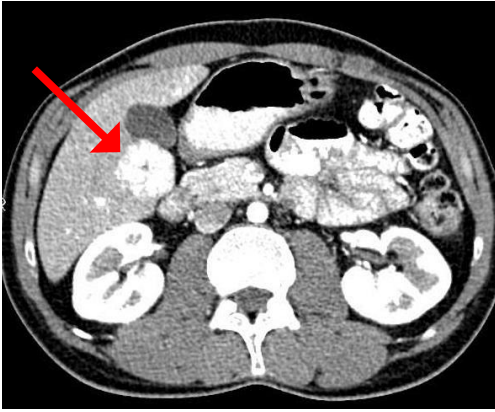
Then becomes more white in late phase

442: Enhancement in delayed phase

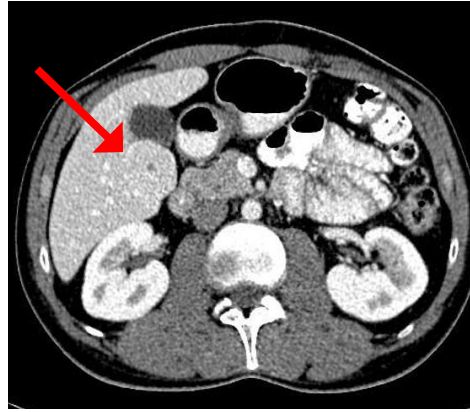


## » Enhancement patterns of liver lesions :

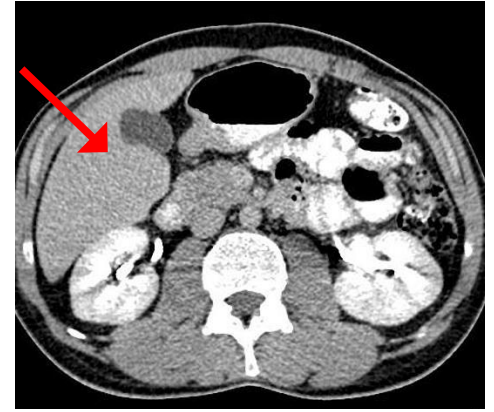
- Focal Nodular Hyperplasia (FNH)



**Arterial phase**  
Hyper-vascularity  
(enhance more than liver)



**Venous phase**  
Iso-dense (like liver)



**Delayed phase**  
Iso-dense (like liver)

- Hepatocellular carcinoma (HCC)



**Arterial phase**  
Hyper-vascularity  
(more than liver)

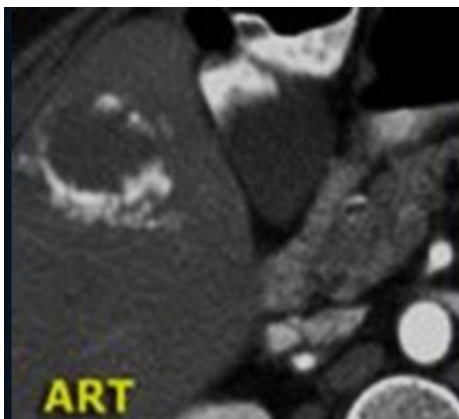


**Venous phase**  
Iso-dense (like liver)

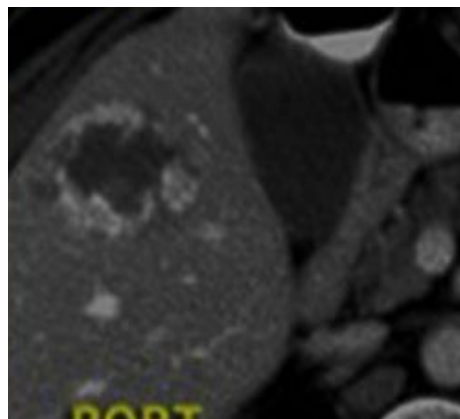


**Delayed phase**  
hypo-dense (less than liver)  
/contrast washout

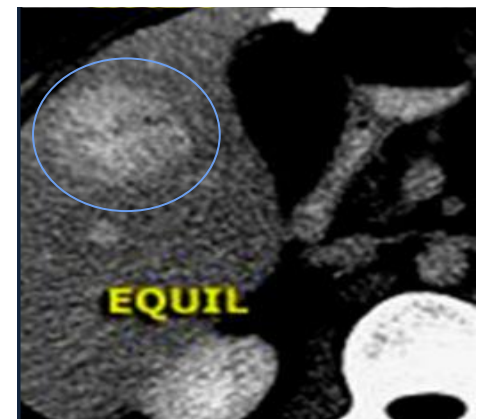
- Hemangioma **A slow filling lesion**



**Arterial phase**  
(Peripheral nodular  
enhancement)



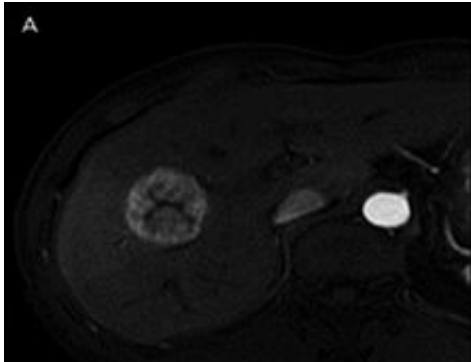
**Venous phase**  
(More peripheral nodular  
enhancement)



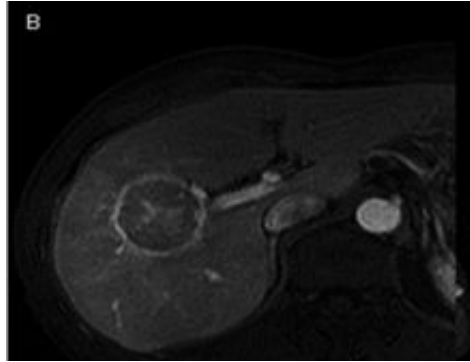
**Delayed phase**  
Complete contrast  
enhancement)

## » MRI of the liver:

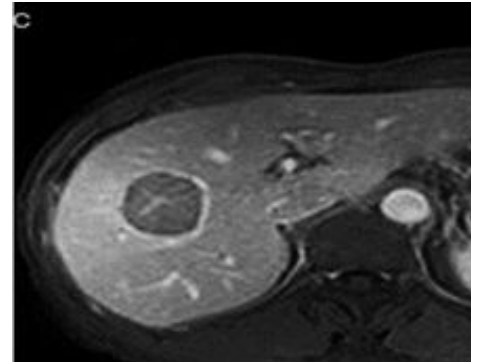
Is it Benign or Malignant? Malignant (HCC).



Arterial phase (white aorta)  
it's taking the contrast and  
rest of the liver not yet



Portal phase, liver start to uptake  
and lesion is almost similar,  
surrounded by capsule which is  
compressed and hyperintense



Late phase  
liver uptake and lesion  
wash it out become  
black



wow, double empty

Male patient with chronic abdominal pain.

## » What is abnormal?

- **Gallbladder calcification:**

442: Radiopaque oval shaped opacity on the right side of the abdomen

- **Porcelain gallbladder** (calcification in whole GB wall).
- Gallbladder stones (NOT common to see on X-ray).



We can't reach to the diagnosis by using x-ray.

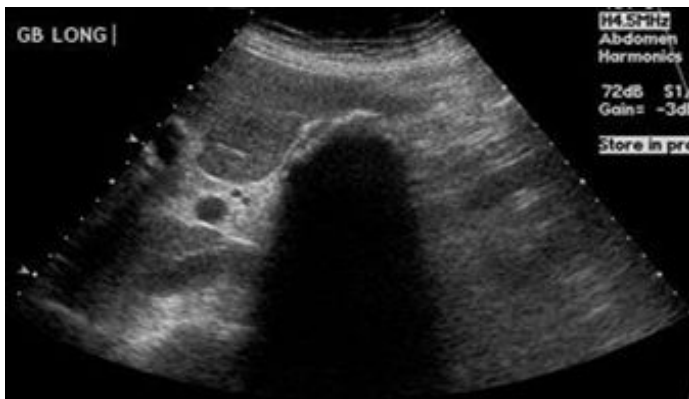
## » How to confirm the diagnosis?

- CT scan or US? 442: we start with US.

CT scan because we don't expect US to be helpful recall that, one of US limitations is a calcified structure as US can't see beyond the calcification

## » Which modality is better?

- US



Not beneficial for this case because the whole wall is calcified which appears as big area of shadow which will hide the gallbladder, we can't differentiate between a large stone with shadow OR calcification on the wall

- CT without contrast



**Porcelain gallbladder**  
In CT we can clearly see the calcification on the wall of gallbladder (white arrow)

## » Porcelain gallbladder (calcification of GB wall):

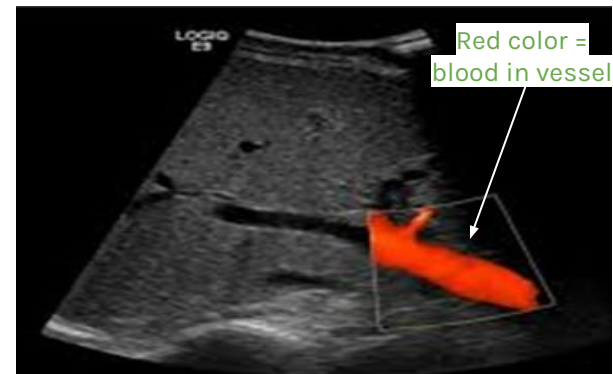
- Complete or partial GB wall calcification
- Risk of developing cancer 5 -7%. (Adenocarcinoma)
- Needs follow every year or surgical resection(better).

50 year-old lady presented to the emergency with RUQ pain and yellow discoloration of sclera, pale stool and dark urine.

## » What is the most likely diagnosis?

- Obstructive Jaundice
- Causes:
  - Stone (because it's painful)
  - If it was painless we think about tumor as malignancy usually a silent disease patients will present if they start to have obstruction

Normal Ultrasound



## » Which radiology modality you prefer to start with?

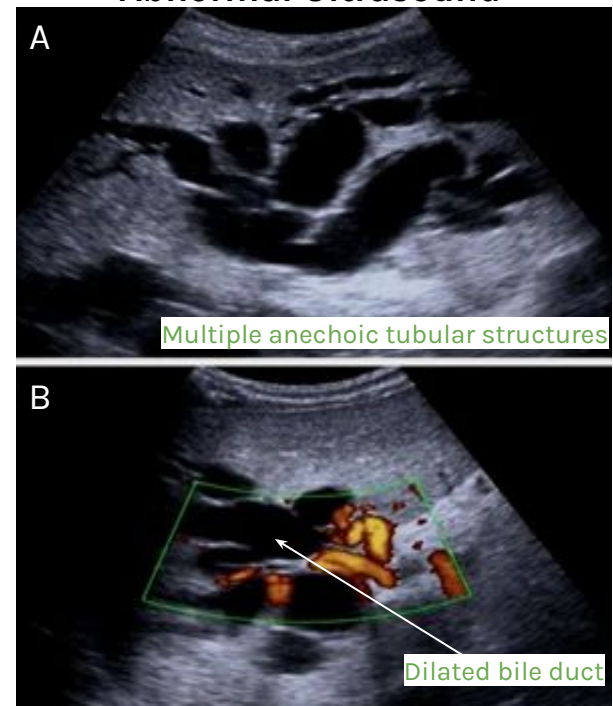
- Ultrasound

## » Interpretation

### Abnormally:

- On ultrasound we see a tubular structures. is it bile ducts or blood vessels? you need to do doppler.
- On doppler, not all the tubular structures are blood vessels. so there is a **severe intrahepatic bile duct dilatation**.
- You can tell if its a bile duct or blood vessels by the flow (blood flow is continuous).
- Doppler confirms the patient has post hepatic obstruction **but we can't tell what's causing the obstruction**

Abnormal Ultrasound



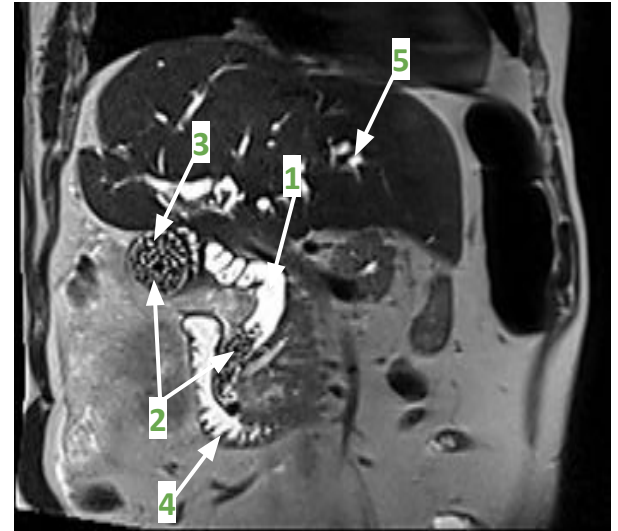
## » What to do next?

- **MRCP/MRI** to first exclude or confirm stones as unfortunately US didn't help & sometimes common bile duct is deep & a lot of bowel over it & we can't see the area of common bile clearly. Why not CT? Because CT will only help with calcified stones & most of biliary stones are not, also if CT was negative we still can't exclude stones

## » Multiple gallstones in GB & common bile duct (CBD)

- **What is abnormal?**  
Multiple **gallstones** in GB and common bile duct (**CBD**).
- **Treatment:** Remove the stones use (ERCP).
- **Labels:**
  1. Dilated common bile duct.
  2. Stones.
  3. Gallbladder.
  4. Duodenum.
  5. Dilated ducts within the liver.

MRI without contrast



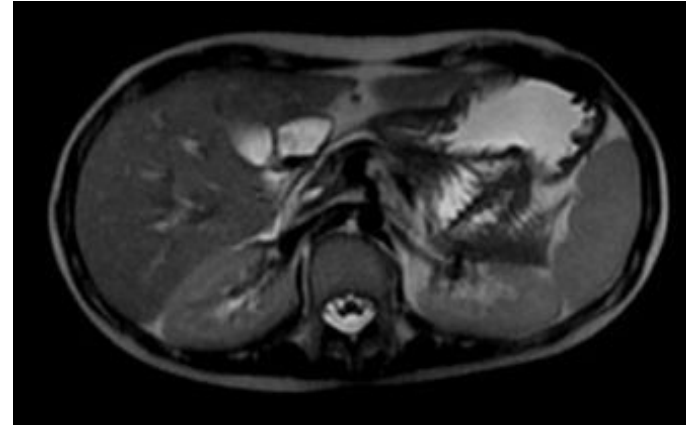
Yes, this Lecture is full of emptiness

20 year-old case of Thalassemia with repeated blood transfusion.

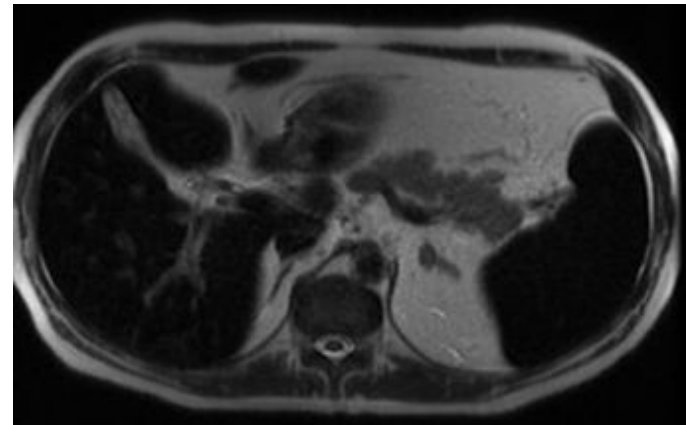
## » What is the Abnormality?

- The liver, spleen and bone marrow are dark in signal (hypo-intense) because of iron overload (**Hemochromatosis**), due to repeated blood transfusion.
- There is splenomegaly.
- The abnormalities are present in iron stores.

Normal MRI



Abnormal MRI  
What is abnormal here?

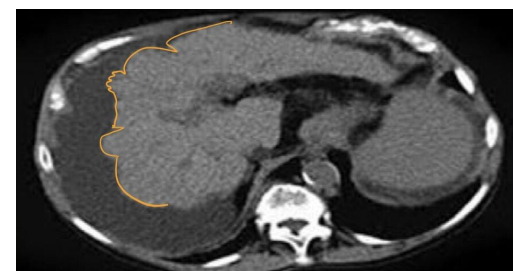
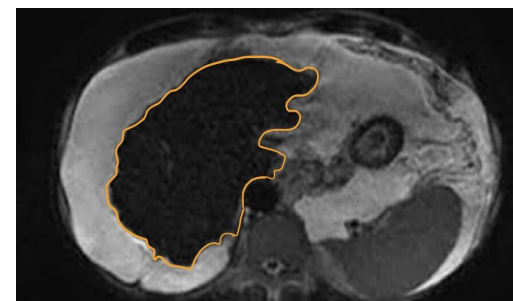


## » Which radiology modality is the choice?

- MRI is the modality of choice to assess and quantify iron in solid organs, and to follow up treatment & dosing of chelation therapy (an agent that bind to iron and get rid of it)

## » For better understanding (special thanks for team 436)

- The orange lining represents the liver edges.
- In MRI, the liver is hypointense in comparison to surrounding fat and fluid.
- In CT the liver is hypodense and shrunken with irregular edges and surrounded by fluid.



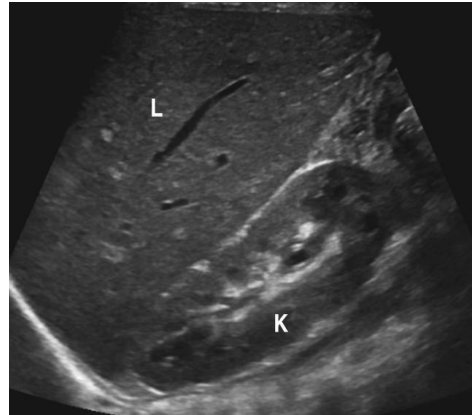
45-year-old male with RUQ pain and abnormal LFTs.

442:

L: liver

K: kidney

On the abnormal pic. :  
hyperechoic liver compared to  
the kidney



Normal



Abnormal

## » Fatty liver (hepatic steatosis):

- Common 25%.
- Causes:
  - Idiopathic.
  - Alcohols.
  - Insulin resistant DM.
  - Obesity.
  - Steroid. Etc..
- Can cause Non-alcoholic steatohepatitis (NASH) and cirrhosis.

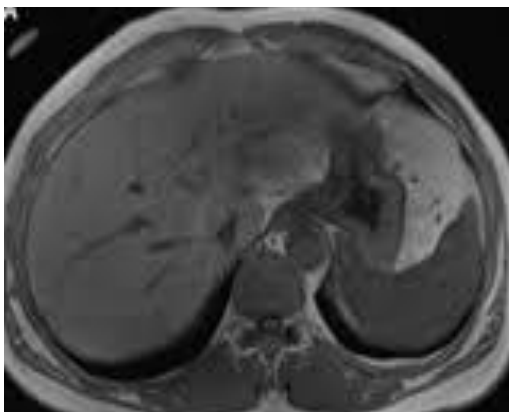
442: continuous inflammation -> cirrhosis



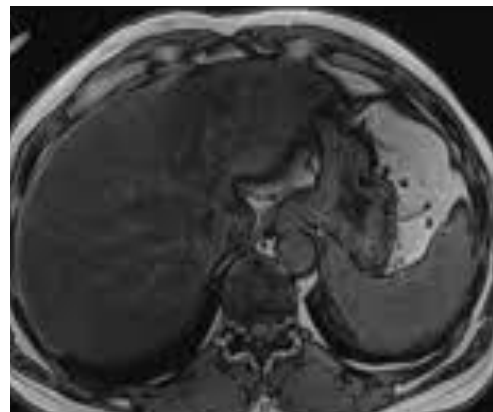
Hyper-echoic liver  
(more than kidney)

442: because of fat accumulation

## » Fatty liver on MRI :



T1 WI (In-phase)  
Normal liver signal



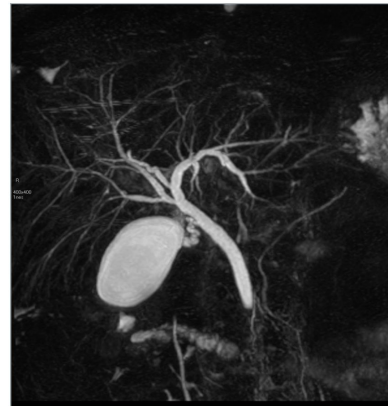
T1 WI (Out-phase)  
Hypo-intense liver signal

45-year-old lady with history of ulcerative colitis with abnormal LFT (elevated alkaline phosphatase (ALP) and bilirubin)

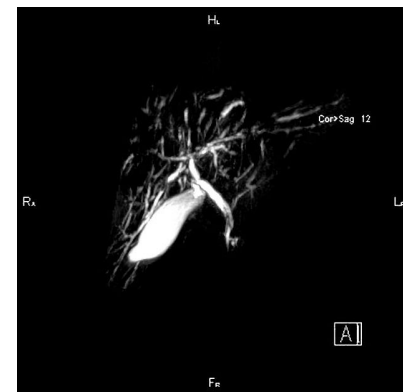
## » What do you suspect?

- Primary sclerosing cholangitis (PSC)
- It is a progressive chronic inflammation of both the intrahepatic and extrahepatic bile ducts. The exact etiology is unknown but there is a strong association with autoimmune diseases, particularly ulcerative colitis (UC).

Normal



Abnormal



## » What to do next?

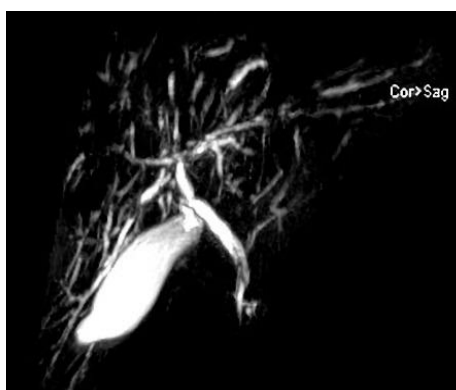
- MRI/MRCP

442:

- Irregular dilatations
- Alternation of strictured and dilated segments

## » Primary sclerosing cholangitis (PSC)

- **Common association with inflammatory bowel disease (70%). MCQ**
- Other association:
  - Autoimmune hepatitis.
  - Sjogran syndrome.
- MRCP findings: Multiple bile ducts structures and dilatations.
- Complications: Cholangiocarcinoma, Liver cirrhosis.
- 442: Tx: may require liver transplant



**MRCP**

(Magnetic resonance cholangiopancreatography)



**ERCP 442: invasive**

(Endoscopic retrograde cholangiopancreatography)

442: Multiple bile duct strictures and dilatations



Not found in 442 slides

Patient with RUQ pain suspecting cholecystitis. US and MRI were not conclusive

## » What to do next?

CT scan? MRI? Nuclear scan?

- Nuclear scan (HIDA scan)

## » What is the difference between the images

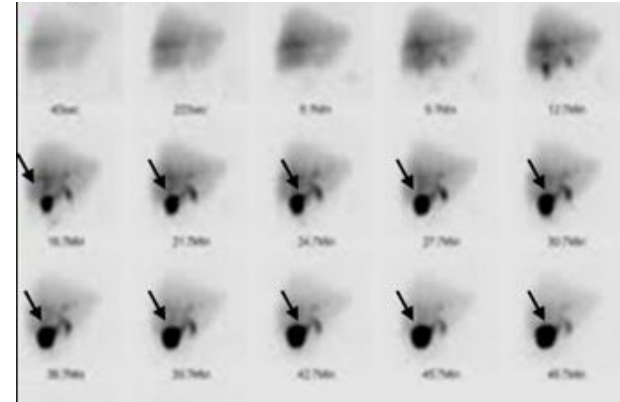
### Normally

1. Liver start to uptakes radioactive material by hepatocyte.
2. Slowly increase the uptake.
3. Liver start to excrete it in the bile duct
4. Slowly start to fill in gallbladder (black arrow).

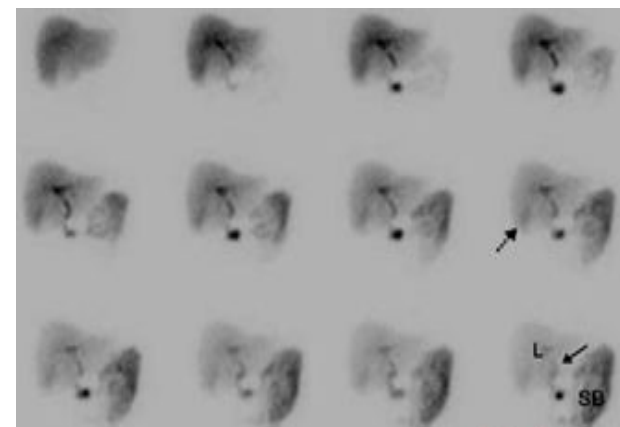
Acute cholecystitis

there is no uptake in gallbladder, means there is an obstruction.

Normal HIDA scan



Abnormal HIDA scan  
what is abnormal here?



## » Other indications for HIDA scan

- Biliary atresia (children): everything accumulate in the liver
- Bile injury post-surgery: instead of going to the normal pathway from bile duct to the bowel, it will escape from the bile duct into the peritoneal space
- Bile obstruction: in functional obstruction (no contraction of gallbladder or no relaxation of the ampulla) it will accumulate in the gallbladder.

# Summary

	presentation	modality	information
Gallstone	<ul style="list-style-type: none"> <li>• Radiating right upper quadrant pain</li> <li>• Aggravated by meals</li> <li>• Vomiting</li> </ul>	Ultrasound (acoustic shadow)	<ul style="list-style-type: none"> <li>• Can be with or without inflammation</li> <li>• <b>With</b>(GB stones) or <b>without</b>(GB polyp) acoustic shadow</li> </ul>
Chronic liver disease (liver cirrhosis)	<ul style="list-style-type: none"> <li>• Chronic alcohol consumptio</li> <li>• Fatigue</li> <li>• Disorientation</li> <li>• Abdominal distention</li> </ul>	Ultrasound	<ul style="list-style-type: none"> <li>• Nodular and irregular liver surface.</li> <li>• Shrunken size.</li> <li>• Hyperechoic parenchyma (fibrosis)</li> <li>• +/- Ascites (fluid)</li> </ul>
Mass	<p>in our case:</p> <ul style="list-style-type: none"> <li>• US for chronic hepatitis B, a mass was noted</li> </ul>	CT or MRI with contrast	Triphasic scan help in differentiating benign from malignant masses
Gall bladder calcification	<ul style="list-style-type: none"> <li>• Abdominal pain</li> </ul>	Better: CT (without contrast) or US	Complete or partial GB calcification need follow-up every year or surgical resection
Obstructive jaundice	<ul style="list-style-type: none"> <li>• RUQ pain</li> <li>• Yellow discoloration of the sclera</li> <li>• pale stool</li> <li>• Dark urine</li> </ul>	US	What to do next? MRI
Iron overload	<p>history of:</p> <ul style="list-style-type: none"> <li>• Thalassemia</li> <li>• Repeated blood transfusion</li> </ul>	MRI	present with Splenomegaly
Acute cholecystitis	RUQ pain suspecting cholecystitis Inconclusive US and MRI	Nuclear scan	Nuclear: No uptake by the gallbladder

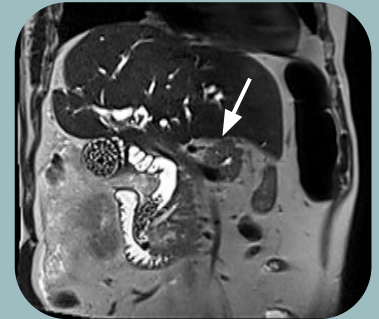
1- what does the image show?

- a. Acalculous cholecystitis
- b. Hepatocellular carcinoma
- c. Liver cirrhosis
- d. Hemangioma
- e. focal nodular hyperplasia



2- What does the arrow show?

- a. Gallbladder
- b. Dtones
- c. Dilated duct within the liver
- d. Dilated cystic duct



3- Which of the following not an indicator for HIDA scan ?

- a. Bile obstruction
- b. Bile duct dilatation
- c. Biliary atresia in children
- d. Bile injury post-surgery

4- What is the modality of choice in case of thalassemia ?

- a. CT
- b. Ultrasound
- c. X-Ray
- d. MRI

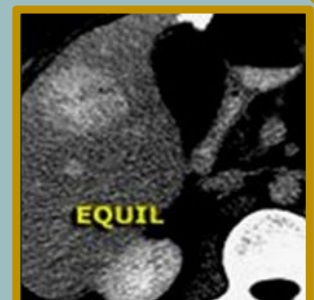
5- What is the most likely diagnosis of the image given below ?

- a. Gallbladder mass
- b. Liver mass
- c. Common bile duct stone
- d. Porcelain gallbladder



6- For the following triphasic liver CT. What is the most likely diagnosis ?

- a. Liver cirrhosis with ascites
- b. Hemangioma
- c. Pancreatitis
- d. Hepatocellular carcinoma



Answers  
1) C  
2) C  
3) B  
4) D  
5) D  
6) B