



# Radiology of hepatobiliary diseases

## Objectives

1. To Interpret plain x-ray radiograph of abdomen with common pathologies.
2. To know the common pathologies presentation.
3. To understand step wise approach in requesting hepatobiliary radiology investigations.
4. To know common radiological pathologies in hepatobiliary system..

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## Color Coding

Important | Notes | Extra

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## Case 1

**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 +/- cholecystitis .

- **What is the best radiology modality to start with?**

Ultrasound.

- **Why not X-Ray?**

It's not good at picking up gallstones. You can only see less than 10%, so you will miss 90%.

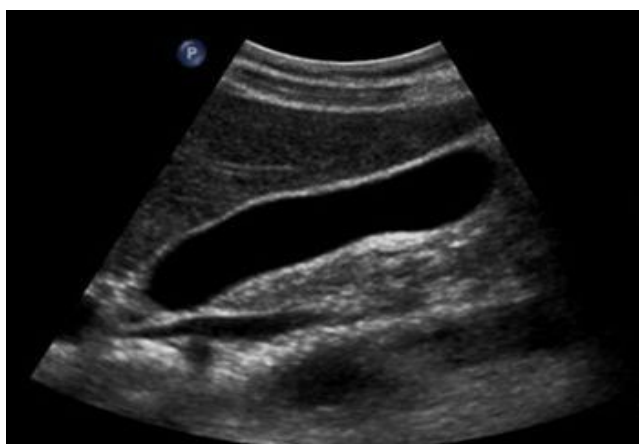
It doesn't provide enough information about the gallbladder. You can't see inflammation.

- **Why not CT?**

It can't see fat.

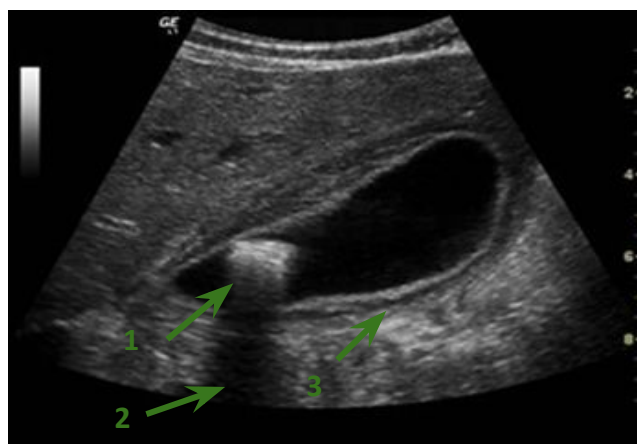
- **Why not MRI?**

Too complicated.



**Normal Gallbladder**

- **What is abnormal?**



**Abnormal Gallbladder**

The image on the right is of a gallbladder with:

1. Hyperechoic filling defect (anything inside a hollow structure we call it filling defect).
2. Posterior acoustic shadow.
3. Diffusely thickened wall (Acute calculous cholecystitis).
4. Distended gallbladder because of obstruction.

- **How do you know it's a stone?**

We have white structure "hyperechoic" with shadow (classic gallstone).

- **What are the most common features of acute cholecystitis in ultrasound?**

1. Thickening of the gallbladder wall (more than 3mm).
2. Gallbladder distension (Usually happens when there is stone → cause obstruction → bile doesn't go out → distension).
3. Surrounding fluid (as in any inflammation).
4. With gallstone (calculous cholecystitis) or without stone (Acalculous cholecystitis).

## What is the difference between the two images?



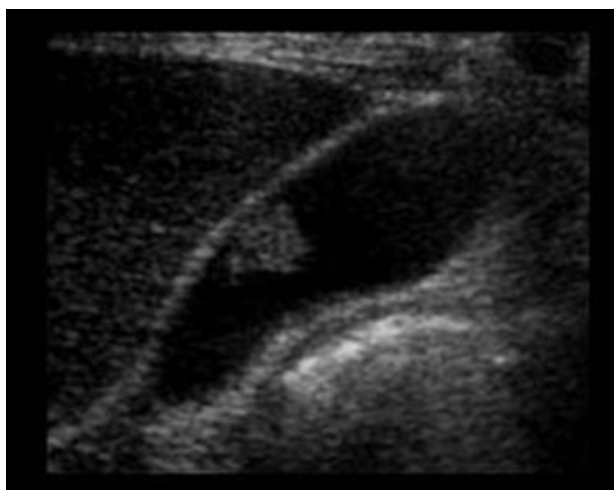
### Stone **WITHOUT** inflammation

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



### Stone **WITH** inflammation

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

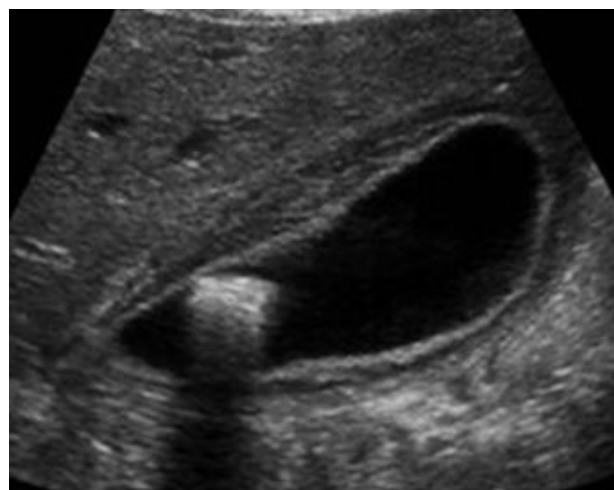


### **WITHOUT** acoustic shadow (GB polyp)

- Filling defect the space is suppose to be filled with clear fluid but here it is filled with something else.
- No shadow.
- There is no inflammation.
- It is a mass "gallbladder Polyp".
- Could be benign or malignant.
- Hanging on the anterior wall (not moving).

It's not stone because there is no shadow, and usually stones moves with position but the mass is clearly attached to the anterior wall.

**Management:** large polyps → cholecystectomy (may be cancerous).

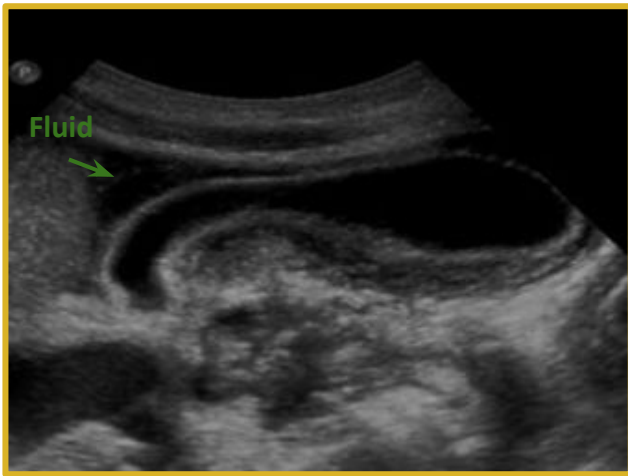


### **WITH** acoustic shadow (GB stone)

Calculus shadow with inflammation close to the neck of gallbladder (lower part)



The key to differentiate between a polyp and stone is the shadow on the soft tissue.



**Acalculous cholecystitis**

The inflammation without stone called (Acalculous cholecystitis) white → fat  
 It has some fluid around.  
 It is usually caused by stasis (ex: pts in ICU-NPO) if it doesn't contract for long time this increase the chance of getting inflamed.



**Calculous cholecystitis**

Inflammation with stone  
 obstruction causes inflammation  
 both images shows thickened gallbladder

**Different gallstones on US:**



**Multiple tiny stones**  
 Big shadow

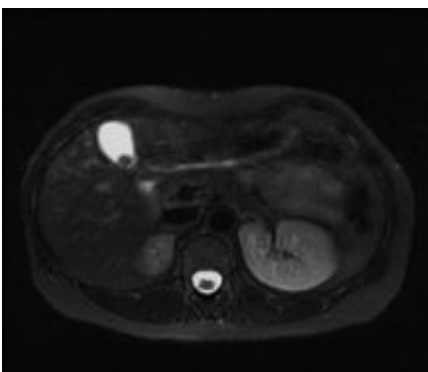


**2 stones**  
 2 shadows

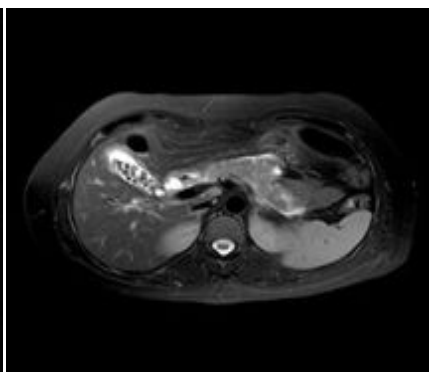


**1 stone**  
 1 shadow

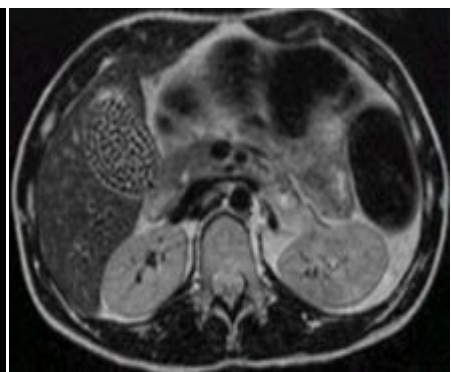
**Gallstones on MRI:**



**1 stone**  
 The hyperintensity is gallbladder, round black → stone



**Multiple stones**



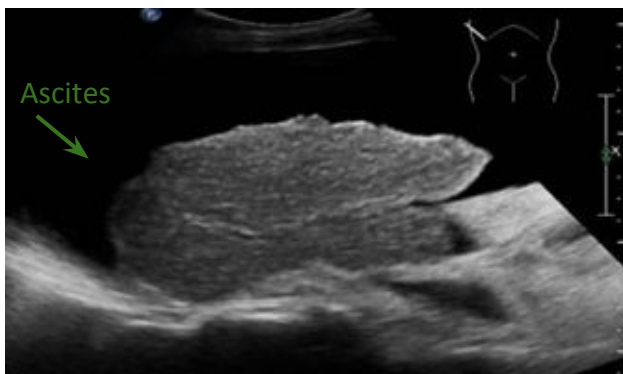
**Multiple stones** replacing the whole gallbladder

## Case 2

**60 year old male with chronic constipation complaining of fatigue, disorientation and abdominal distention** → indicate ascites.

- What do you think this patient has? Liver cirrhosis.
- What radiology modality you will start with? Ultrasound.

**What's the difference between the two images (US)?**



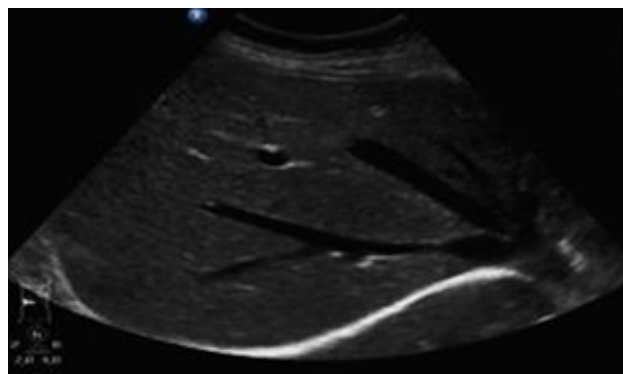
### Liver cirrhosis

Nodular and irregular surface.

Shrunken size.

Hyperechoic parenchyma (replaced by fibrous tissue).

Ascites (fluid around the liver appears black).



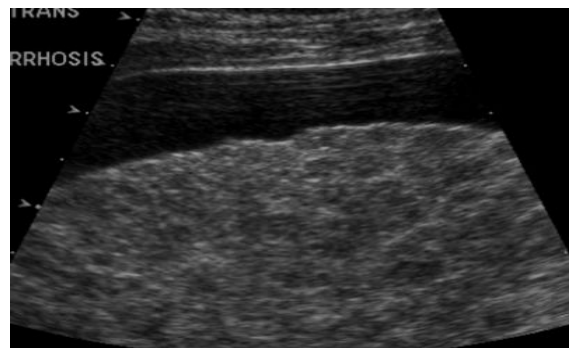
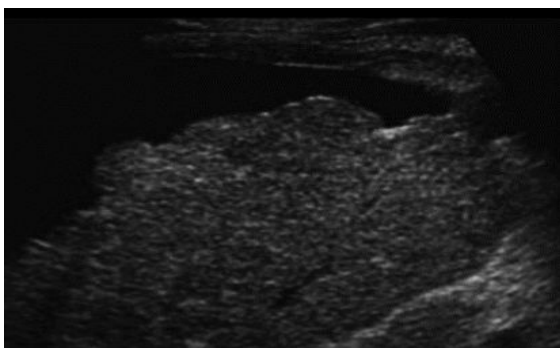
### Normal Liver

Smooth surface

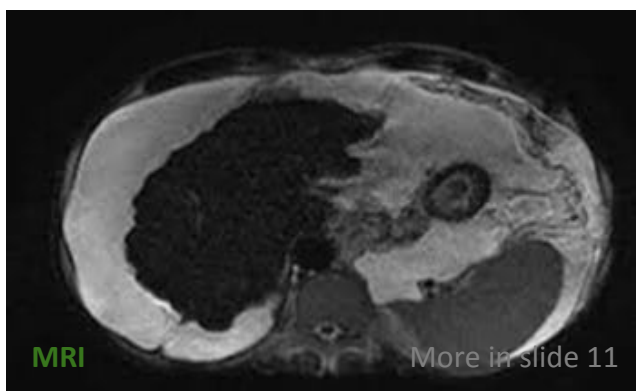
Hypoechoic

The normal liver don't occur in singal US image, you need to move the probe and see the other parts.

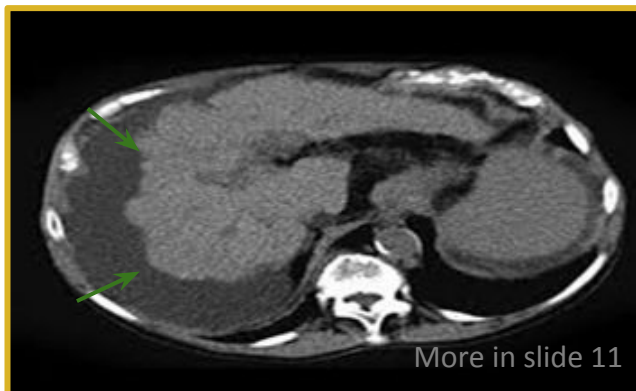
Other examples of cirrhosis:



**Cirrhosis on CT scan and MRI** CT & MRI are used to assess complications ex:HCC



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



**Liver cirrhosis with ascites (CT)**  
shrunken liver with irregular surface  
surrounded by fluid



## Case 3

- **US for chronic hepatitis B virus patient. What is your diagnosis?**

Hypoechoic lesion within the liver (look like a mass), from ultrasound we can't tell if it is benign or malignant. The patient has risk for cancer & cirrhosis.

- **What is DDx?**

a) Benign: abscess or cyst

1- Hemangioma. 2- Adenoma. 3- Focal nodular hyperplasia.

b) Malignant:

1- Hepatocellular carcinoma. 2- Metastasis.

- **What is the next step?**

CT with contrast to tell if it is benign or malignant. They behave differently with the contrast.

- In this case will take an extra step: the patient is known to have chronic hepatitis do US as routine screening every year, you may find hypoechoic lesion within the liver that it's like a mass, but we can detect with US whether it is benign or malignant.
- In a patient known with chronic liver disease, first thing you have to think about HCC, could be anything else benign but the most important thing is to exclude the more serious case (HCC).
- The liver can be affected by a benign lesions such as: hemangioma, adenoma, focal nodular hyperplasia, or it could be malignant e.g. HCC or metastasis.

**How to tell if it's benign or malignant? DO CT scan or MRI with intravenous contrast.**

Note: MRI is better than CT only if we can not use contrast with the CT.

In CT even in MRI if it's with contrast usually we will do a (triphasic scan).

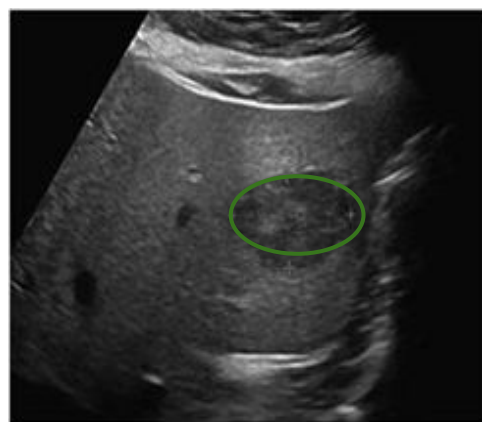
- **What do we mean by triphasic?** Scanning liver with IV contrast in three different phases:

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

- **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 get 100% of their blood supply from the hepatic artery, so the tumor will be enhanced in the arterial phase.



Well circumscribed mass hypoechoic lesion

## Triphasic scan helps in differentiating benign from malignant masses:

- Benign: BLACK in phase 1 / WHITE in phase 3 (e.g. hemangioma → most common benign tumor of the liver).
- Malignant: WHITE in phase 1 / BLACK 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!).

### 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.

- **CT scan with IV contrast (triphasic scan):** three phases of scan, same pt. same location.

### a. Hepatocellular carcinoma



White → uptaking contrast

- Most of the contrast in the arteries.
- The lesion is enhanced (white).
- The liver is not enhanced yet.



Lesion Similar to liver

- Most of the contrast in the portal vein.
- Liver starts taking up the contrast and the lesion starts to wash out → Lesion is almost similar to the liver.



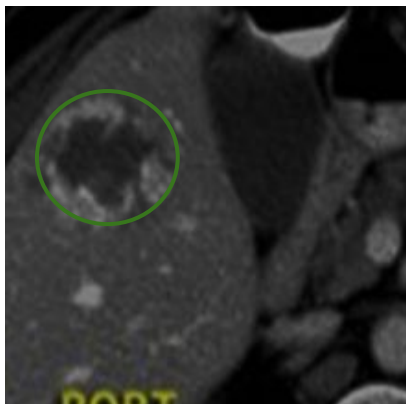
Black lesion

- Lesion is completely washed out and became black before the rest of the liver (no contrast).
- Equilibrium phase/delayed phase.

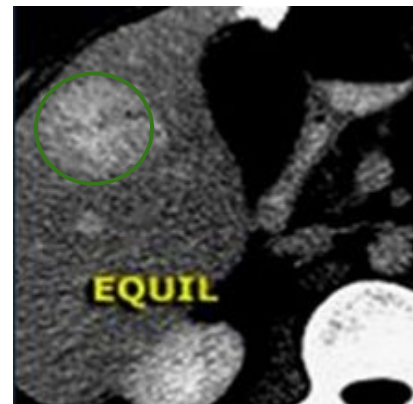
### b. Hemangioma enhanced very slowly (hypovascular) and the enhancement is only peripheral



More black, with some contrast around

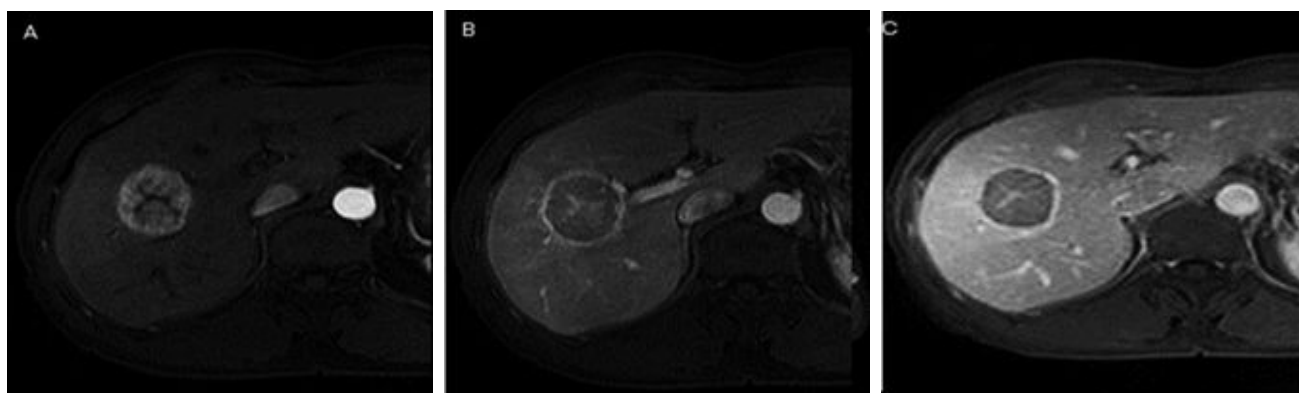


Contrast start to increase around (white area)



Then becomes more white in late phase

## MRI: Is it Benign or Malignant? Malignant (HCC).



In arterial phase (the aorta hyperintense) it's taking the contrast and rest of the liver not yet

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

Late phase liver uptake and lesion wash it out become black

### Case 4

Male patient with chronic abdominal pain. **What is abnormal?** Radiopaque oval shaped opacity.

Gallbladder calcification:

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

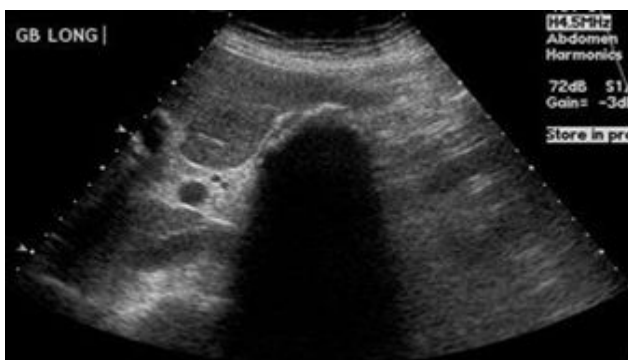
We can't reach to the diagnosis using x-ray.

**How to confirm the diagnosis?**

By doing CT scan or US.

Note: not MRI because CT better in calcification.

**Which modality is better?** CT.



In US this there is a calcification with shadow and we can't differentiate between a large stone with shadow OR calcification on the wall



In CT we can clearly see the calcification on the wall of gallbladder

### Gallbladder opacity:

1- Porcelain gallbladder (calcification of GB wall).

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

2- Gallbladder stones (NOT commonly seen on X-ray).



## Case 5

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?

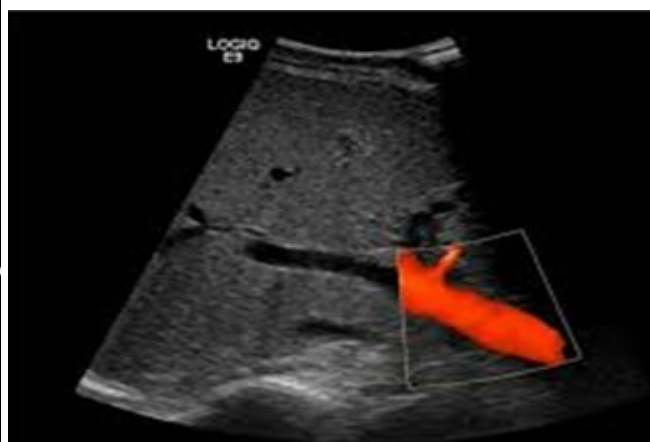
- Obstructive jaundice.
- Causes of biliary obstruction: stones (the most common with pain), tumors.
- Gallstone usually present with pain but neoplasm usually present without pain.

Which radiology modality you prefer to start with? Ultrasound.

### a. Ultrasound



**Abnormal**



**Normal US**

Red color shows the blood in vessel (no obstruction)

#### 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).

What to do next? MRI to know the cause.

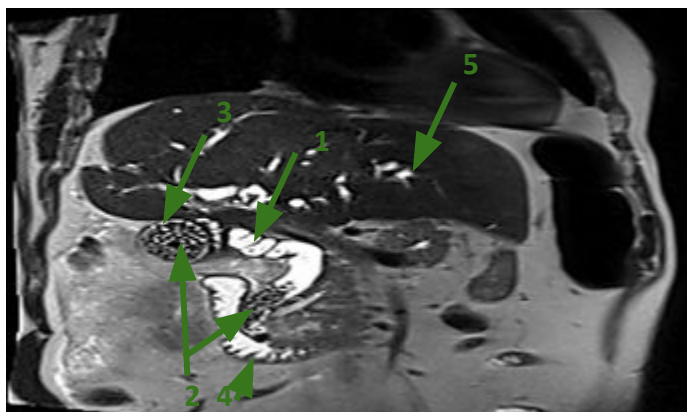
**b. MRI:** Without contrast! the white is fluid (bile).

Multiple gallstones in GB & common bile duct (CBD).

**Treatment:** Remove the stones use (ERCP).

#### Labels:

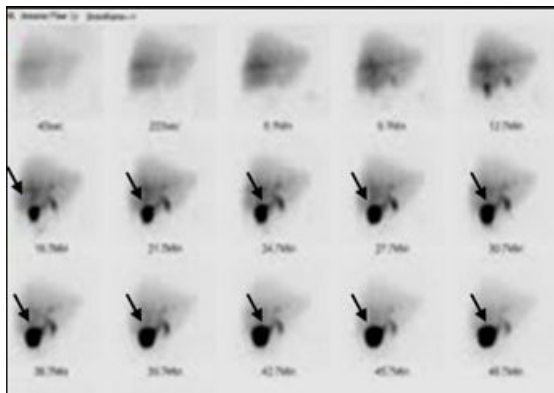
1. Dilated bile duct.
2. Stones.
3. Gallbladder.
4. Duodenum.
5. Dilated ducts within the liver.



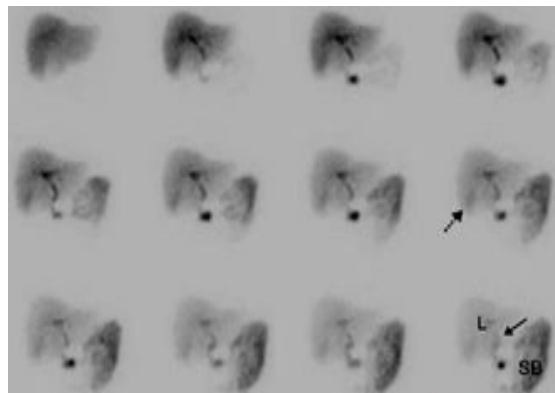
## Case 6

**Patient with RUQ pain suspecting cholecystitis. US and MRI was not conclusive would you do next?** Nuclear scan (HIDA scan) hepatobiliary iminodiacetic acid scan Imaging of the liver and gallbladder.

- **What is the difference between the two images ?**



**Normal**



**Abnormal**

No uptake in gallbladder (Acute cholecystitis)  
make sure there is no cholecystectomy

### Normally

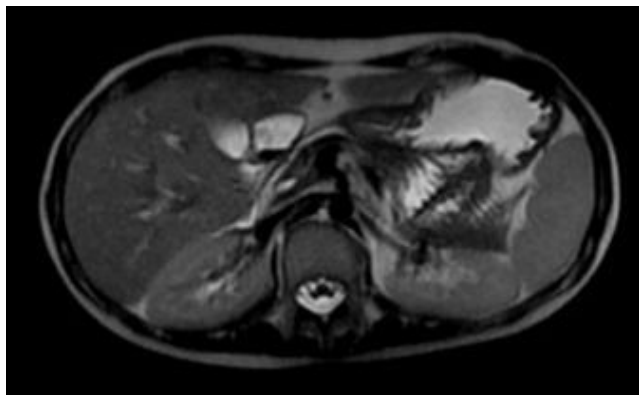
1. Liver start to uptakes radioactive material by hepatocyte.
2. Slowly increase the uptake.
3. Liver start to excrete it in the bile duct (there is something present as it's tube).
4. Slowly start to fill in gallbladder (black arrow).

- **Other indication of HIDA scan:**

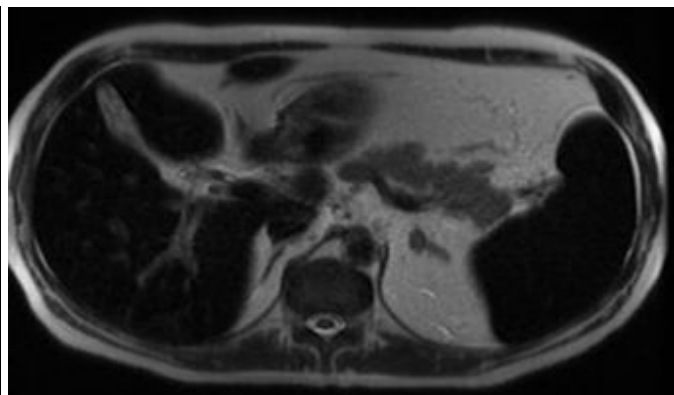
1. Biliary atresia (children) (congenital disease ): abnormality or absence of bile duct. The patient presents with juvenile jaundice. Radionuclide go to the liver → nothing comes out.
2. Bile injury post-surgery: Radionuclide go to the liver → it goes around the liver instead of going to gallbladder.
3. Bile obstruction.

## Case 7

20 year-old case of Thalassemia with repeated blood transfusion. What are the differences between the 2 images?



Normal MRI



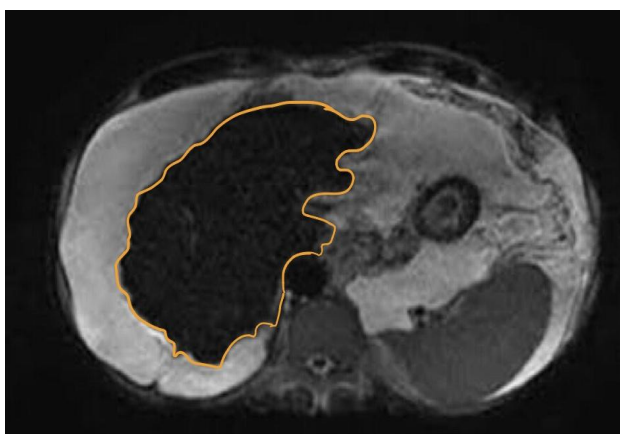
Abnormal MRI

What is abnormal here?

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

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



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.

# Summary

Organ	Disease	Modality	Feature 1	Feature 2	Feature 3
Gallbladder	Cholecystitis & stones	US	Hyperechoic	Shadow	+/- Wall thickening
		MRI	Black		
Gallbladder	Porcelain Gallbladder	US	Calcification		
		CT	Calcified wall		
Liver	Liver cirrhosis	US	Hyperechoic parenchyma surrounded by fluid	Shrunken	Irregular surface
		MRI & CT			
Liver	Malignant Tumor	MRI & CT +contrast	Light up in arterial phase		
Liver	Benign Tumor	MRI & CT +contrast	Light up in delayed phase		

# Questions

## 1. What is the difference between polyp and stone ?

- A. size.
- B. colour.
- C. shadow.
- D. shape.

## 2. How can you differentiate between benign or malignant tumor?

- A. CT with contrast.
- B. US.
- C. X- ray.
- D. Nuclear scan.

## 3. When we can not use CT or MRI with contrast?

- A. Pregnancy.
- B. Allergy.
- C. Renal impairment.
- D. Both B&cC.

Answers :  
1- C  
2- A  
3- D

WE NEED  
**YOUR**  
**FEEDBACK**

