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Radiology of Hepatobiliary Diseases

[Editing File](#)

objectives:

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

Sources

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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 +/- inflammation (cholecystitis)

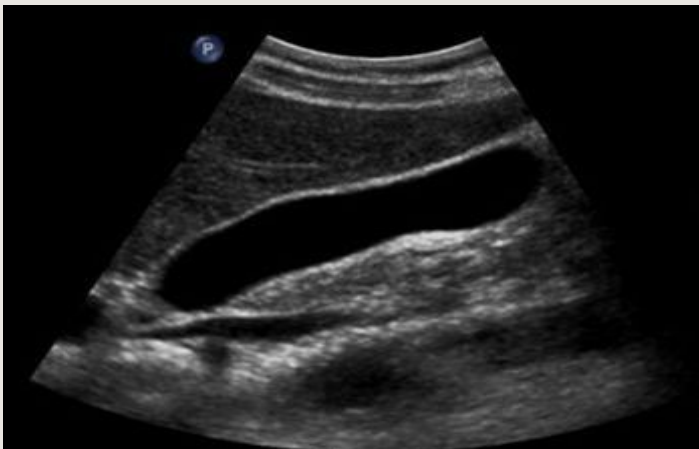
What is the best radiology modality to start with?

Ultrasound.

Why not CT? It can't see 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 filling defect = stone (anything inside a hollow structure we call it filling defect).
- Posterior **acoustic shadow**.
- Thickening of the wall
- Distended gallbladder because of obstruction.

Acute cholecystitis features in ultrasound:

- **Thickening of the gallbladder wall (more than 3mm).**
- Gallbladder distension
- Surrounding fluid
- **With gallstone (calculous cholecystitis) or without stone (Acalculous cholecystitis).**

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?



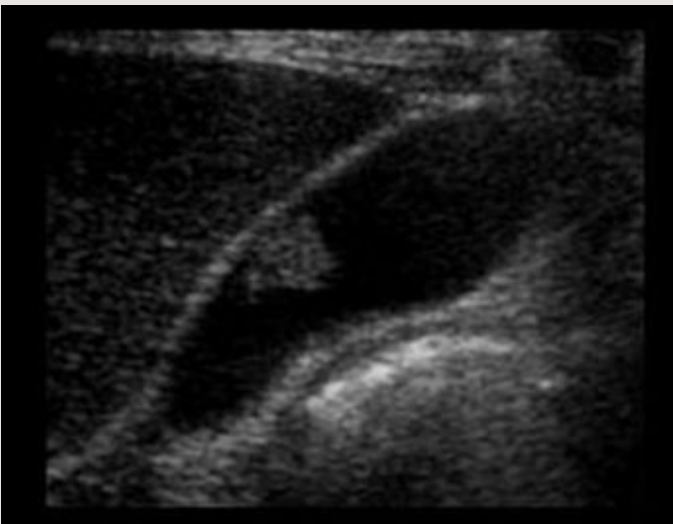
Stone **WITHOUT** inflammation

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



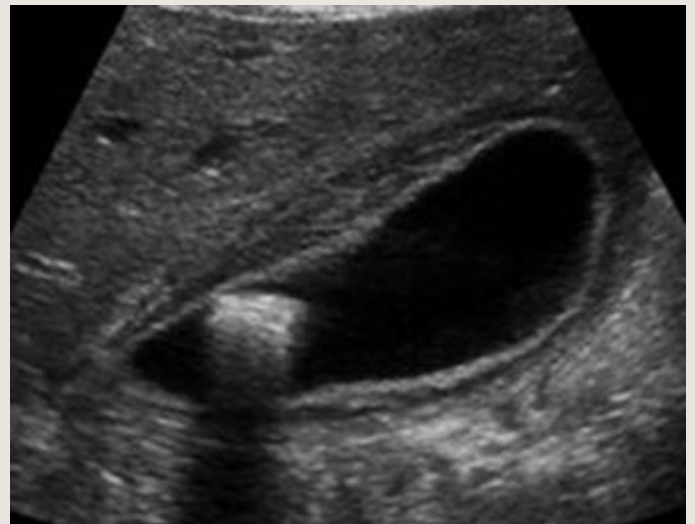
Stone **WITH** inflammation

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



WITHOUT acoustic shadow (GB **polyp**)

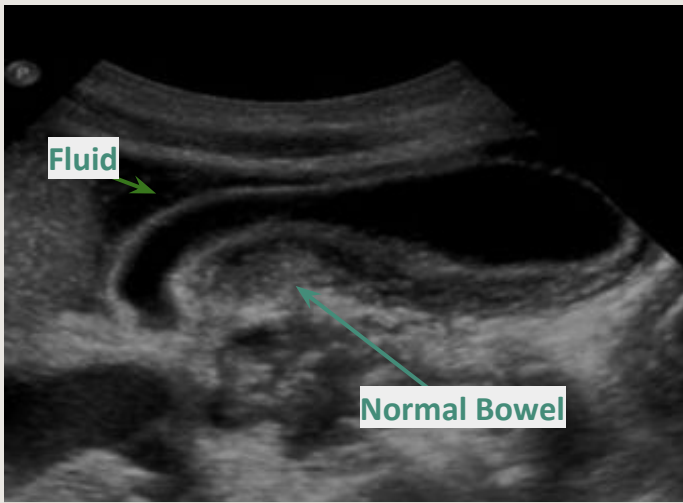
- Rounded hyperechoic (Filling defect) hanging on the wall of gallbladder
- No shadow.
- There is no inflammation.
- It is a mass "gallbladder Polyp".
- Could be benign or malignant.



WITH acoustic shadow (GB **stone**)

- Calculus shadow with inflammation

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)
- It has some fluid around.
- Tx by relieving the distention with tube



Calculous cholecystitis

- Inflammation with stone
- Treated by cholecystectomy

Acalculous cholecystitis 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 that will cause inflammation

Different gallstones on US:



Multiple tiny stones
Big shadow

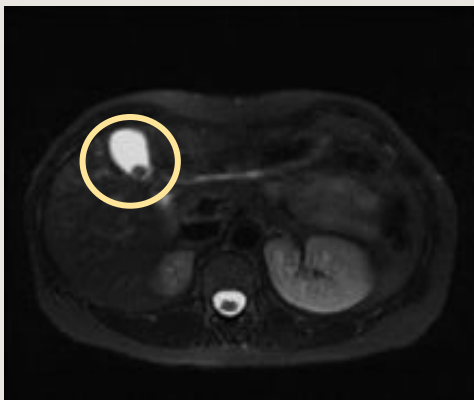


2 stones (2 shadows)

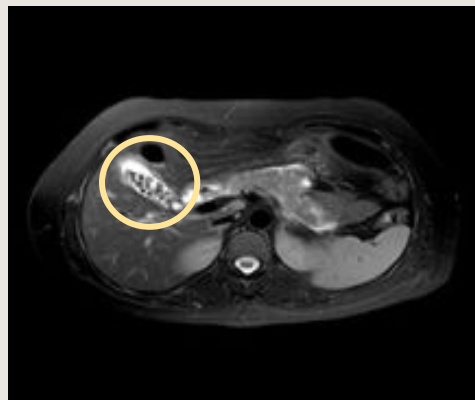


1 stone (1 shadow)

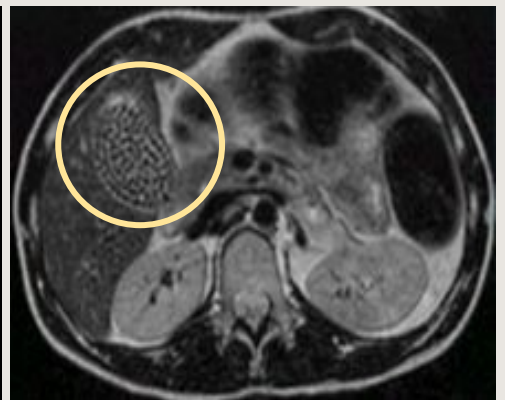
Gallstones on MRI:



1 stone



Multiple stones



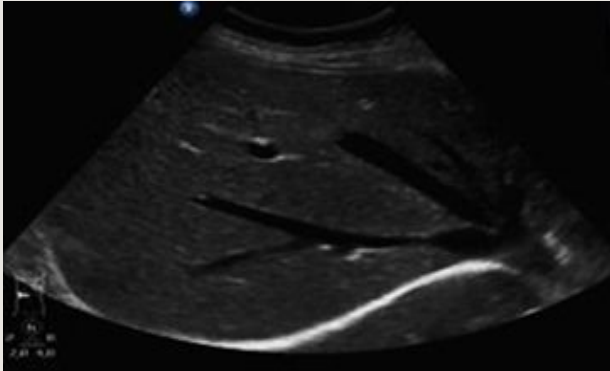
Multiple stones replacing
the whole gallbladder

Case 2

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

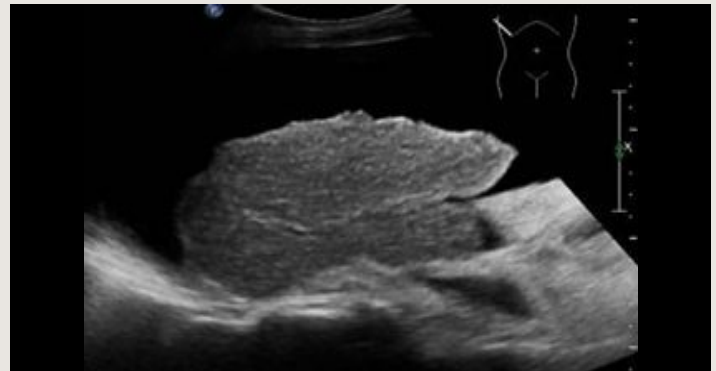
- **What do you think this patient has?** Chronic liver disease (Liver cirrhosis)
- **What radiology modality you will start with?** Ultrasound. Because it's the simplest.
 - X-ray is not good for liver and soft tissue

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



Normal Liver

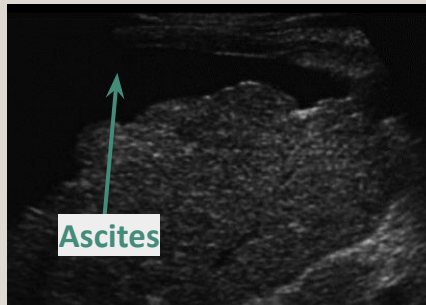
- Smooth surface
- Hypoechoic



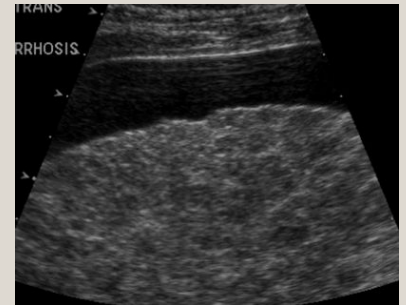
Liver cirrhosis

- Nodular and irregular liver surface.
- Shrunken size.
- **Hyperechoic parenchyma (fibrosis)**
- +/- Ascites (fluid)
- In liver cirrhosis, we must look for masses

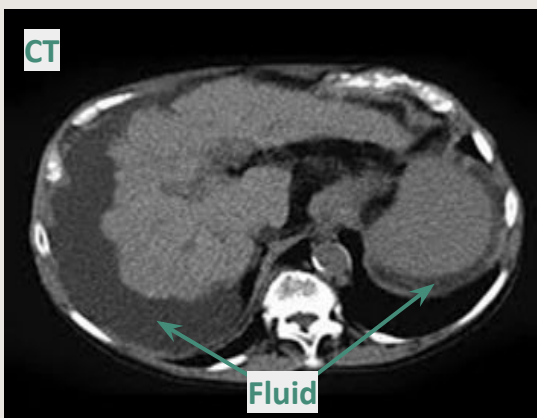
Other examples of cirrhosis:



Ascites



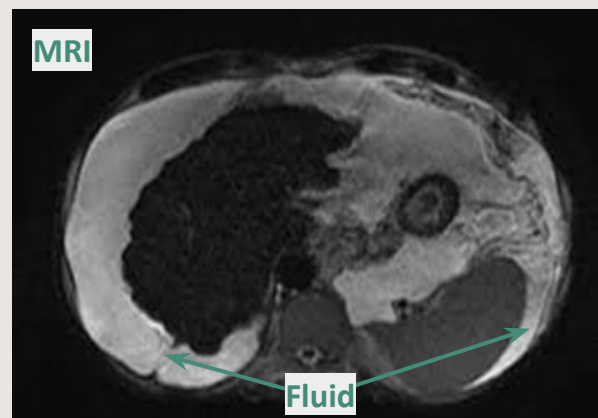
Cirrhosis on CT scan and MRI:



CT

Fluid

Liver cirrhosis with ascites
shrunken liver with irregular
surface surrounded by fluid



MRI

Fluid

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

Case 3

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

- Well defined Hypoechoic lesion within the liver (look like a mass), from ultrasound we can't tell if it is benign or malignant.

What is DDx?

a) Benign:

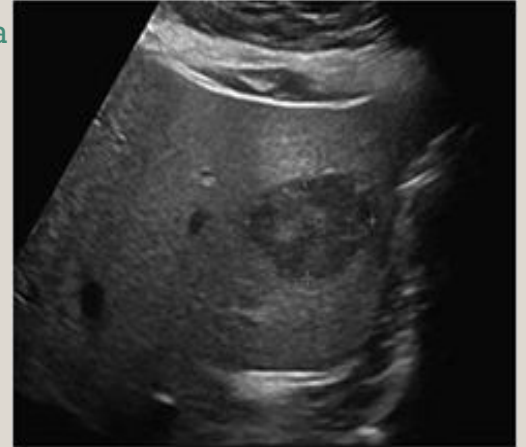
1- Hemangioma. 2- Adenoma. 3- Focal nodular hyperplasia.

b) Malignant:

1- Hepatocellular carcinoma. 2- Metastasis.

How to tell if it's benign or malignant?

- DO CT scan or MRI with intravenous contrast.



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.

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 (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!).

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.

Important to understand the triphasic concept!

CT scan with IV contrast (triphasic scan)

a. Hepatocellular carcinoma



White → uptaking contrast

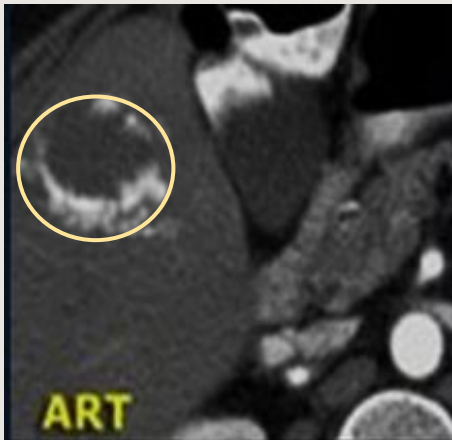


Lesion Similar to liver

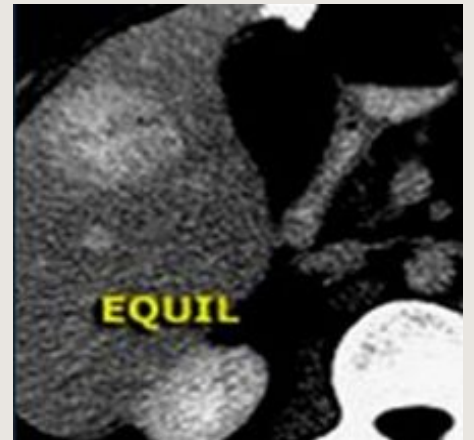
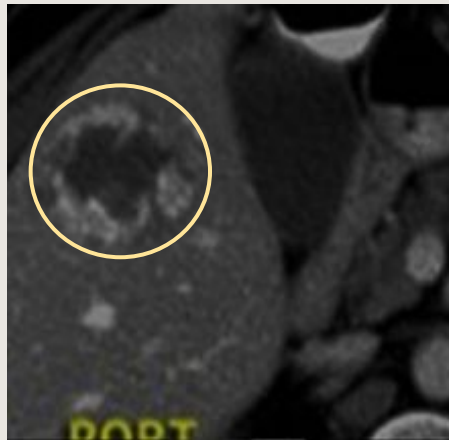


Black lesion (early washout from the lesion)

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



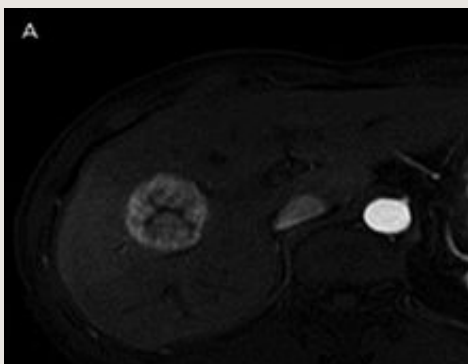
Slow accumulation of contrast only the peripheral of the lesion



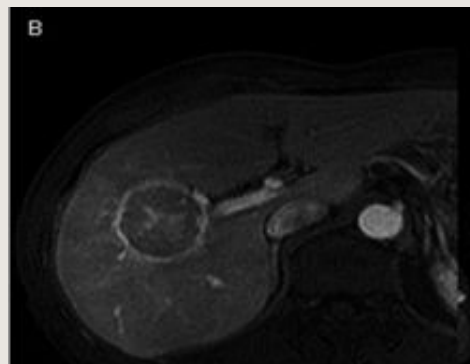
Then becomes more white in late phase

MRI of the liver:

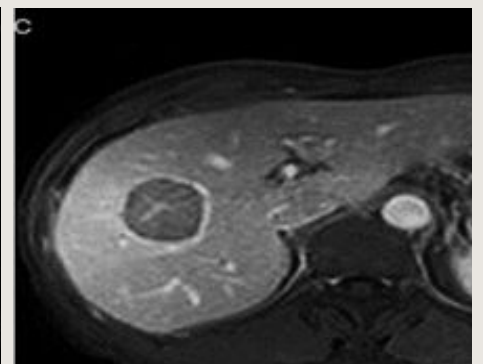
Is it Benign or Malignant? Malignant (HCC).



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

Case 4

Male patient with chronic abdominal pain. What is abnormal?

Gallbladder calcification (Radiopaque oval shaped opacity):

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

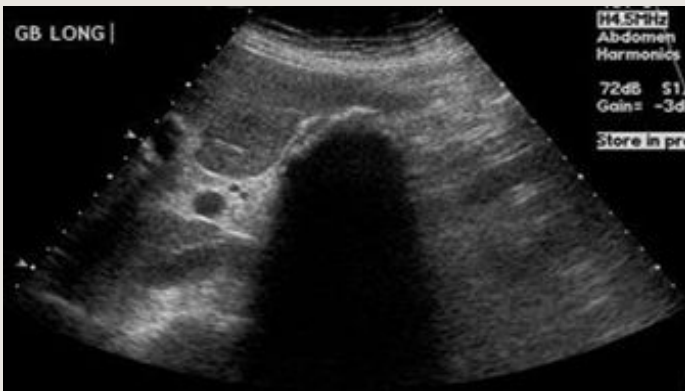
We can't reach to the diagnosis by using x-ray.

How to confirm the diagnosis?

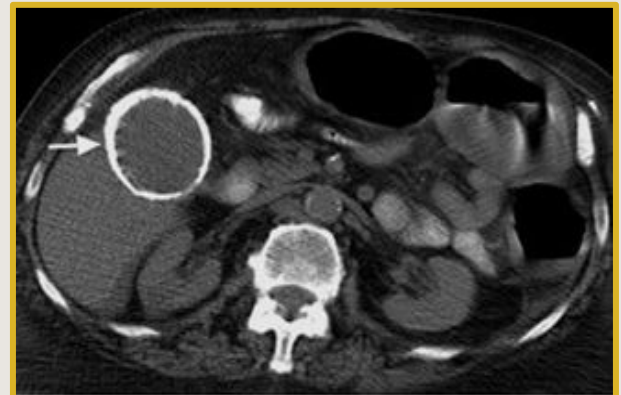
By doing CT scan or US.



Which modality is better? CT without contrast



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



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

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%.

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?

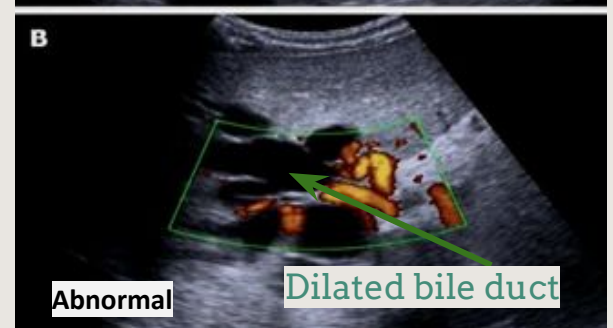
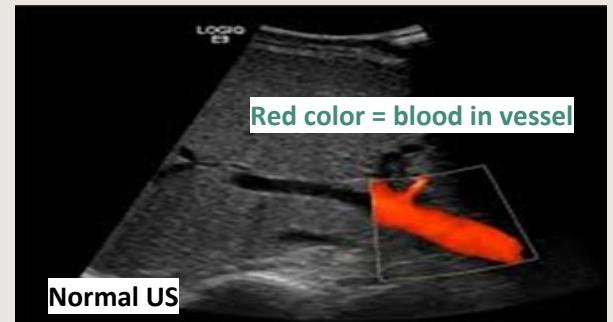
- Obstructive Jaundice
- Stone (because it's painful)
- If it was painless we think about tumor

Which radiology modality you prefer to start with? Ultrasound.

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.
Because I'm thinking of stone, if we suspect tumor we can do CT



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

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

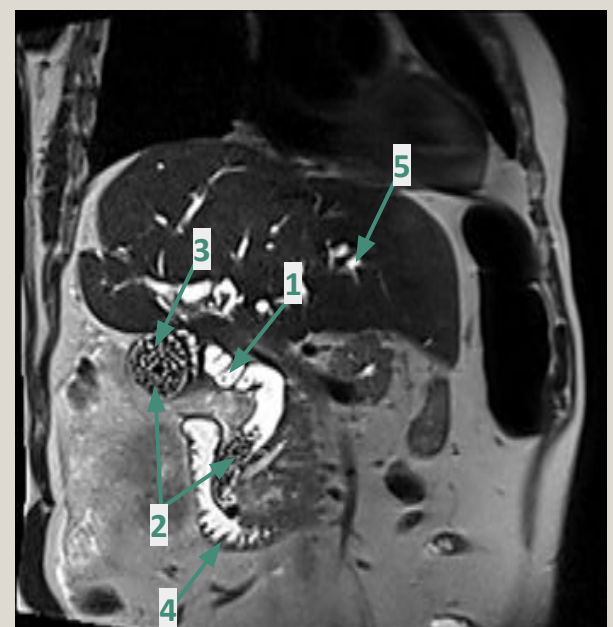
What is the diagnosis?

Common bile duct stone (choledocholithiasis)

Treatment: Remove the stones use (ERCP).

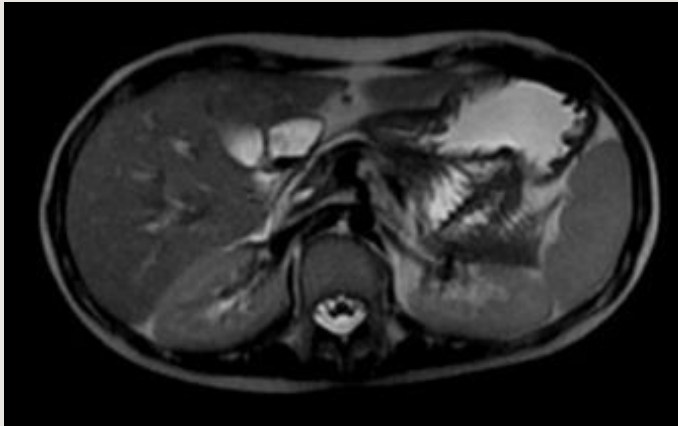
Labels:

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

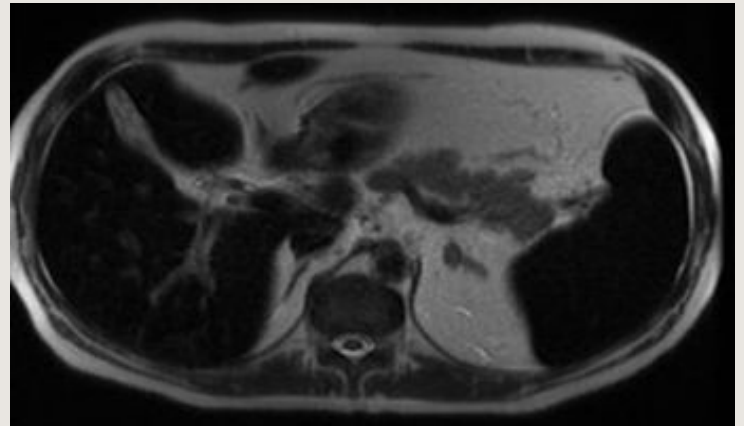


Case 6

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



Normal MRI



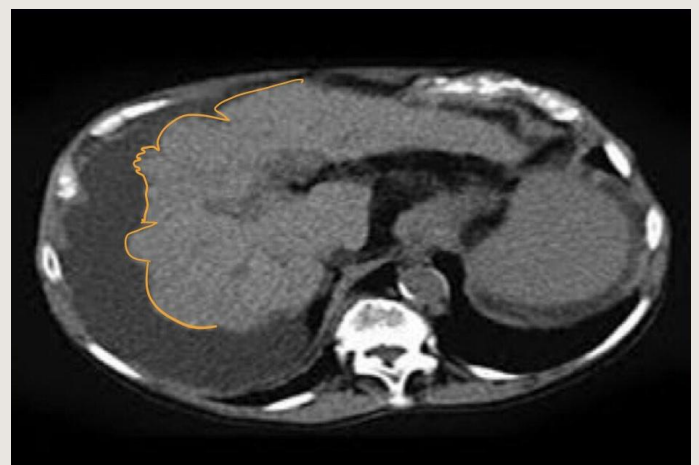
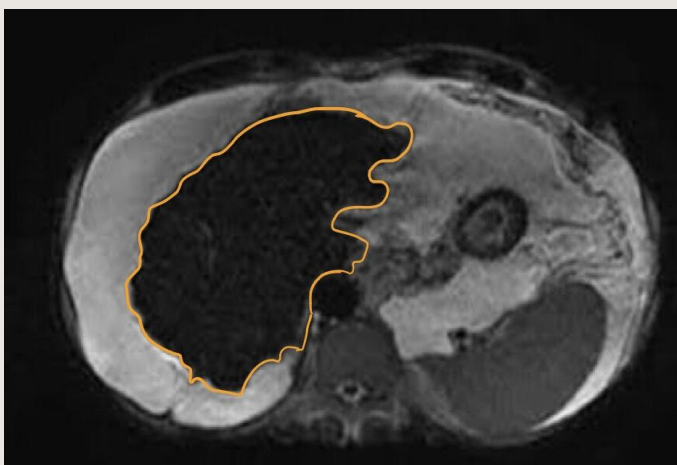
Abnormal MRI

What is abnormal here?

The liver and spleen and bone marrow are dark in signal (hypo-intense) because of iron overload (Hemochromatosis), 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 binds to iron and gets rid of it).

For better understanding from 436 team



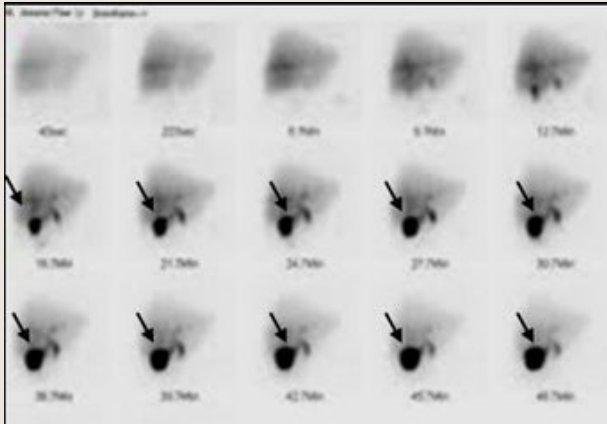
The orange lining represents the liver edges. In MRI, the liver is hypointense in comparison to surrounding fat and fluid. In CT the liver is hypodense and shrunken with irregular edges and surrounded by fluid.

Case 7

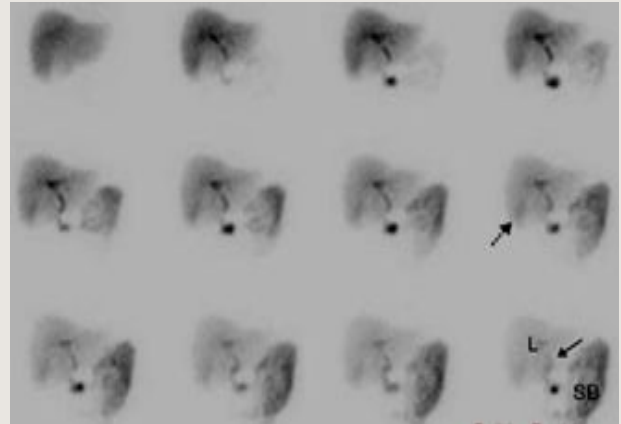
Patient with RUQ pain suspecting cholecystitis. US and MRI was not conclusive

What 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 = obstruction
(Acute cholecystitis)

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).

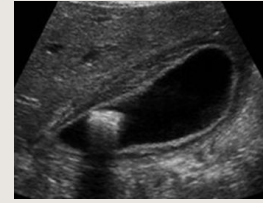
- **Other indication of HIDA scan:**

1. Biliary atresia (children): everything accumulate in the liver
2. 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
3. Bile obstruction: in functional obstruction (no contraction of gallbladder or no relaxation of the ampulla) it will accumulate in the gallbladder.

Radiological finding of :-

1- Acute cholecystitis by US:

- Gallbladder wall thickening.
- Gallbladder distension.
- Surrounding fluid .
- May present with gallstone which called "*Calculous cholecystitis*" or without gallstones wick called "*Acalculous cholecystitis*"
the one in this photo with gallstones .

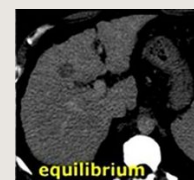


2-Liver cirrhosis by US:

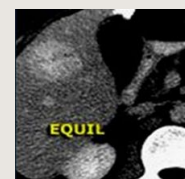
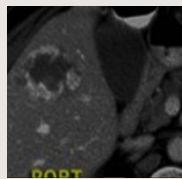
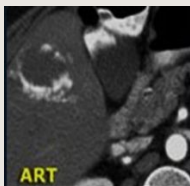
- Nodular surface
- Shrunk size
- Hyperechoic parenchyma (fibrosis)
- +/- Ascitis



3-Two different liver masses identified by CT with contrast which one is malignant and which one is benign?



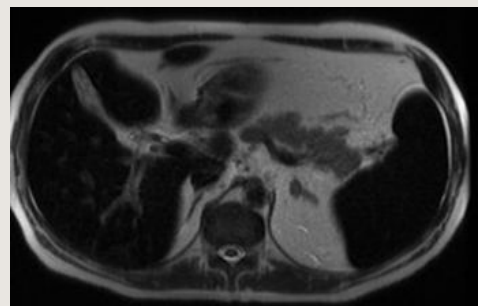
- This is hepatocellular carcinoma because in the 1- arterial phase the lesion appear whiter than the live after contrast uptake 2- portal venous phase similar color in both liver and lesion 3-equilibrium phase the lesion appear darker because it is slower than the liver in washing out the contrast



- This is hemangioma as the lesion appears whiter slowly as it take the contrast

4- Hypointense liver and spleen in MRI?

- first thing MRI is the modality of choice to measure the iron load in solid.
- second thing the liver and spleen appear dark because of iron overload in patient with repeated blood transfusion .



QUESTIONS

1. patient with right upper quadrant pain suspected cholecystitis. US and MRI were not conclusive what's next ?

- a) MRI
- b) CT scan
- c) US
- d) Nuclear medicine

2. the name of inflamed gallbladder with absence of gallstones ?

- a) Calculous cholecystitis
- b) Acalculous cholecystitis
- c) Cholelithiasis
- d) Acalculous cholelithiasis

3. what is the diagnosis ?

- a) Liver cirrhosis
- b) HCC
- c) Hemangioma
- d) normal liver



4. how can you differentiate between benign and malignant liver tumor ?

- a) CT without contrast
- b) CT with contrast
- c) x-ray
- d) nuclear scan

- 1- D
- 2- B
- 3- A
- 4- B

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References

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