RADIOLOGY
TEAM 435

Radiological and investigation of Hepato-biliary system

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• Objectives:

1. What is hepatobiliary system HBS?
2. Radiological modalities used in imaging HBS.
3. Advantages and disadvantages of each radiology modality
4. Indications of imaging HBS

• Resources:

- 435 Slides
- 434 Team
- 435 Notes

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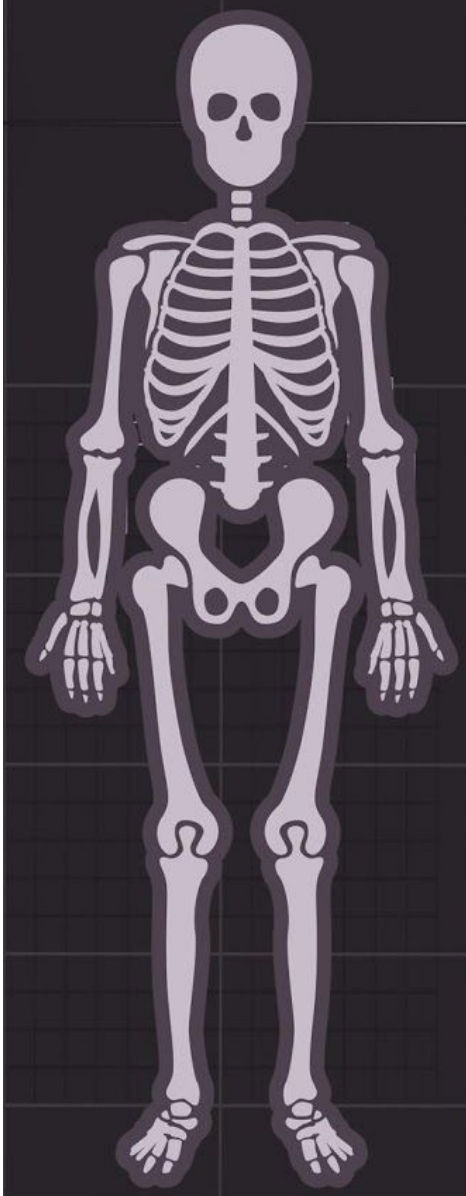


Hepatobiliary System

❖ What is hepatobiliary system (HBS)?

- It includes **liver**, **gallbladder** and **biliary ducts.**

❖ What are the Radiological modalities used in imaging HBS ?

1) X Ray.
2) Ultrasound.
3) Computed tomography (CT) scan.
4) Magnetic resonance imaging (MRI).
5) Nuclear scan.

1) X-Ray

❖ What is X-ray?

It is energetic form of electromagnetic and ionizing radiation that can penetrate solid objects and used to take images of the human body.

Is it worth it to use X-ray in assessing hepatobiliary? Very limited.

uses: it can detect radiopaque stones and it also can detect calcifications in the gallbladder wall.

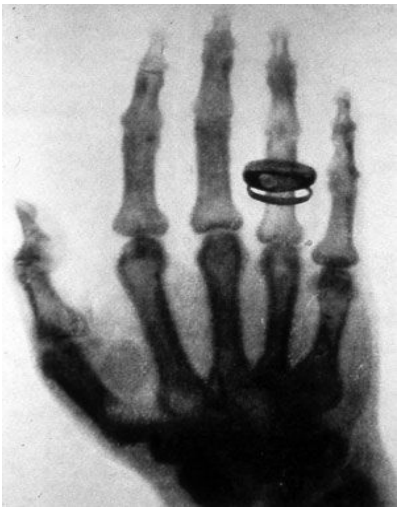
❖ X-ray language:

Radio-lucent = black = air

Radio-opaque= white= bone

Advantages	Disadvantage
- Cheap. - Quick and widely available. - Can be done bedside (portable). - Don't need skills	- Use ionizing radiation. > avoid in pregnant & pediatric. - Very poor in tissue details. - Very limiting in detecting gallbladder stones. - Won't show bile duct dilatation. - Can't detect radio-lucent stones.

This is an "Abdominal x-ray" or "Abdominal radiography"



-The First x ray taken in history.

- X-ray was first observed and documented in 1895 by Wilhelm Conrad Roentgen.

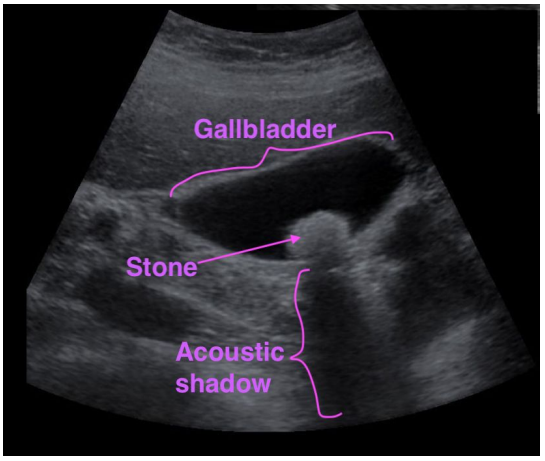
2) Ultrasound

❖ What is US?

- A diagnostic technique in which high-frequency sound waves penetrate the body and produce multiple echo patterns.
- It is diagnostic Medical applications in use since late 1950's.
- The High frequency sound waves will pass through the body, and will be reflected according to the density of the structure.
- Dense structure e.g. bones, calcifications will reflect all sound waves (giving white color on the image).
- Fluid will pass without reflection (giving black color).
- Anything in between such as abdominal organs (as it's dense as it reflects more waves).

❖ Echo patterns:

- Hyper-echoic = White (bones for example)
- Hypo-echoic = Light Grey
- An-echoic = Black (fluid for example)
- Acoustic shadow: black band behind dense object (e.g. stone)

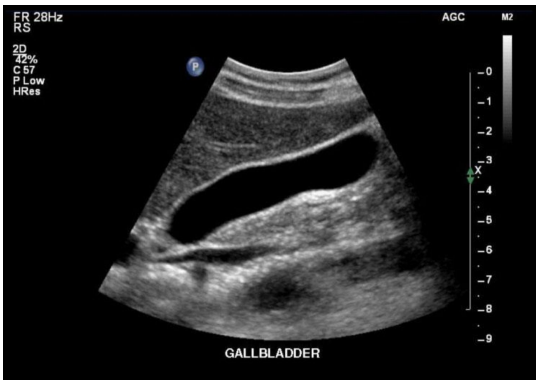


Advantages	Disadvantage
- No radiation > used in pregnant & Pediatric - Widely available - Relatively cheap - Very good in evaluating abdomen solid organs - Can be done bedside(portable) - Real time scan e.g. when scanning a pregnant lady, you will be able to see the fetus moving. - Good in assessing soft tissue compared to X-ray. ex, gallbladder inflammation. - Excellent in picking up stones. - The modality of choice to start with in HBS.	- Operator dependent - Very limited in evaluating structures with air (e.g. bowel) > can't see under it or calcification (e.g. bone) > can't see structure behind the bone.(ex, ribs > can cause acoustic shadow) - Very limited in patient who is not cooperative.

#Extra info about US

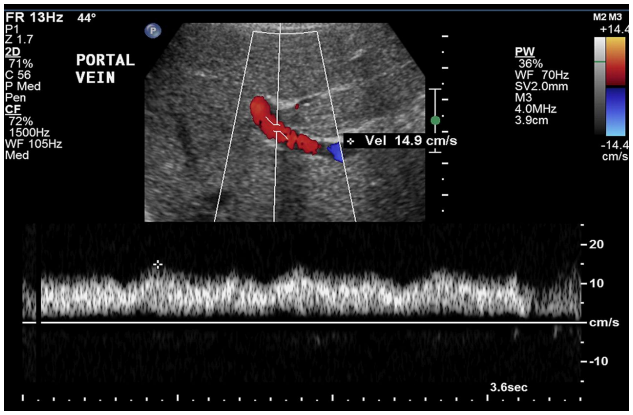
B-MODE

This is portal vein without flow known as B-MODE or greyscale



Normal gallbladder

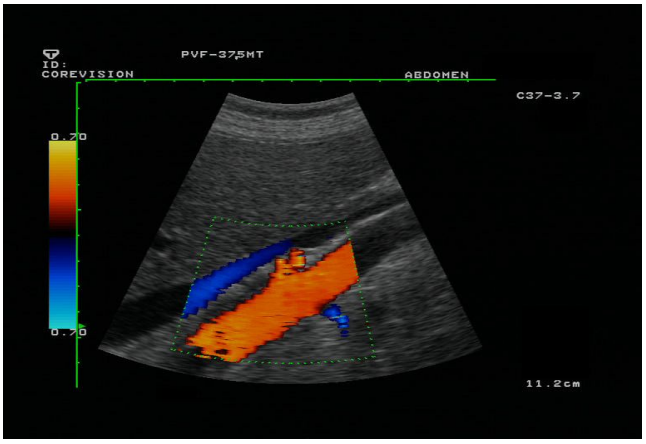
DUPLEX



You can see the flow in this image.

- Shows waves that differentiate between arteries and veins.
- one of duplex techniques is the ability to use the probe that allows to hear the sound but not seeing the image, especially used in obstetrics to assess the babies.
- It shows the pulse of the vessels in graph,

COLOR DOPPLER



what does these colors indicate?

- they represent vessels. If the direction of the flow is toward the probe it will be red “artery”; if it’s moving away from the probe it will be blue “vein”.
- In liver for example, the portal vein is going into liver so it will be red and hepatic veins is going away from liver so it will be blue.
- If we see the opposite there might be a problem

3) CT scan

❖ What is CT scan?

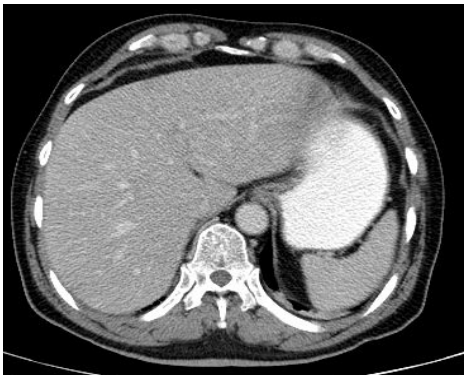
- A CT scan (Advanced technique of x-ray) makes use of computer-processed of **many x-ray** images taken from different angles to produce cross-sectional **tomographic images** = Create 3D image of specific areas of a scanned object.
- CT scan can be done with and without intravenous IV contrast.
- CT scan is limited in evaluating gallstones, Why?

  The composition of gallbladder is cholesterol which is fat which is black in CT, also fluid will be black " gallbladder also filled with fluid". And most of the stones are black or grey so you can't see it. So you have to use US rather than exposing the patient to radiation for nothing.

❖ CT language:

- Hypo-dense = grey-black
- Hyper-dense = white

e.g. Bones are more hyper-dense when compared to the aorta



❖ How to differentiate between CT and MRI?

because bone will appear dense white in CT. However in MRI it will be grey to black

Advantages	Disadvantage
- It's very good at evaluating solid organs. - Available more than MRI - Cheaper & faster than MRI and more readily used - Good assessing tumor.	- It uses ionizing radiation which can be harmful. - The use of a contrast can be harmful for certain Patients like those with kidney disease or allergy. - It is not widely available as an U/S or X-ray. - It's relatively expensive.

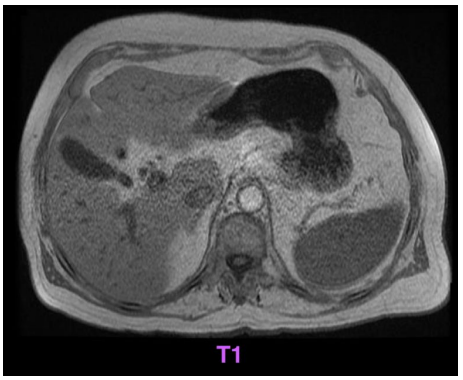
CT **without IV contrast**	CT **with IV contrast**
	

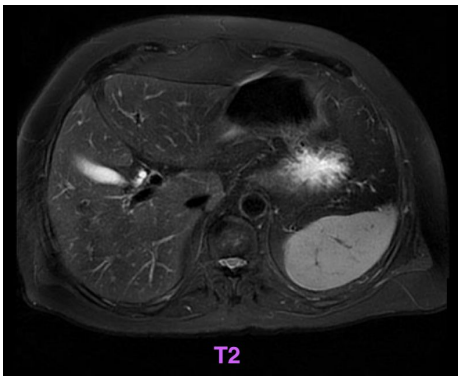
- How you know if there is contrast? You see more details and vessels.
- It shows how good the image with contrast, which circulates in the body then into the vessels.
- Contrast is also taken up by the liver so you can easily see details and this helps in case of mass in liver, which can be missed as it has a similar density to liver. But with contrast, liver will take it up in different way from the mass.

4) MRI

❖ What is MRI ?

- A medical imaging technique used in radiology to form pictures of the anatomy using strong magnetic field and radio waves.
- It has no radiation.
- It is more complex than CT scan and produces different images (or what called sequences), that can be taken like T1 and T2 etc.
- It gives a far more great detail of information when compared to a CT scan as it uses a sequence system.





❖ MRI language :

- Hyper-intense signal= more white
- Hypo-intense signal = more grey/black

T1: The fluid will appear black
T2: The fluid will appear white

Advantages	Disadvantage
- Excellent in tissue details - No ionizing radiation - Can pick up almost all stones, but US requires less time and money.	- Expensive - Long scan time - Less available than other modalities - Intravenous contrast is not safe with poor renal function - Not for all patient (such as: patients with pacemaker, claustrophobia etc)

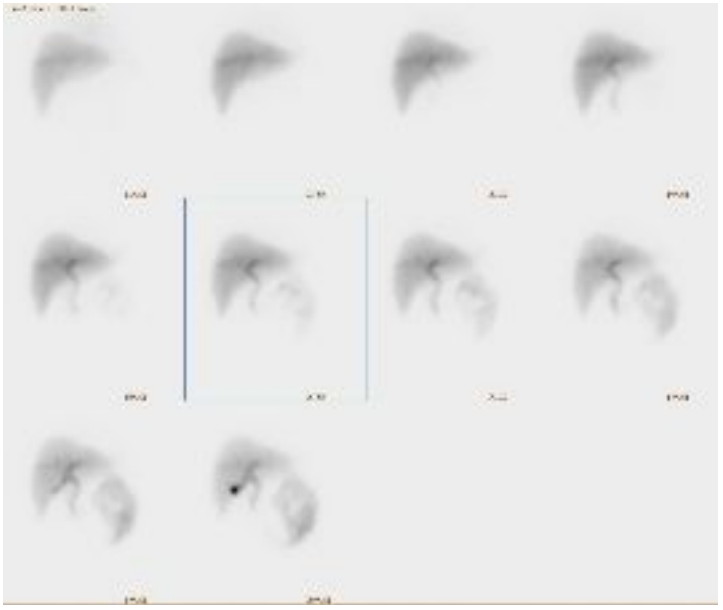
How to differentiate between a CT and an MRI ?

Always look at bone:
MRI: grey to black, CT: always white

5) Nuclear Scan

❖ What is a nuclear medicine?

- It's a Medical specialty involving the application of radioactive substances in the diagnosis and treatment of a disease.
- It is good at assessing the function, but poor at assessing the anatomy.



- how is this procedure carried out?
- Radioactive material given intravenously, is labeled with a material that mimics normal physiology of the body e.g if we wanted to scan the liver or bile duct, to be sure this radioactive material reached the organ we label it with something like bilirubin " because it is metabolized in liver" so this will make all radioactive material directed to liver, then start to scan.

Advantages	Disadvantage
- Excellent in evaluating organ function/physiology - Assessing HBS obstructions.	- Use ionizing radiation (gamma rays). - Not widely available. - Very poor in evaluating anatomy. - Expensive