Radiology Techniques Department

The Radiological Anatomy

Lecture 2

Liver and Biliary Tree

By

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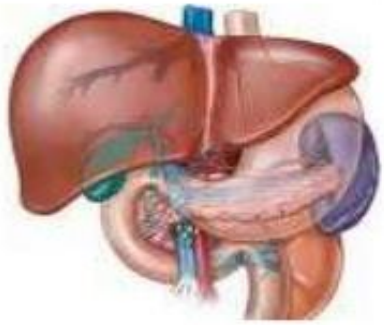
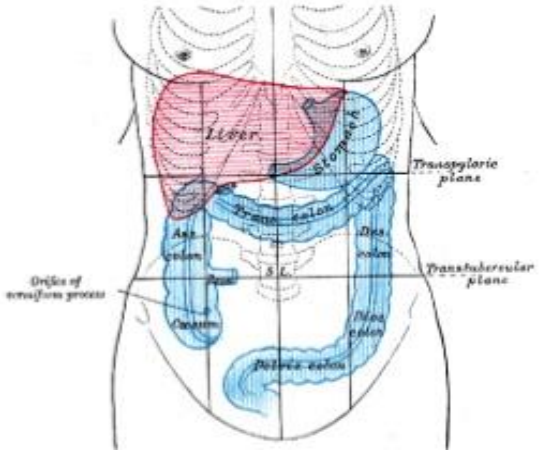
3rd Stage

Liver-Introduction





- Also called 'hepar'.
- Largest/heaviest solid organ in the body.
- Weighs about 1600 gm in males,1300 gm in females.
- Occupies the right hypochondrium, epigastrium & left hypochondrium.
- Most part of the liver is covered by ribs & costal cartilages.
- It is covered by network of connective tissue (Glisson's Capsule)

Peritoneal ligaments

These ligaments connect the liver to the undersurface of the diaphragm

Falciform ligament = It is a double fold of peritoneum from umblicus to liver.Contains ligamentum teres,the remnant of umblical vein,which attaches to the left portal vein.

- In the fetus, umblical vein carries oxygenated blood from the cord via the left portal vein and ductus venosus to the IVC.
- Umblical vein can recanalize in portal hypertension.

Falciform ligaments split into **coronary ligament** (which becomes the **right triangular ligament**) and left triangular ligament, between which lies the bare area of the liver.

Lobes of the liver

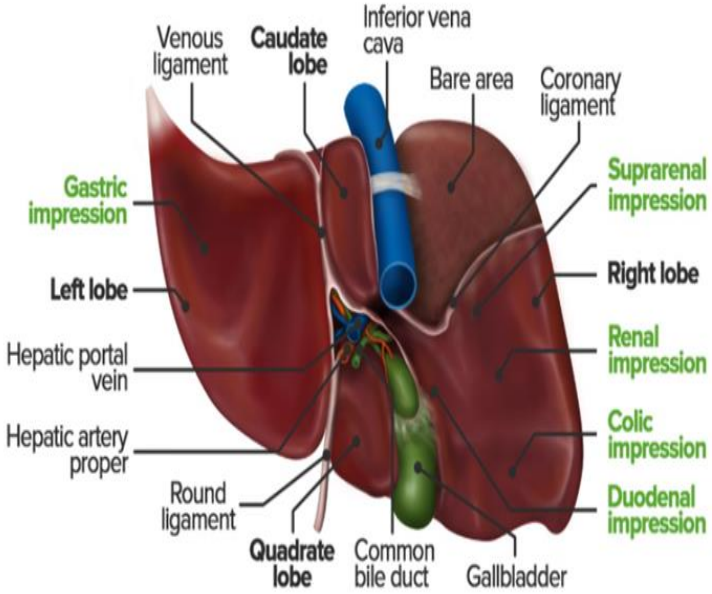
Anatomical division

- By means of falciform ligament, fissure for ligamentum venosum, and fissure for ligamentum teres is divided into:
  - ✓ Right large lobe, having caudate and quadrate lobes.
  - ✓ Left small lobe.

Functional division

- By means of imaginary line passing through groove for IVC and fossa for gall bladder is divided into:
  - ✓ Right functional lobe: supplied by right branches of hepatic artery and portal vein, and its bile is drained by right hepatic duct.
  - ✓ Left functional lobe: supplied by left branches of hepatic artery and portal vein, and its bile is drained by left hepatic duct.

Liver



Liver surfaces

- Divided into 2 anatomical regions:

1.Diaphragmatic surface:

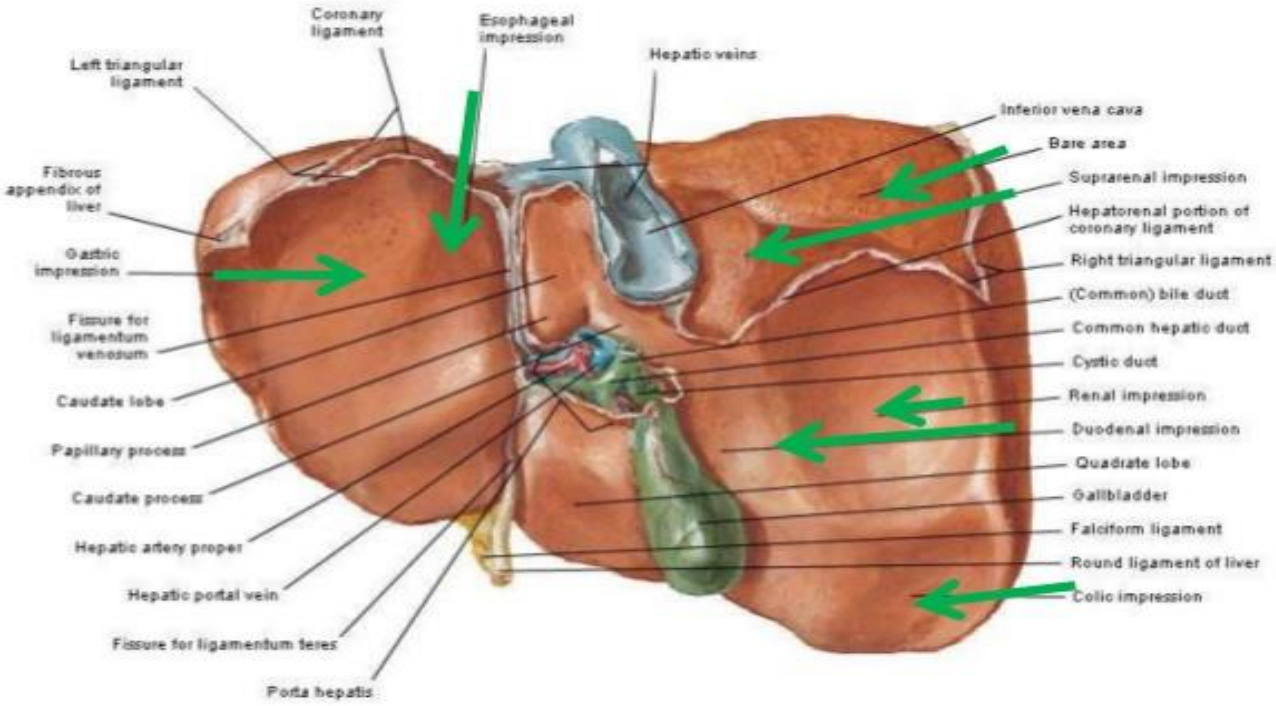
- ✓ Smooth and dome-shaped surface
- ✓ Inferior to diaphragm
- ✓ Separated from diaphragm by subphrenic recess and from posterior organs {kidney and suprarenal glands} by hepatorenal recess
- ✓ Covered by peritoneum except on the posterior surface of liver which is not invested in peritoneum and is known as the bare area of liver.

2. Visceral surface

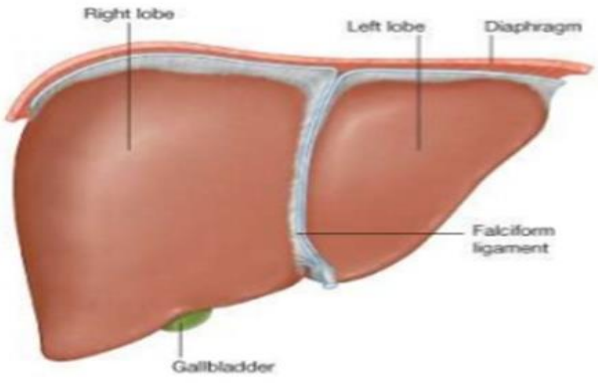
- ✓ Covered by visceral peritoneum except porta hepatis and gall bladder bed.

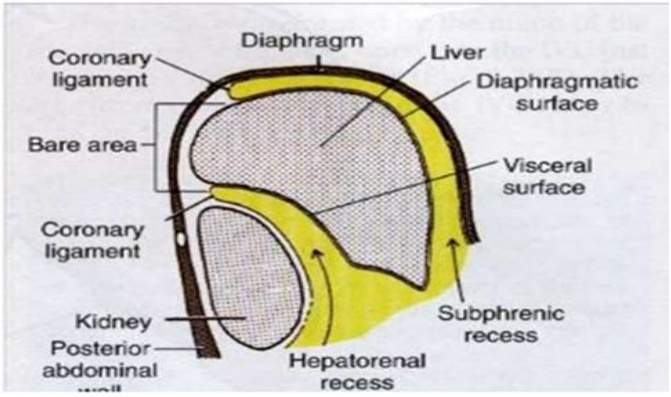
- The visceral surface is related to:
  - ❖ Right side of the stomach i.e. gastric and pyloric areas
  - ❖ Superior part of the duodenum i.e. duodenal area
  - ❖ Lesser omentum
  - ❖ Gall bladder
  - ❖ Right colic flexure and right transverse colon ; colic area
  - ❖ Right kidney and suprarenal gland; Renal area

Visceral relations : impression of neighbouring viscera



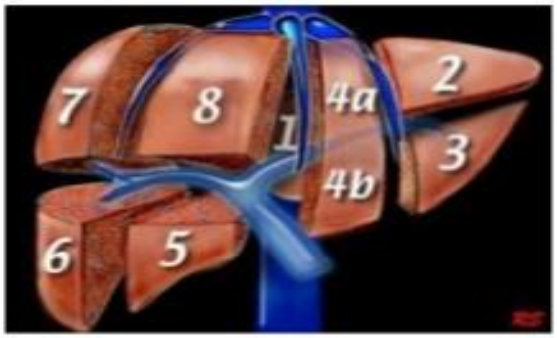
Diaphragmatic surface



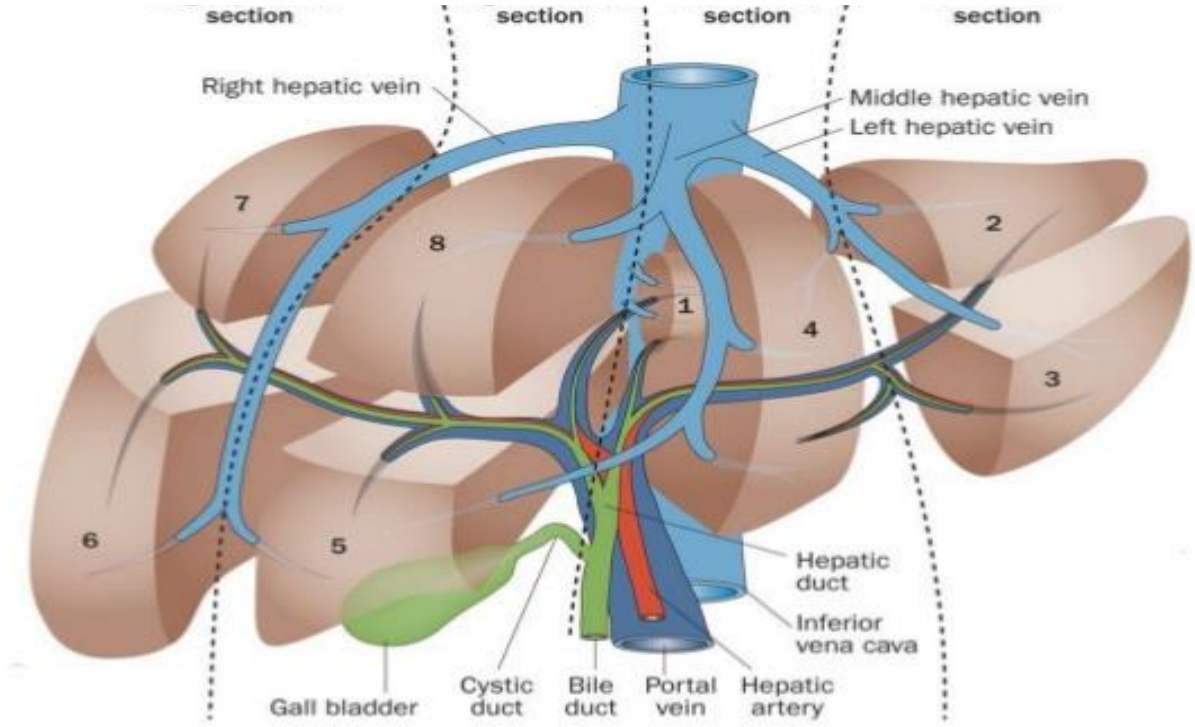


Liver is now divided into segments as per **Couinaud System.**

- Caudate lobe = Segment I.
- Portal and hepatic veins used as landmarks to divide the remainder of the liver into eight segment.



- **Right hepatic vein** divides the right lobe into **anterior (segment V and VIII) and posterior segments (segment VI and VII).**
- **Middle hepatic vein** divides the liver into right and left lobes (or right and left hemiliver). This plane runs from the inferior vena cava to the gallbladder fossa.
- **Left hepatic vein** divides the left lobe into a **medial (segment IV** and **lateral part (segment II and III).**



Blood supply of the liver

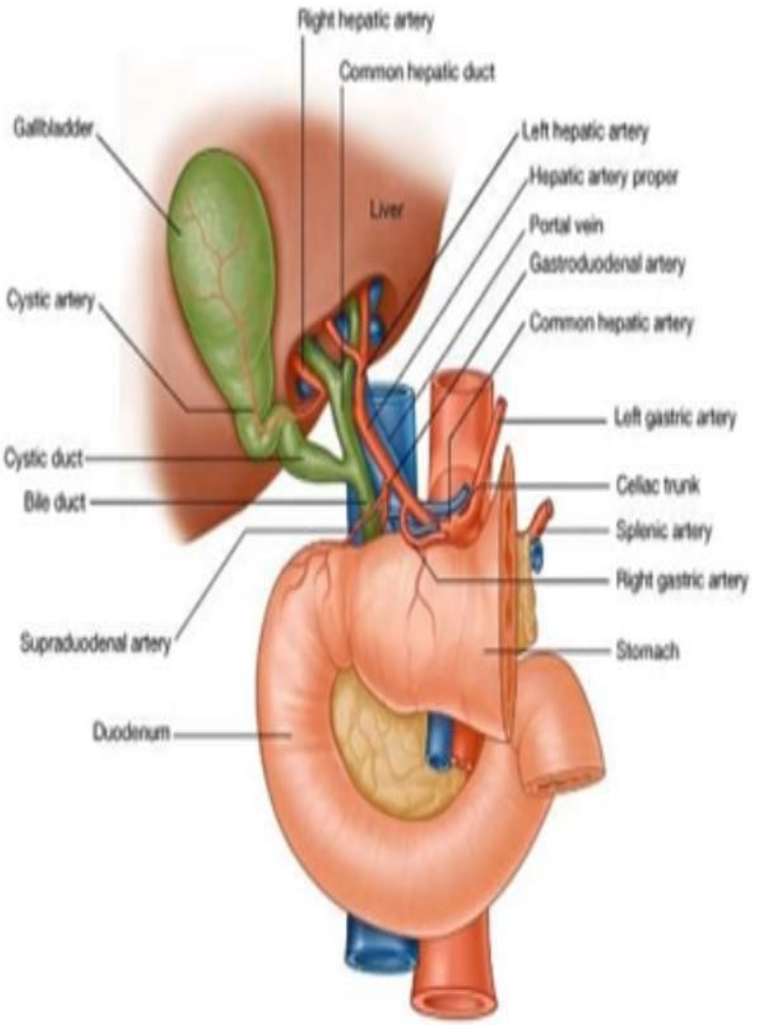
It depends on the functional division of the liver.

Arterial

- Hepatic artery: it gives right and left branches to deliver 20% of the blood (to the corresponding functional lobes).
- Portal vein: it gives right and left branches to deliver 80% of blood (to the corresponding functional lobes).

Venous drainage

- By 3 hepatic veins (right, left, and middle). They drain into the IVC.



Biliary Apparatus :

It collects bile from the liver ,stores in the gallbladder & transmits to 2nd part of duodenum.

- Gall bladder.
- Cystic duct.
- Right and left hepatic ducts which unite to form Common Hepatic Duct.
- Common Bile duct formed by the union of cystic duct and common hepatic duct.

Gall Bladder

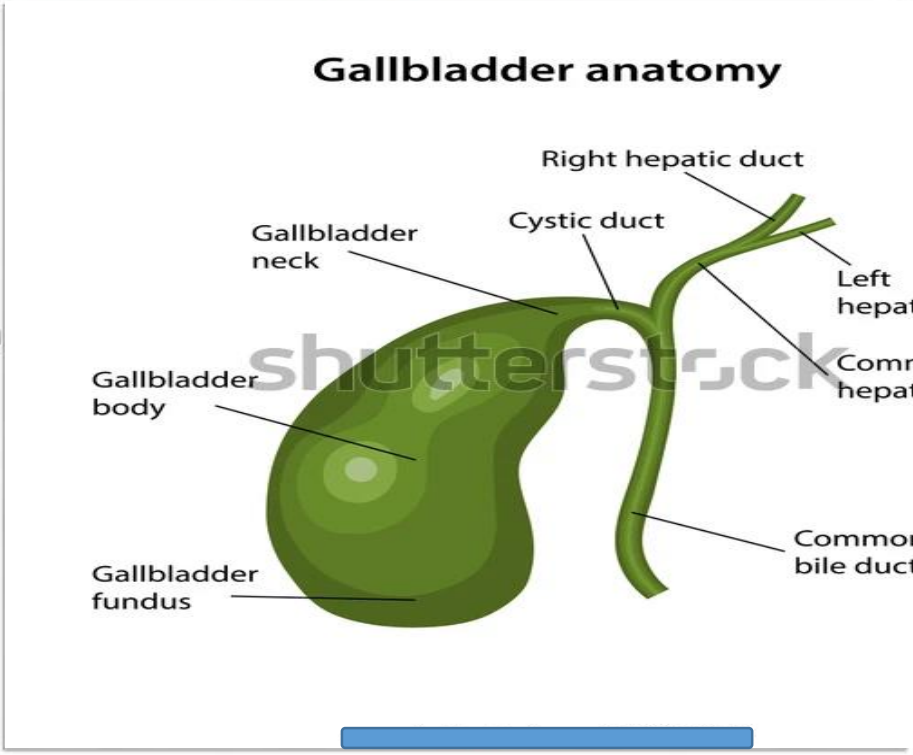
- Gall bladder – a pear shaped sac and reservoir of bile and is responsible for concentration of bile. It can hold upto 30-50 ml.
- 9-10 cm long , 3 cm in diameter.
- Wall thickness < 4mm.

- Cystic duct arises from the neck of the gallbladder.

- Covered by peritoneum on fundus and inferior surface, occasionaly hangs on its own mesentry.

Parts of Gall Bladder

- Fundus
- Body
- Neck
- Infundibulum
- Cystic duct



Anatomical Relations

- Anterosuperiorly: Gallbladder bed of liver and layer of peritoneum
- Posteroinferiorly: Lesser omentum, 1st part of duodneum and transverse colon.

Blood Supply :

- Cystic artery , a branch of the right hepatic artery.
- Cystic vein drains into portal vein.

Nerve Supply :

- Parasympathetic supply is by pre-ganglionic fibers from the vagus nerve.
- Sympathetic innervation is by post-ganglionic fibers from the coeliac plexus.

Lymphatic Drainage :

- Lymphatics drain into cystic nodes, hepatic nodes and coeliac nodes.

Billiary tree anatomy

Bile secretes at level of biliary canaliculi

↓

These joins to form the terminal bile ductules

↓

Which joins to form the interlobular ducts

↓

These joins to form the sectorial ducts/segmental ducts

↓

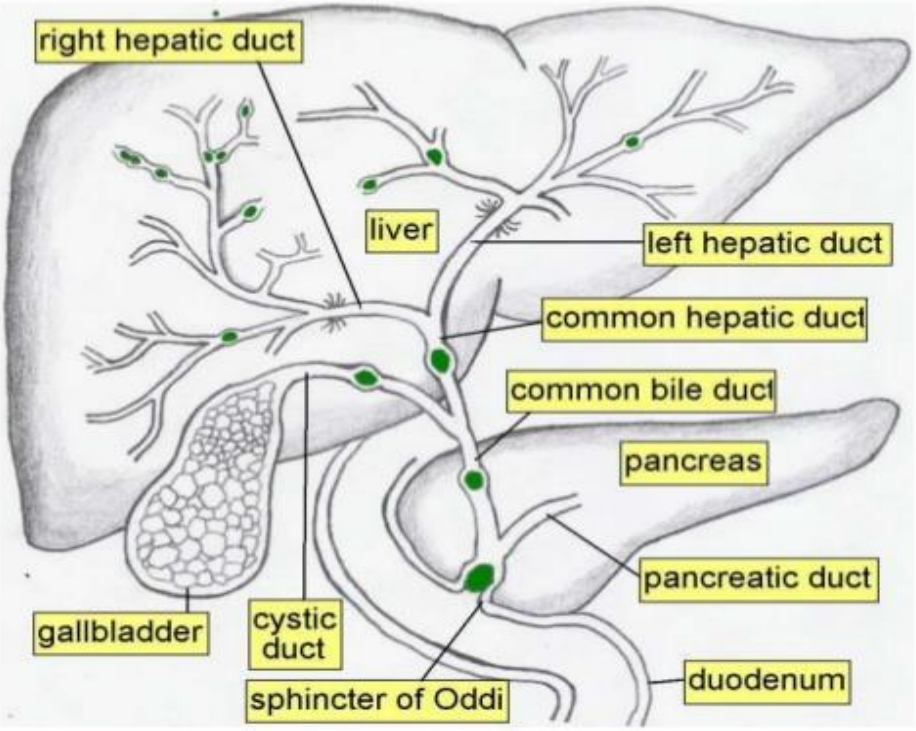
That joins to form the hepatic duct and right and left hepatic duct form the common hepatic duct (CHD)

↓

That joins with cystic duct to form common bile duct (CBD)

↓

That joins with pancreatic duct to form ampulla of vater and opens into 2nd part of duodenum.



Intrahepatic Bile duct

- The classic billiary anatomy appears in about 58% of the population.
- It consists of the right hepatic duct and left hepatic duct and drains the right and left lobes of the liver, respectively.

- The fusion of the right and left hepatic ducts gives rise to the common hepatic duct at porta hepatis usually.

Extrahepatic Bile Ducts (CBD)

- It includes Cystic duct and common bile duct.
- CHD is joined by the cystic duct at a variable position (usually) 3.5 cm to form the CBD.
- Diameter of CBD is variable :
  - i.e upto 5mm till 50 yrs of age then 1mm/decade after that age.
  - Diameter can be larger in postcholecystectomy patients i.e up to 10mm.

ULTRASOUND

- Based on pulse- echo principle
- The ultrasound transducer converts electrical energy to high-frequency sound energy that is transmitted into tissue.
- waves are transmitted through the tissue, some are reflected back,
- ultrasound image is produced when the receiver detects those reflected waves.
- augmented by Doppler flow imaging.
- can detect the presence of blood vessels but also can determine the direction and velocity of blood flow

advantages

- inexpensive,
- widely available,
- no radiation exposure,

disadvantages

- Incomplete imaging (at dome,beneath ribs,lesion boundaries)
- Obesity & bowel gas reduce quality
- lower sensitivity and specificity of ultrasound compared with CT and MRI

uses

- Liver size
- Detects lesions in liver
- Detects gall stones
- Detects biliary dilatation
- Differentiates solid from cystic masses
- Determines flow in vessels
- As a guide in percutaneous biopsy
- As a guide in aspiration of liver abscess

Computerised tomography

- Increased accuracy of diagnosis & staging
- CECT is widely used & best validated for liver imaging
- Most of liver pathologies have similiar density to liver parenchyma
- Liver has dual supply ,portal vein 75 % & hepatic artery 25 %
- Many liver tumours recieve major supply from hepatic artery

	Arterial phase	Portal/venous phase
Time since contrast delivery	20 – 30 sec	60 – 70 sec
Tumours	enhancement	
Hypervascular conditions	enhancement	
Liver parenchyma		enhanced

Hypervascular conditions like HCC,FNH,adenoma, metastasis from colorectal, [redacted] seen in arterial phase

Mets from breast lung,hypovascular conditions, best seen in venous phase

MRI

- AS effective as CT
- Useful in case of allergy to iodinated contrast
- Biliary pathology

- On MRI the liver is of equal signal intensity to the pancreas and higher on T1- and lower on T2-weighted images the spleen.
- Normal hepatic vessels are seen as areas of signal void on standard imaging.
- The major hepatic veins and the secondary branches of the portal veins are visible.
- Hepatic arteries are less well seen unless intravenous contrast is given.
- The intrahepatic biliary radicals are seen on fluid-sensitive imaging in MR cholangiography.
- On T2-weighted images the ligamentum venosum and the ligamentum teres are of low intensity but the fat within their fissures is of high intensity.

- As with CT and ultrasound, the hepatic veins and these fissures aid in identification of segments and lobes of the liver than hepatic arteriography
- This is achieved via the aorta and the coeliac trunk with greater selectivity if the contrast agent is injected distal to the origin of the gastroduodenal artery.
- MR and CT angiography can also produce excellent images of the coeliac trunk and SMA.
- These are acquired after the injection of gadolinium or iodine contrast agents intravenously as a bolus, after several seconds to allow the contrast to pass into the arterial system.
- In both techniques axially acquired data can be displayed in any plane.
- With MR, angiographic images can also be acquired without contrast using flow-sensitive imaging techniques.

MRCP

- Hepatic , pancreatic and biliary duct information
- Heavily T2 weighted sequences, acquired with thin slice sections or thick slabs or both
- Better **include sequences to evaluate contents of upper abdomen** essentially, liver and pancreas: to exclude presence of any pathology associated witht these organs that may affect calibre and condition of any duct.

Advantage

- High diagnostic accuracy to assess the ducts (hepatobiliary and pancreatic) and associated organs (liver, gall bladder and pancreas)
- Non invasive and less costly than ERCP
- Less examination time, few staff and no ionizing radiation