KREP

2025

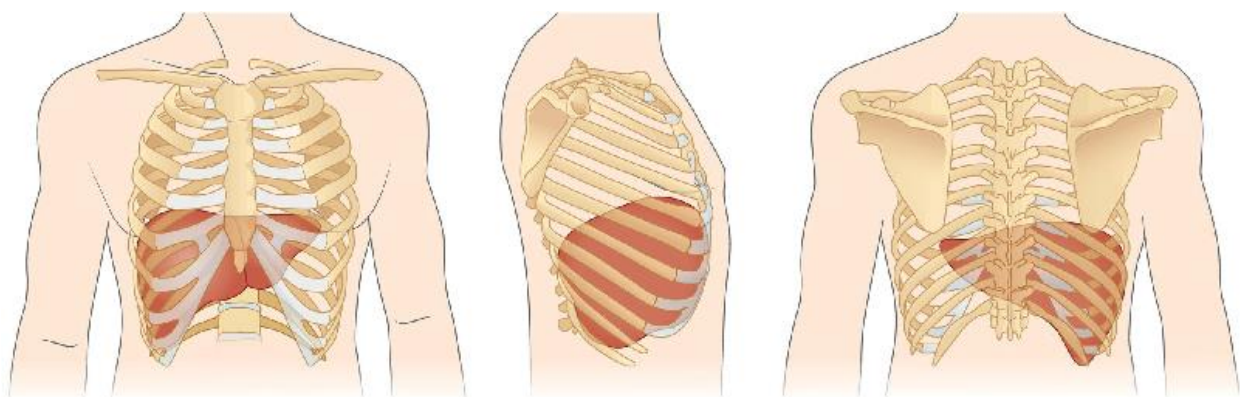
KARNATAKA RADIOLOGY EDUCATION PROGRAM

LIVER Anatomy and applied radiology -2

Ultrasound

Ultrasound is considered one of the first-line diagnostic tests for liver imaging. Based on its findings, decisions that have a direct impact on the patient pathway are made, leading to further investigations, follow-up, or discharge. Along these lines, it should be kept in mind that greyscale ultrasound images lay out an anatomical and structural view of the liver, and therefore it is important to have a significant knowledge of abdominal anatomy and to ensure that the whole liver is assessed thoroughly.

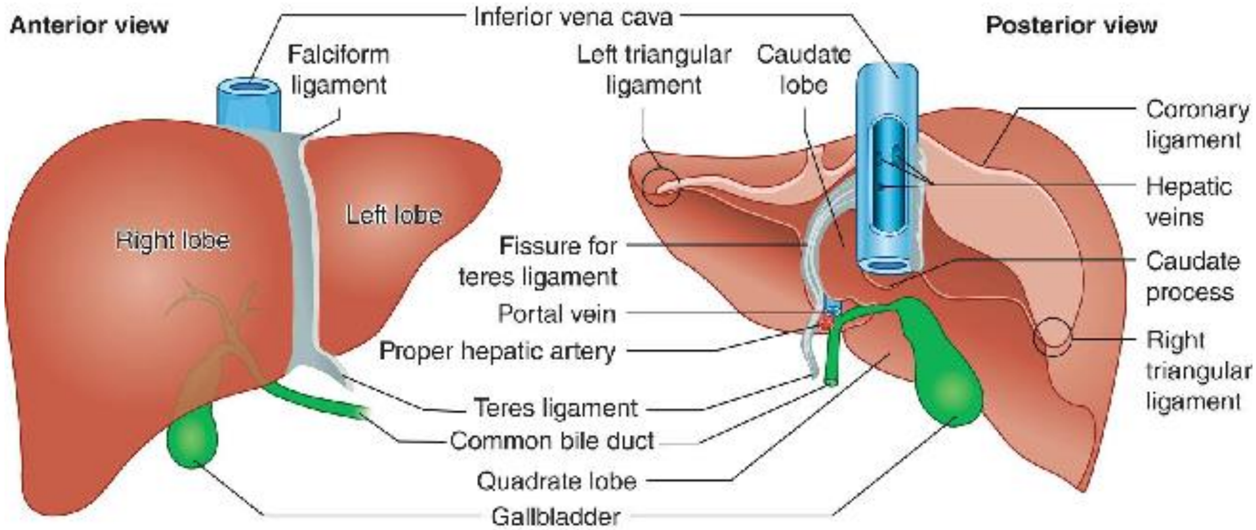
The liver is the largest parenchymal organ in the abdominal cavity. It is located below the diaphragm, extending from the right hypochondrium to the epigastrium, usually reaching the left subcostal edge.



ANTERIOR LATERAL POSTERIOR

The liver is located below the diaphragm, extending from the right hypochondrium to the epigastrium, usually reaching the left subcostal edge. The liver is shown here from three different angles: anterior, right lateral and posterior. More specifically, a transverse and longitudinal scan view, in both the subcostal and intercostal approaches, is routine. A longitudinal scan parallel to the intercostal spaces allows assessment of the lateral segments of the liver and rarely, if needed, a posterior acoustic window can also be used.

It has a smooth, dome-shaped diaphragmatic surface and a visceral, more irregular one, moulded by the adjacent organs and indented by the left, right, and interlobar fissures



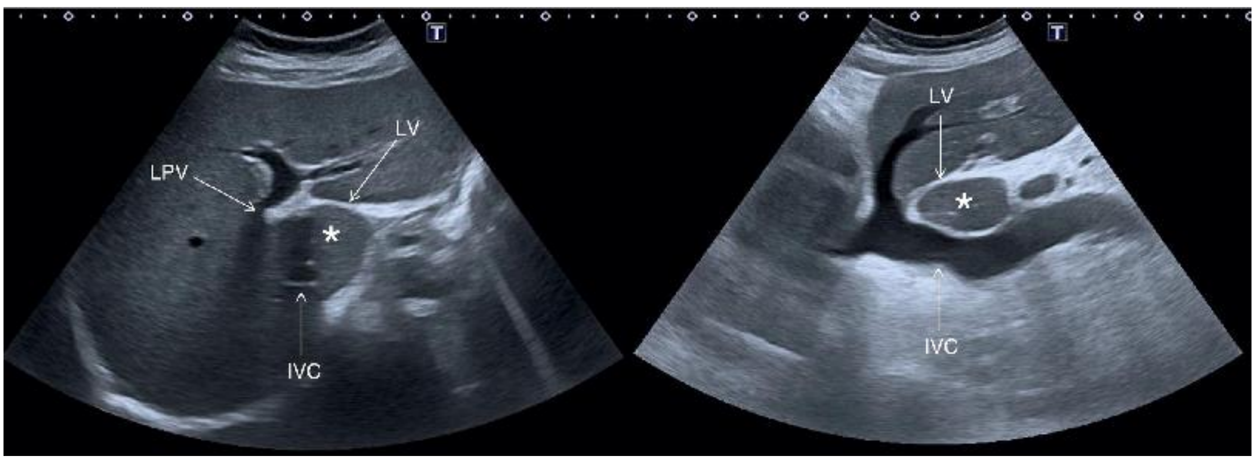
The liver has a smooth, dome-shaped diaphragmatic surface and a mildly irregular visceral one, which is moulded by the adjacent organs and indented by the interlobar fissures.

Normally during respiration, the liver moves following the diaphragm. This movement is important and can be increased with deep inspiration to optimise liver visualisation during ultrasound imaging in a subcostal view. The magnitude of these excursions depends on the individual's lung capacity as well as body habitus and the mechanical properties of the thoracic wall (obesity and some structural diseases of the musculature or bone of the thoracic wall reduce this oscillation). Owing to the liver's high anatomical variability, it is generally accepted to compare its size to the right kidney to gauge whether it is enlarged, normal, or atrophic, rather than taking an exact measurement of its diameter . A subcostal maximal length of 16 cm taken in the mid-clavicular is considered the upper limit of normal.

The suspensory system of the liver is constituted by ligaments that are seen on ultrasound as hyperechoic linear structures of different widths that fix the liver to the diaphragm, abdominal wall, and adjacent organs. Other ligaments envelope vascular and biliary structures and provide useful landmarks for the description of the complex liver structure. More specifically, the falciform ligament connects the dorsal surface of the liver to the diaphragm and to the anterior abdominal wall dividing the liver into the anatomic right and left lobes. Its free margin continues with the remnant of the obliterated umbilical vein, which is known as the ligamentum teres (or round ligament) and runs along the ventral surface of the liver, coming into direct contact with the left branch of the portal vein (PV).

Ligamentum teres (LT) or round ligament takes direct contact with the left branch of the portal vein (LPV). LT runs along the ventral surface of the liver continuing with the falciform ligament (FL) along the dorsal surface of the liver. By changing the plane of insonation from transverse to longitudinal scan view (left to right image) the LT will be seen elongating in full extent to join the FL (right side image).

The obliterated remnants of the ductus venosus constitute the venous ligament, which is seen on ultrasound as a thin hyperechoic line that surrounds the parenchyma adjacent to the retrohepatic inferior vena cava (IVC) defining the borders of the caudate lobe.

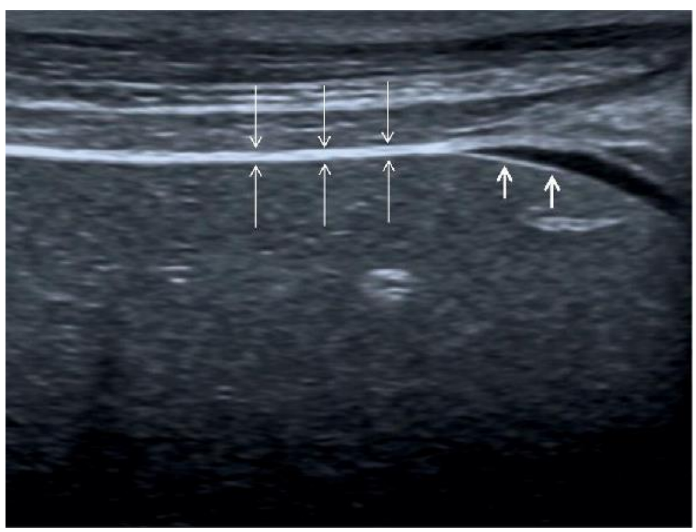


The boundaries of the caudate lobe (asterisk) are defined by the retrohepatic inferior vena cava (IVC), the ligamentum venosum (LV), and the left branch of the portal vein (LPV) that is better seen when imaging in transverse section (left side image).

In normal conditions, the liver has smooth margins and regular contour, the echotexture is homogeneous, and the echogenicity is almost equal to or slightly brighter than the cortex of the right kidney.

Examples of liver size compared to the right kidney. (a) Normal size of the right lobe compared to the right kidney. (b) Enlarged right liver lobe with subtle increase in echogenicity compared to the cortex of the right kidney. (c) The right liver lobe is smaller and has rounded margins and an irregular outline, in keeping with fibrotic retraction.

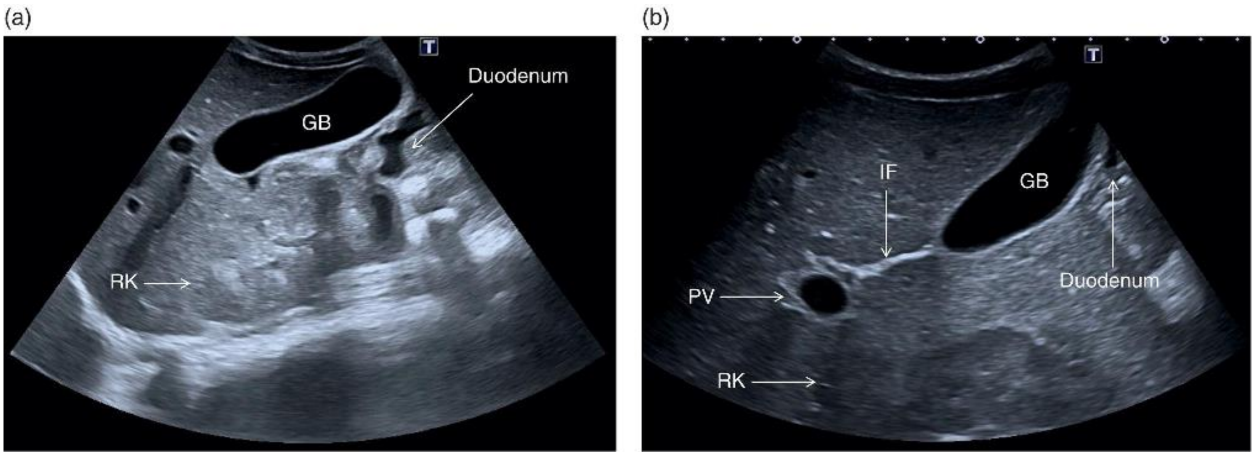
The liver is enveloped within the fibrous Glisson's capsule, which contains sensitive nerve endings supplied by the phrenic nerve. The capsule can be barely seen on ultrasound as a hyperechoic line that permeates the liver in direct contact with the peritoneum and is therefore more easily distinguished when there is ascites.



The Glisson's capsule can barely be seen surrounding the liver, since it is in direct contact with the peritoneum (thin arrows point to the interface of the peritoneum and Glisson's capsule). Note is made of a small amount of intraperitoneal fluid that detaches the liver from the peritoneum, highlighting a subtle hyperechoic line surrounding the liver corresponding to the Glisson's capsule (thick arrows).

Gall Bladder

The gallbladder (GB) is a pear-shaped structure located in the GB fossa along the inferior surface of the right liver lobe, lateral to the second portion of the duodenum and anterior to the right kidney Its position is variable according to the patient's body habitus [2]. Four anatomical variants are described and should be borne in mind, since anatomical landmarks and GB positioning might vary considerably:



The gallbladder (GB) is a pear-shaped structure located in the GB fossa, a depression on the visceral surface of the liver between the right and left lobe. The GB is usually lateral to the second part of the duodenum and anterior to the right kidney (RK). (b) Note is made of the main interlobar fissure (IF) between the portal vein (PV) and the GB.

Hypersthenic body habitus: the diaphragm, liver, GB, and stomach tend to lie high in the abdomen and the ultrasound examination is often limited due to the presence of overlying bowel gas and food residue.

Sthenic: the liver and GB lie as expected in the right upper quadrant and the GB has an oblique position.

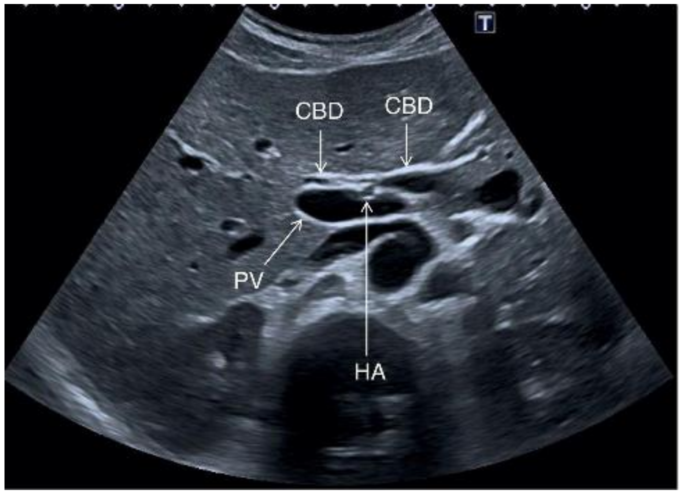
Hyposthenic: the liver and GB lie lower, often in the lumbar region, and the GB is more vertically oriented.

Asthenic (extremely hyposthenic): the liver and GB might lie as low as in the right iliac fossa and the GB is vertically oriented.

Biliary Tree

The biliary tree can be divided into intrahepatic and extrahepatic segments. The intrahepatic ducts run across the liver from the periphery to the liver hilum, converging in larger ducts, and are in tight anatomical connection with the hepatic arterial supply and the portal venous system. In proximity to the liver hilum, the cystic duct that drains bile from the GB joins the main hepatic duct to form the common bile duct (CBD). The CBD terminates with the pancreatic duct at the ampulla of Vater within the second portion of the duodenum.

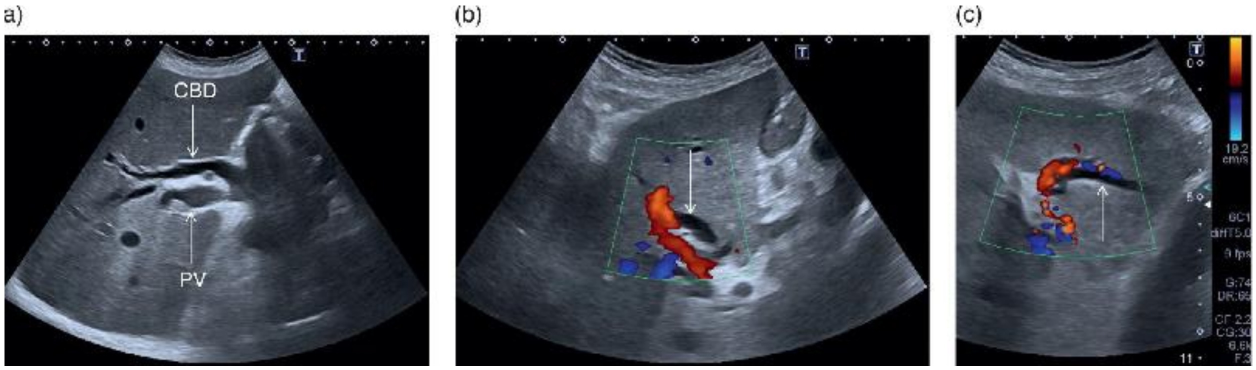
In normal physiological conditions, the CBD is the only biliary duct that can be clearly seen as a thin tubular structure with echogenic walls that in the majority of cases runs anteriorly and parallel to the PV at the level of the hepatic hilum .



The common bile duct (CBD) can be seen as a thin tubular structure with echogenic walls that, in the majority of cases, runs anteriorly and parallel to the portal vein (PV) at the level of the hepatic hilum. The hepatic artery (HA) is often seen at this level in transverse section, hence it is visualised as a small rounded or ovoid structure (depending on the angle of insonation) with echogenic walls between the CBD and the PV.

However, the anatomical relationship of the biliary ducts and the portal vessels may vary along their course, and usually the peripheral biliary ducts (which are only clearly visible when dilated or significantly thickened) run posteriorly to the PV .

In the majority of cases the portal vein (white arrow) lies posterior to the common bile duct (red arrow) at the hepatic hilum. Note that shortly after entering the liver, its position becomes anterior to the bile ducts.



In this sequence of images, the dilated bile ducts help to clearly delineate their anatomical relationship with the portal venous system. At the level of the hepatic hilum the portal vein (PV) is posterior to the common bile duct (CBD) (a). As the portal venous tree progresses within the liver, its position gradually changes (b), crossing over to run anteriorly to the bile ducts in the more peripheral regions of liver parenchyma. Bile ducts are identified in (b) and (c) by white arrows, while the color signal highlights the portal venous blood flow.

The CBD measures between a minimum of 2–3 mm and an upper limit of 6–7 mm. Larger calibres are observed, especially post cholecystectomy and with age, where it is generally accepted that the calibre may increase by 1 mm each decade after 70 year

Compiled by: Dr Pravin G U Principal,Prof.RadioDiagnosis . Sri Chamundeshwari Medical college Hospital & Research Institute,Channapatna,Karnataka.President IRIA Karnataka.

https://radiologykey.com/