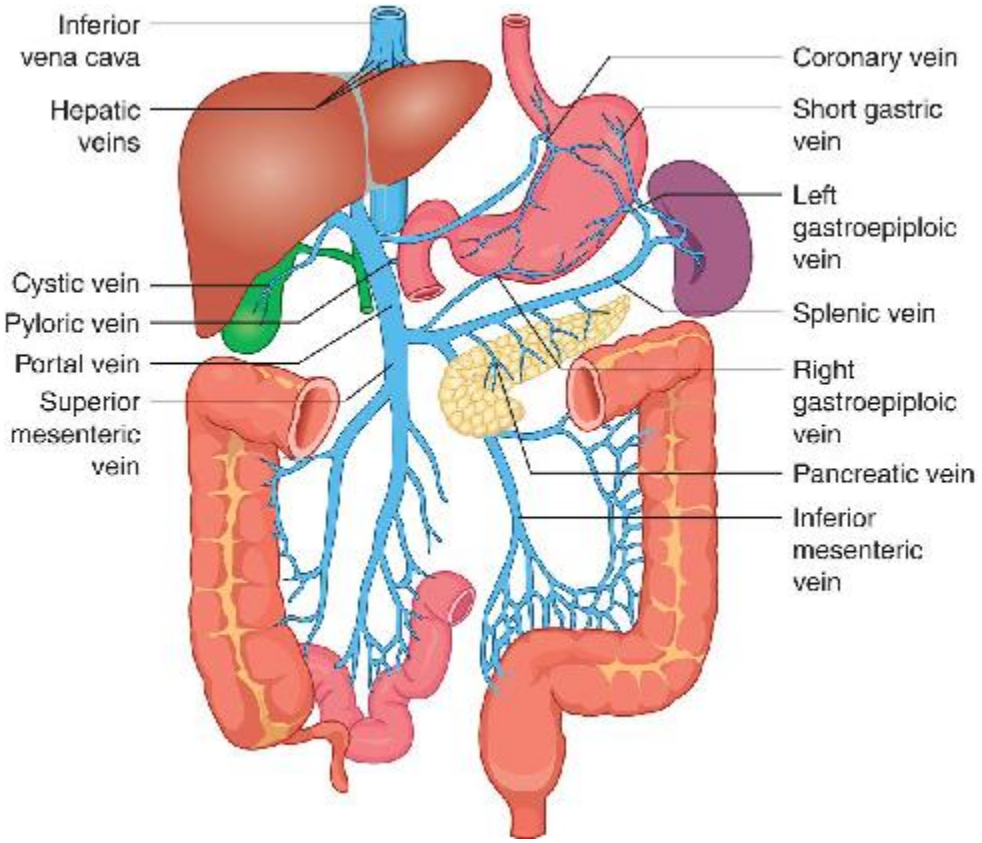
KARNATAKA RADIOLOGY EDUCATION PROGRAM

LIVER Anatomy and applied radiology -3

Liver Vascular Anatomy

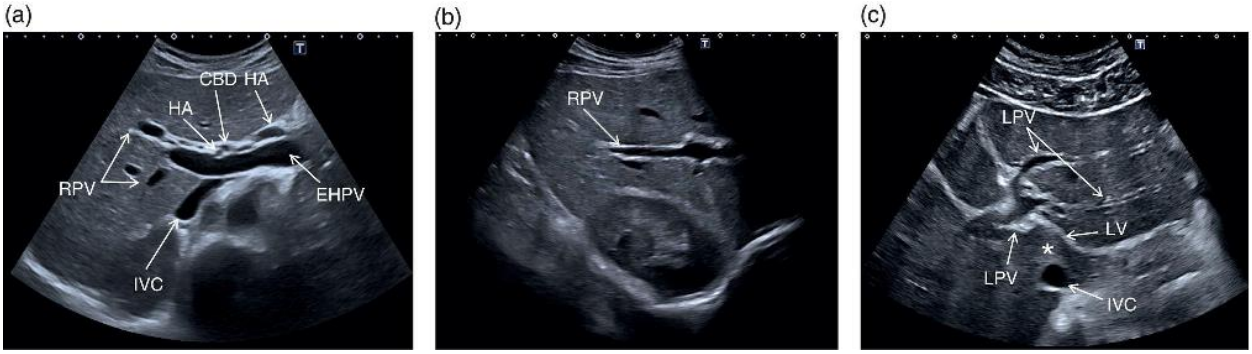
The PV is formed by the confluence of the superior mesenteric vein and the splenic vein, draining the blood of the whole digestive system and spleen .



Pictorial view of the portal venous system draining blood from the digestive system and the spleen

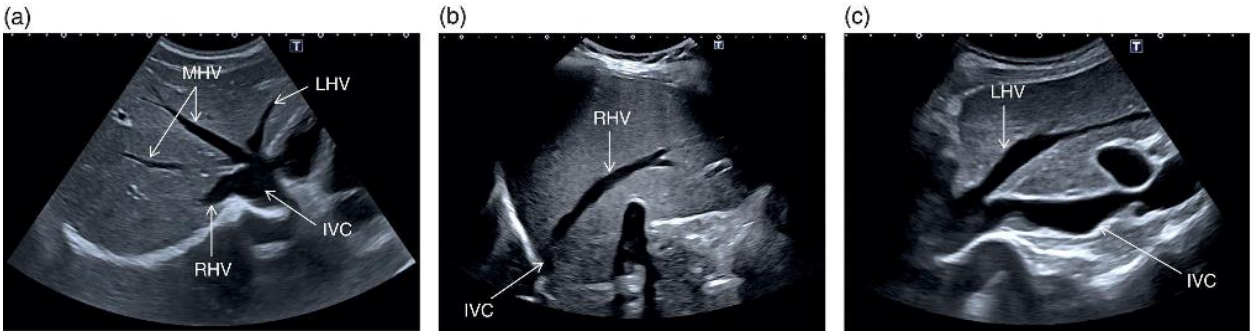
Under physiological conditions the portal venous system delivers 75% of the total hepatic inflow, whereas the hepatic artery (HA) is responsible for the remaining 25%. It is important to keep in mind the physiology and pathophysiology of the hepatic blood inflow, since during the progression of liver disease, especially when cirrhosis and portal hypertension develop, the portal venous inflow is reduced while the arterial hepatic inflow is increased .

The PV can be recognised on ultrasound as a tubular structure with a variable normal calibre of approximately 8–12.5 mm, with thick echogenic walls that enters the liver together with the HA at the level of the hepatic hilum. It is followed by the HA and the biliary system in its whole intrahepatic course and for a short portion in its extrahepatic tract at the level of the porta hepatis, where it is contained within the hepatoduodenal ligament. Upon entering the liver, the PV and HA divide into the left and right branches, with further divisions providing the blood supply to each of the eight main liver segments .



The portal venous system can be recognised on ultrasound as a tubular structure with echogenic walls that enters the liver together with the hepatic artery (HA) at the level of the hepatic hilum (a), and reaches the more distal liver segments. (b) Posterior branch of the right portal vein (RPV); (c) left portal vein (LPV) branches. (c) The caudate lobe can be clearly visualised in this scanning plane (asterisk) between the inferior vena cava (IVC), the ligamentum venosum (LV), and LPV. CBD, common bile duct; EHPV, extrahepatic portal vein.

At the periphery of the liver lobules the arterial and venous blood mix and enter the sinusoids, terminating finally in the central veins that converge to form the right (RHV), middle (MHV), and left hepatic veins (LHV) that finally drain into the IVC .

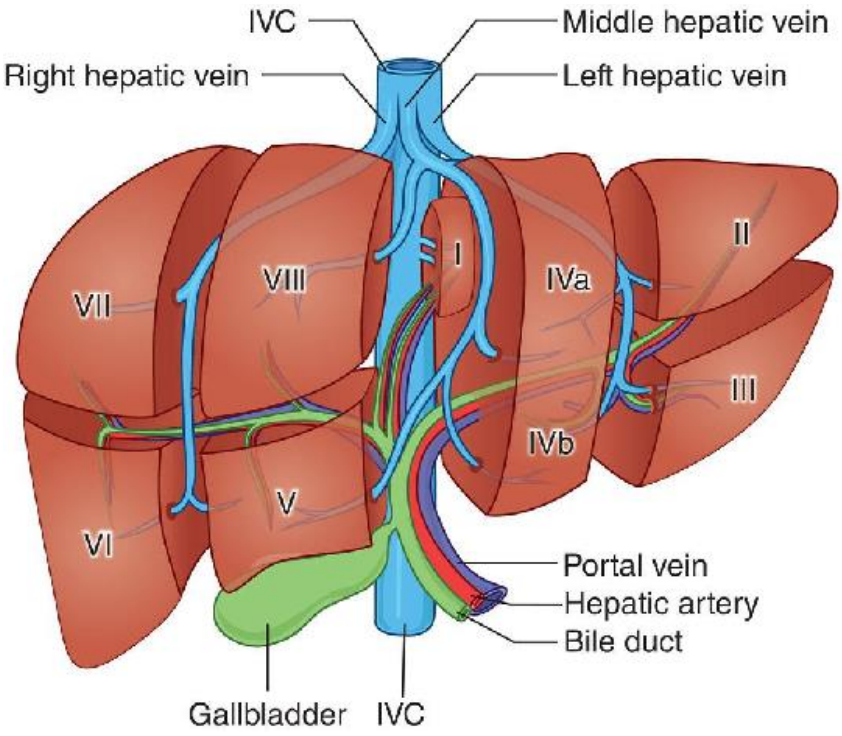


(a–c) The hepatic veins originate from the periphery of the liver, converging into the inferior vena cava (IVC). LHV, left hepatic vein; MHV, middle hepatic vein; RHV, right hepatic vein.

It is of note that the caudate lobe is drained independently by a main or multiple small pericaval veins. Its independent venous drainage system is the reason why the caudate lobe typically hypertrophies in advanced chronic liver disease. In Budd–Chiari syndrome, this compensatory mechanism is even more pronounced, since while the main three hepatic veins are obstructed, the pericaval ones often remain patent, leading to an abnormally hypertrophied caudate lobe

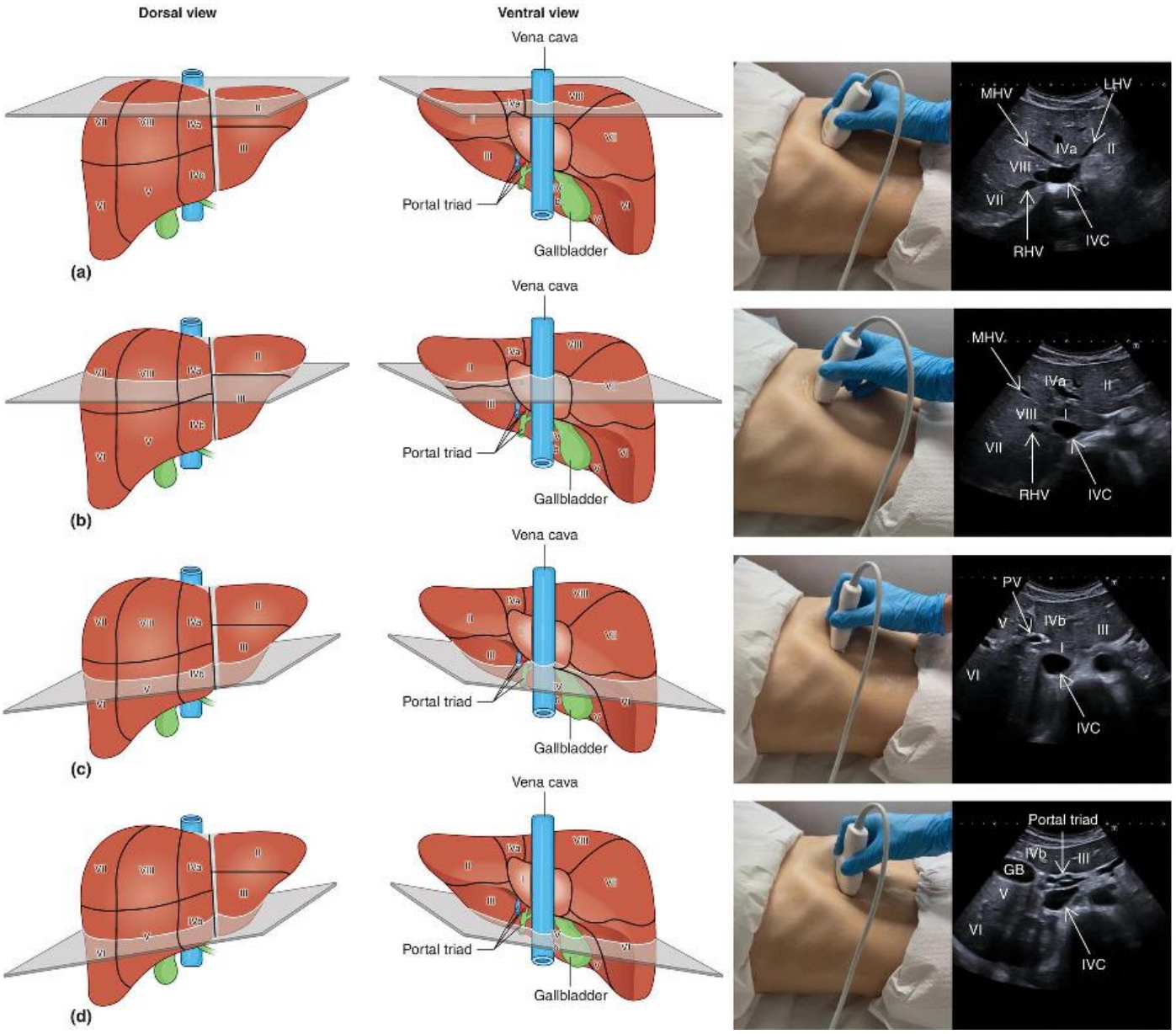
Vascular Segments of the Liver

Based on the divisions of the portal and hepatic veins, the liver may be divided into eight segments, as first suggested by the French surgeon Claude Couinaud in 1957 .



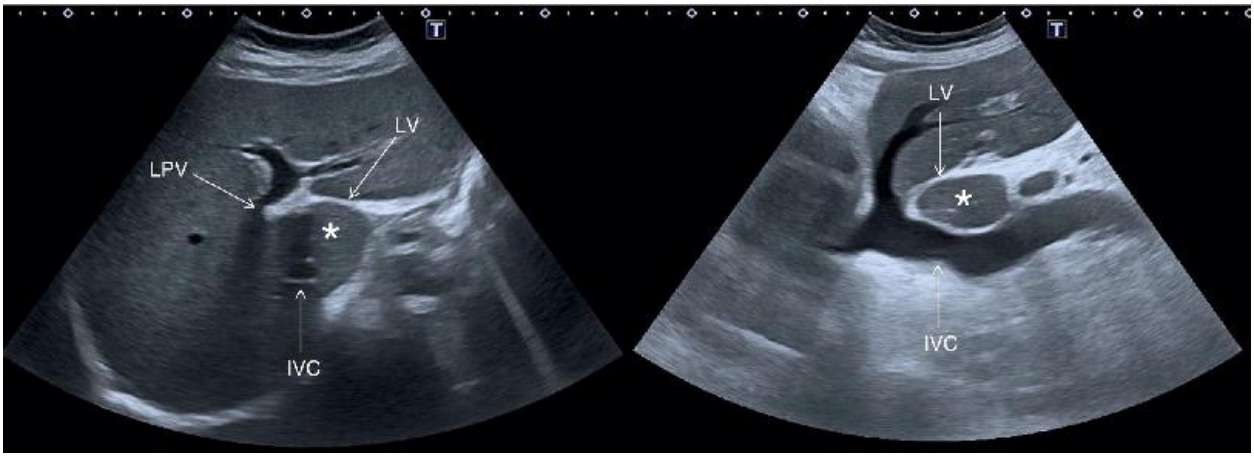
Liver segmentation following Couinaud classification. IVC, inferior vena cava.

This classification relies on the fact that each of these segments has its own individual blood supply and might be resected without jeopardising the viability of other segments. In this classification, the liver segments II and III are situated to the left of the LHV and falciform ligament, and the left branch of the PV (LPV) divides them into segment II (above the PV) and segment III (below the LPV). Segment IV is situated between the LHV and the MHV and the LPV divides them into segment IVA (above the LPV) and segment IVB (below the LPV). Segments V and VIII are located between the MHV and RHV, whereas segments VI and VII represent most lateral segments situated to the right of the RHV. The right branch of the RPV divides segment V (caudal) from VIII (cranial) and segment VI (caudal) from VII (cranial) .

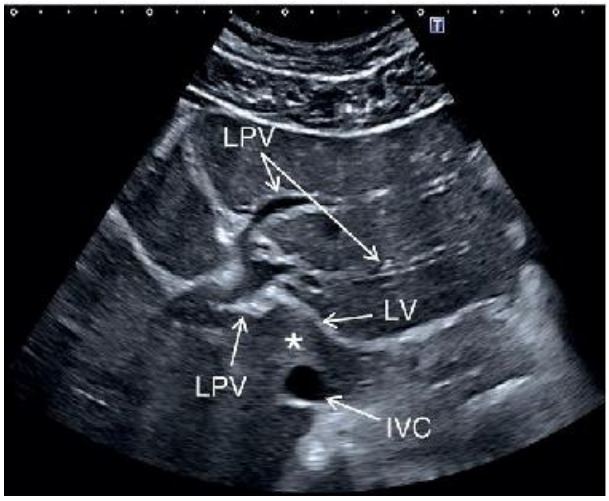


(a–d) This sequence of images shows how the ultrasound beam transverses the liver along sequential axial planes when moving the probe craniocaudally (i.e. from top to bottom) and how the hepatic and portal veins serve as reference landmarks, in line with Couinaud classification. Note is made of a pictorial view of the dorsal and ventral surfaces of the liver, with an adjacent right hand image of the corresponding liver segments seen ultrasonically. The sectional planes correspond to the orientation of the ultrasound beam. RHV, right hepatic vein; MHV, medium hepatic vein; LHV, left hepatic vein; IVC, inferior vena cava; PV, portal vein; GB, gallbladder.

On the dorsal, central part of the liver, between the IVC and the venous ligament, lies the caudate lobe that corresponds to segment I .



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).



The caudate lobe can be clearly visualised in this scanning plane (asterisk) between the inferior vena cava (IVC), the ligamentum venosum (LV), and LPV. CBD, common bile duct; EHPV, extrahepatic portal vein.

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