

# Anatomy of the liver

Harold Ellis

## Abstract

The liver is the largest organ in the body. Its gross anatomical divisions comprise the right, left, caudate and quadrate lobes, which do not correspond with its functional division into eight hepatic segments, each with their own blood supply and biliary drainage. The porta hepatis transmits the hepatic artery, portal vein and right and left hepatic ducts (the portal triad), together with lymphatic and autonomic nerves. The venous drainage of the liver, directly into the inferior vena cava, comprises the right, left and middle hepatic veins, together with the small accessory hepatic veins.

**Keywords** bile ducts; hepatic artery; hepatic lobes (right, left, quadrate and caudate); liver; liver segments; portal vein; right, left, middle and accessory hepatic veins

The liver is the largest organ in the body. Its domed upper surface relates entirely to the diaphragm while its postero-inferior, or visceral, surface rests against the abdominal oesophagus, stomach, upper duodenum, hepatic flexure of the colon, right kidney and suprarenal gland, as well as carrying the gall bladder (Figure 1).

Its surface relations can be marked out by joining points on:

- the right costal margin in the mid-axillary line, (the 10th rib)
- the right 5th intercostal space ditto
- the left 5th intercostal space in the mid-clavicular line.

The liver can readily be marked out on the subject by its dullness to percussion. Note that the liver in the normal subject is not palpable on clinical examination; especially in a well-developed male, the contracted anterior abdominal muscles mimic the liver edge, but careful percussion reveals that the so-called liver edge is resonant!

## Peritoneal attachments (Figure 2)

Apart from a small posterior *bare area*, demarcated as the peritoneum from the diaphragm reflects onto it as the upper and lower layers of the *coronary ligament*, the liver is otherwise enclosed in peritoneum. To the right, these layers fuse to form the short *right triangular ligament*. The *falciform ligament* runs to the liver from the umbilicus carrying the *ligamentum teres* (the obliterated fetal umbilical vein), in its free border. The ligamentum teres passes into its fissure on the inferior surface of the liver, while the falciform ligament passes over the dome of the liver and then divides; its right limb joins the upper layer of the coronary ligament, while its left limb stretches out as the long narrow *left triangular ligament*, which joins the lesser omentum as this arises from the

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**Harold Ellis CBE FRCS FRCOG** is Emeritus Professor of Surgery, University of London (Charing Cross and Westminster Medical School). He is Clinical Anatomist in the Division of Anatomy at King's College (Guy's Campus), London, UK. Conflicts of interest: none.

fissure for the ligamentum venosum. The *lesser omentum* arises from the fissures of the porta hepatis and the ligamentum venosum to attach along the lesser curvature of the stomach.

## Anatomical subdivisions (Figure 2)

The superior aspect of the liver is divided by the falciform ligament into an anatomical right and smaller left lobe. Postero-inferiorly it bears an H-shaped arrangement of fossae:

Anteriorly and to the right – the fossa for the gall bladder.

Posteriorly and to the right – the groove for the inferior vena cava.

Anteriorly and to the left – the groove for the ligamentum teres (often partially bridged by liver tissue).

Posteriorly and to the left – the fissure for the ligamentum venosum. This represents the obliterated fetal ductus venosus, which shunts oxygenated blood from the umbilical vein to the inferior vena cava, short-circuiting the liver.

The cross-bar of the H is the *porta hepatis*.

Two additional lobes are marked out on the visceral aspect of the liver between the limbs of the H – the *quadrate lobe* anteriorly and the *caudate lobe* behind.

Lying in the porta hepatis, which measures about 5 cm in length, are a triad of important structures (Figures 3 and 4). These are:

- The right and left hepatic ducts, fusing into the common hepatic duct – anteriorly and to the right.
- The hepatic artery dividing into its left and right branches – rather more posteriorly and to the left.
- The portal vein, dividing into its left and right branches – posteriorly.

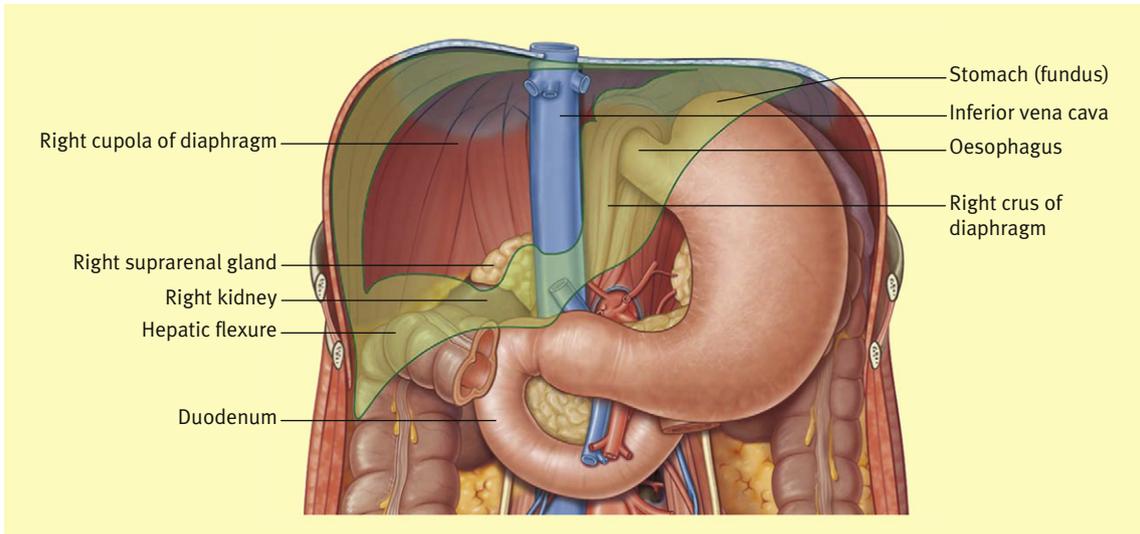
In addition to this portal triad, there are autonomic nerves (parasympathetic from the hepatic branch of the anterior vagus nerve, and sympathetic from the coeliac axis) and the portal lymph nodes.

## Segmental anatomy

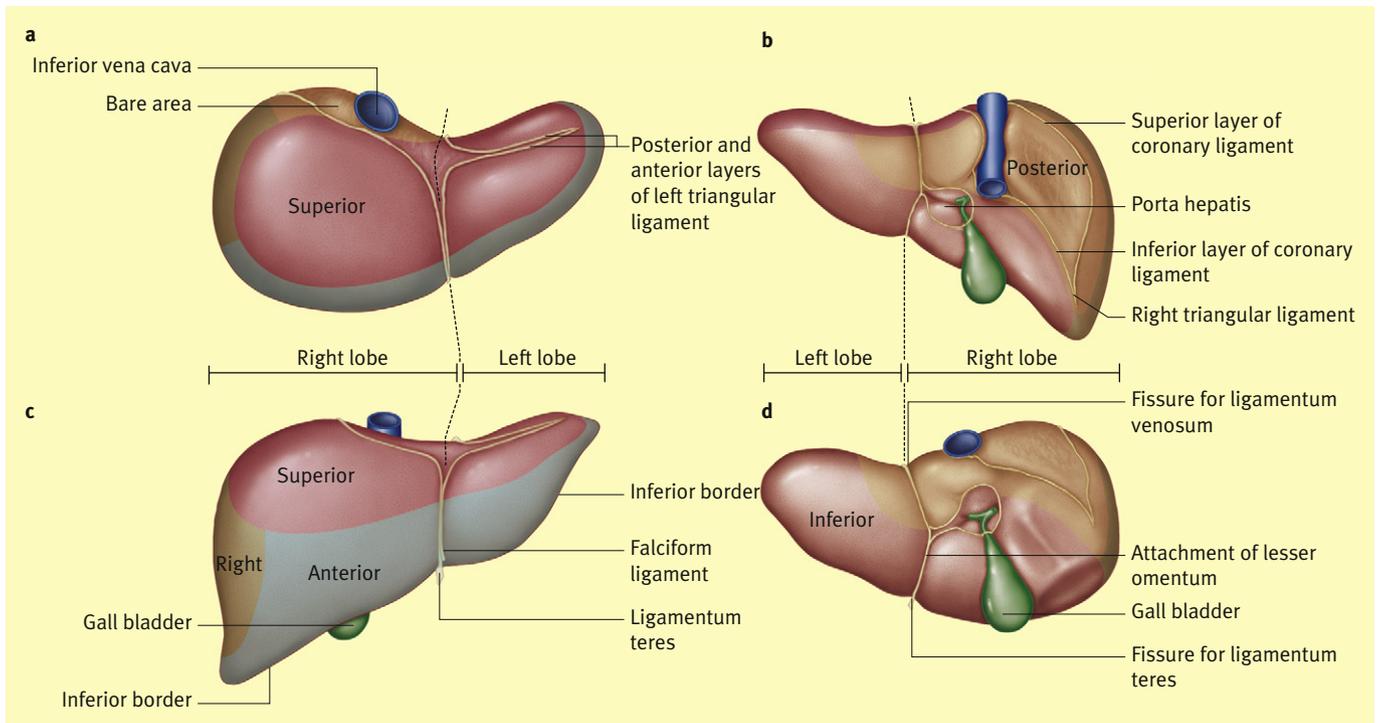
The gross anatomical division of the liver into its right and left lobes is useful in gross description but is without morphological significance. The areas of supply of the right and left hepatic arteries, with accompanying portal vein and bile duct branches, can be demarcated by a line passing through the inferior vena cava and the fossa of the gall bladder, i.e. into roughly equal functional right and left lobes. These can be subdivided into a further eight segments, four to each functional lobe (Figure 5), each segment with its individual blood supply and biliary drainage. This arrangement allows the surgeon to carry out segmental hepatic resections.

## The hepatic veins (Figure 6)

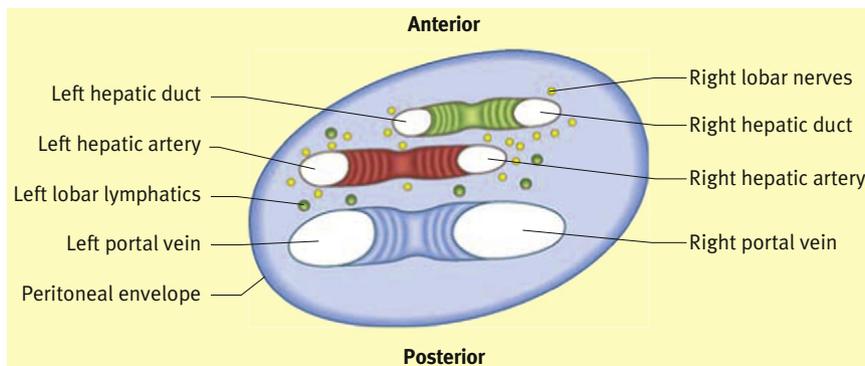
The portal venous blood returns to the inferior vena cava via the hepatic veins. These are large and have a different distribution to the portal triad. The three major veins are the *right, left and central hepatic veins*. These pass in a postero-superior direction through the liver substance to drain into the inferior vena cava at the postero-superior aspect of the liver. The arrangement is variable, but usually the middle vein (the smallest of the three),



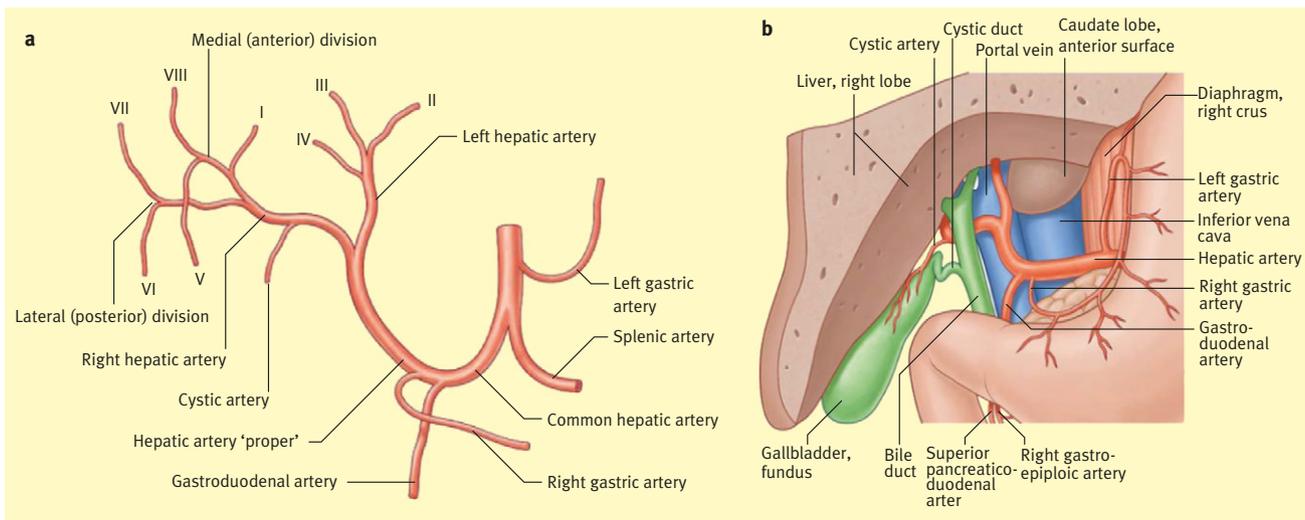
**Figure 1** The 'bed' of the liver. The outline of the liver is shaded green. The central bare area is unshaded.



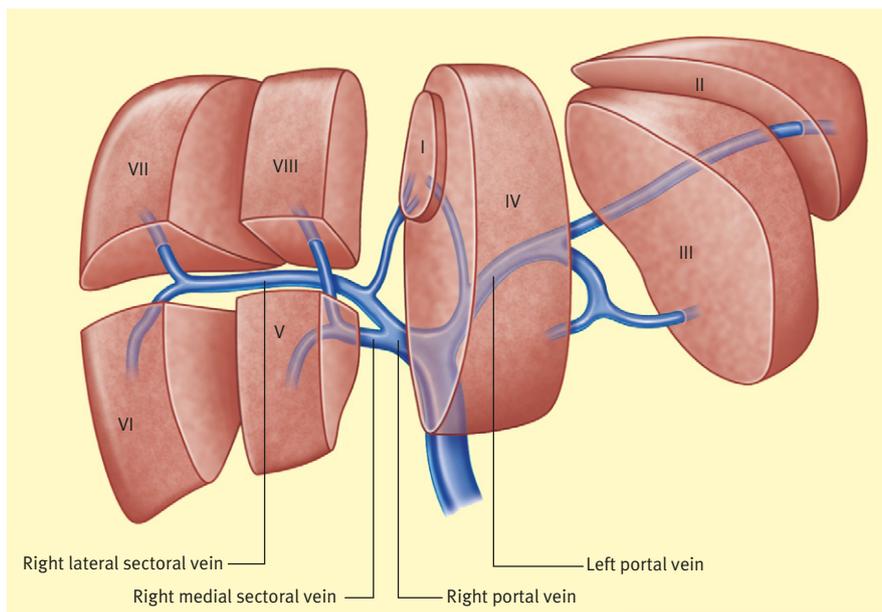
**Figure 2** The surface features, ligaments and peritoneal attachments of the liver.



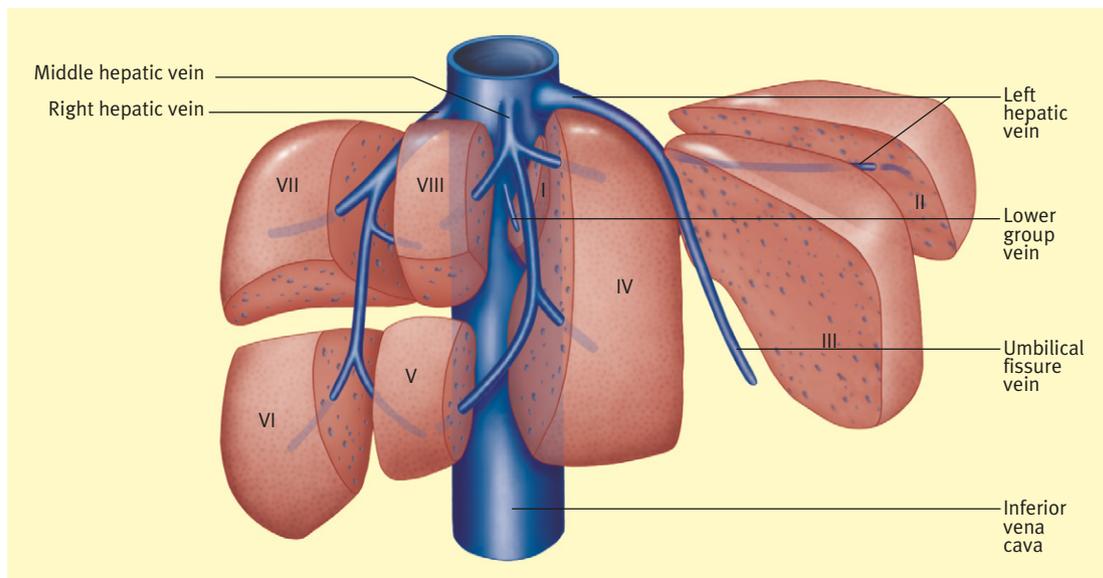
**Figure 3** Cross-section of the structures at the porta hepatis.



**Figure 4** The portal triad entering the hilum of the liver.



**Figure 5** The segmental anatomy of the liver with the tributaries of the portal vein.



**Figure 6** The hepatic veins.

opens into the left vein just before its termination. In addition, there is always a variable number of accessory veins that run directly from the liver to open along the inferior vena cava distal to the openings of the main veins.

Note that compression of the portal triad at the foramen of Winslow (Pringle's manoeuvre), will not control bleeding from divided hepatic veins in partial liver resections or in liver trauma. ◆