

ACKNOWLEDGEMENT

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To my great lovely family, Mam, sisters, husband and pretty daughter, Thank you for your support and patience.

Lastly, to my father, Hope of making your dream comes true.

The liver Anatomy

The liver is the largest of the abdominal viscera, occupying a substantial portion of the upper abdominal cavity. It performs a wide range of metabolic activities necessary for homeostasis, nutrition and immune defense. It is composed largely of epithelial cells (hepatocytes), which are bathed in blood derived from the hepatic portal veins and hepatic arteries. There is continuous chemical exchange between the cells and the blood. Hepatocytes are also associated with an extensive system of minute canals, which form the biliary system into which products are secreted. The liver is populated by phagocytic macrophages, which form part of the mononuclear phagocyte system of the body, and are important in the removal of particulates from the blood stream (*Standring et al, 2005*).

Position and shape

The liver lies in the upper right part of the abdominal cavity. It occupies most of the right hypochondrium and epigastrium, although it frequently extends into the left hypochondrium as far as the left lateral line. In adults the liver weighs 2% of body mass. The liver has an overall wedge shape, which is in part determined by the form of the upper abdominal cavity. The narrow end of the wedge lies towards the left hypochondrium,

with the anterior edge pointing anteriorly and inferiorly. The superior and right lateral aspects are shaped by the anterolateral abdominal and chest wall as well as the diaphragm. The inferior aspect is shaped by the adjacent viscera. The liver capsule plays an important part in maintaining the integrity of its shape.

Hepatic surfaces and relations:

The liver having superior, anterior, right, posterior and inferior surfaces, and has a distinct inferior border. However, superior, anterior, right surfaces are continuous with no definable borders.

(1) Superior surface:

The superior surface is the largest surface and lies immediately below the diaphragm, separated from it by peritoneum except for a small triangular area where the two layers of falciform ligament diverge. It is related to the right diaphragmatic pleura, base of the right lung, pericardium, ventricular part of the heart, part of the left diaphragmatic pleura and base of the left lung(*Standring et al., 2005*).

(2) Anterior surface:

The anterior surface is triangular and convex. It is covered by peritoneum except at the attachment of the falciform ligament. ***On the right***, the diaphragm separates it from the pleura and sixth to tenth ribs and cartilages, ***and on the left*** from the seventh and eighth costal cartilages. The median area

of this surface lies behind the xiphoid process and the anterior abdominal wall in the infracostal angle (*Standring et al., 2005*).

(3) Right Surface:

It is covered by peritoneum and lies adjacent to the right dome of the diaphragm which separates it from the right lung, pleura and seventh to eleventh ribs (*Standring et al., 2005*).

4) Posterior surface:

The posterior surface is convex, wide on the right, but narrow on the left. A deep median concavity corresponds to convexity of the vertebral column. Much of the posterior surface is attached to the diaphragm by loose connective tissue which forms the so-called ` **bare area** `. The ` bare area ` is an anterior relation of the upper pole of the left suprarenal gland. **The inferior vena cava** lies in a groove in the medial end of the ` **bare area** `. To the left of IVC the **caudate lobe** is present. To the left of caudate lobe, the fissure for the ligamentumvenosum is present. The posterior surface over the left lobe bears a shallow oesophageal impression and gastric impressions (*Standring et al., 2005*).

(5) Inferior surface:

The inferior surface is bounded by the inferior edge of the liver. It is marked near the midline by fissure of ligamentumteres. Posteriorly it is related to the ligamentumvenosum and the gall bladder. Between the fissure for the ligamentumteres and the gall bladder lies the quadrate

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lobe. The inferior surface of the left lobe is related inferiorly to the fundus of the stomach and the upper part of the lesser omentum. The quadrate lobe lies adjacent to the pylorus, first part of the duodenum and the lower part of the lesser omentum. Occasionally the transverse colon lies between the duodenum and the quadrate lobe. To the right of the gall bladder, the inferior surface is related to the hepatic flexure of the colon, the right suprarenal gland and the right kidney, and the first part of the duodenum (*Standring et al, 2005*).

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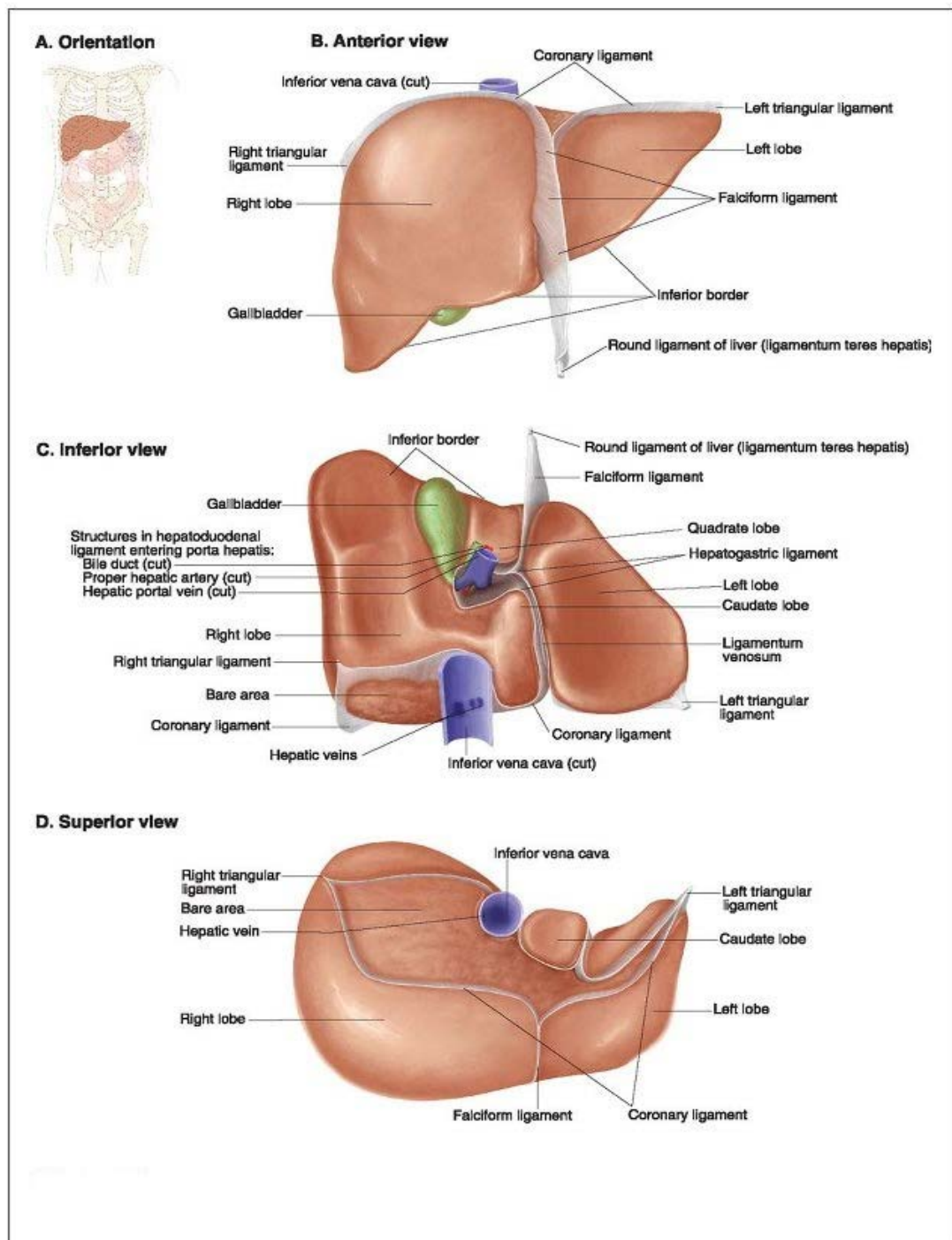


Figure (1): Liver surfaces (Quoted from Williams & Wilkins, 2008).

The portahepatis

The portahepatis is the area of the inferior surface through which all the neurovascular and biliary structures, except the hepatic veins, enter and leave the liver. It is situated between the quadrate lobe in front and the caudate process behind. The portahepatis is actually a deep fissure into which the portal vein, hepatic artery and hepatic nervous plexus ascend into the parenchyma of the liver. The right and left hepatic bile ducts and some lymph vessels emerge from it. At the portahepatis, the hepatic ducts lie anterior to the portal vein and its branches, and the hepatic artery with its branches lies between the two. The left hepatic duct remains extrahepatic as it runs down to the bifurcation along the base of segment IV - the quadrate lobe. This extrahepatic length of duct is particularly useful when performing high biliary duct reconstructions where a length of jejunum is anastomosed to form a biliary enteric bypass, for strictures of the common hepatic duct (*Standring et al, 2005*).

Hepatic lobes and segmental anatomy of the liver:-

A-Anatomical lobes of the liver:

(1)Right lobe :

The right lobe of the liver is the largest in size and contributes to all surfaces; it exceeds the left lobe by a ratio of 6:1. It occupies the right hypochondrium and is bordered on its upper surface by the falciform ligament, on its posterior surface

by the left sagittal fossa, and in front by umbilical notch. Its inferior and posterior surfaces are marked by three fossae; the portahepatis, the gall bladder fossa, and the inferior vena cava. A congenital variant, Riedel's lobe, can sometimes be seen as an anterior projection of the liver (*Standring et al., 2005*).

(2) Left lobe:

The left lobe of the liver is the smaller of the two main lobes. It lies in the epigastric and left hypochondrium regions. Its upper surface is convex. Its under surface includes the gastric impression and omental tuberosity. The medial segment of the left lobe is oblong and situated on the postero-inferior surface of the left lobe. In front it is bounded by the anterior margin of the liver, behind by the portahepatis, on the right by the fossa for the gall bladder, and on the left by the fossa for the umbilical vein (*Standring et al., 2005*).

(3)Caudate lobe:

The caudate lobe is a small lobe visible on the posterior surface. It is bounded on the left by the fissure for ligamentumvenosum, below by the portahepatis, on the right by the groove for the inferior vena cava. Above it continues into the superior surface. Below and to right, it is connected to the right lobe by a narrow caudate process. In gross anatomical descriptions this lobe is said to arise from the right lobe, but it is functionally separate (*Standring et al., 2005*).

(4) Quadrate lobe:

The quadrate lobe is only visible from the inferior surface, it appears somewhat rectangular. It is bounded on the right by the fossa for the gall bladder, on the left by the fissure for ligamentum teres, in front by the inferior border, and posteriorly by the porta hepatis. In gross anatomical description it is said to be a lobe arising from the right lobe, however, it is functionally related to the left lobe (*Standring et al., 2005*).

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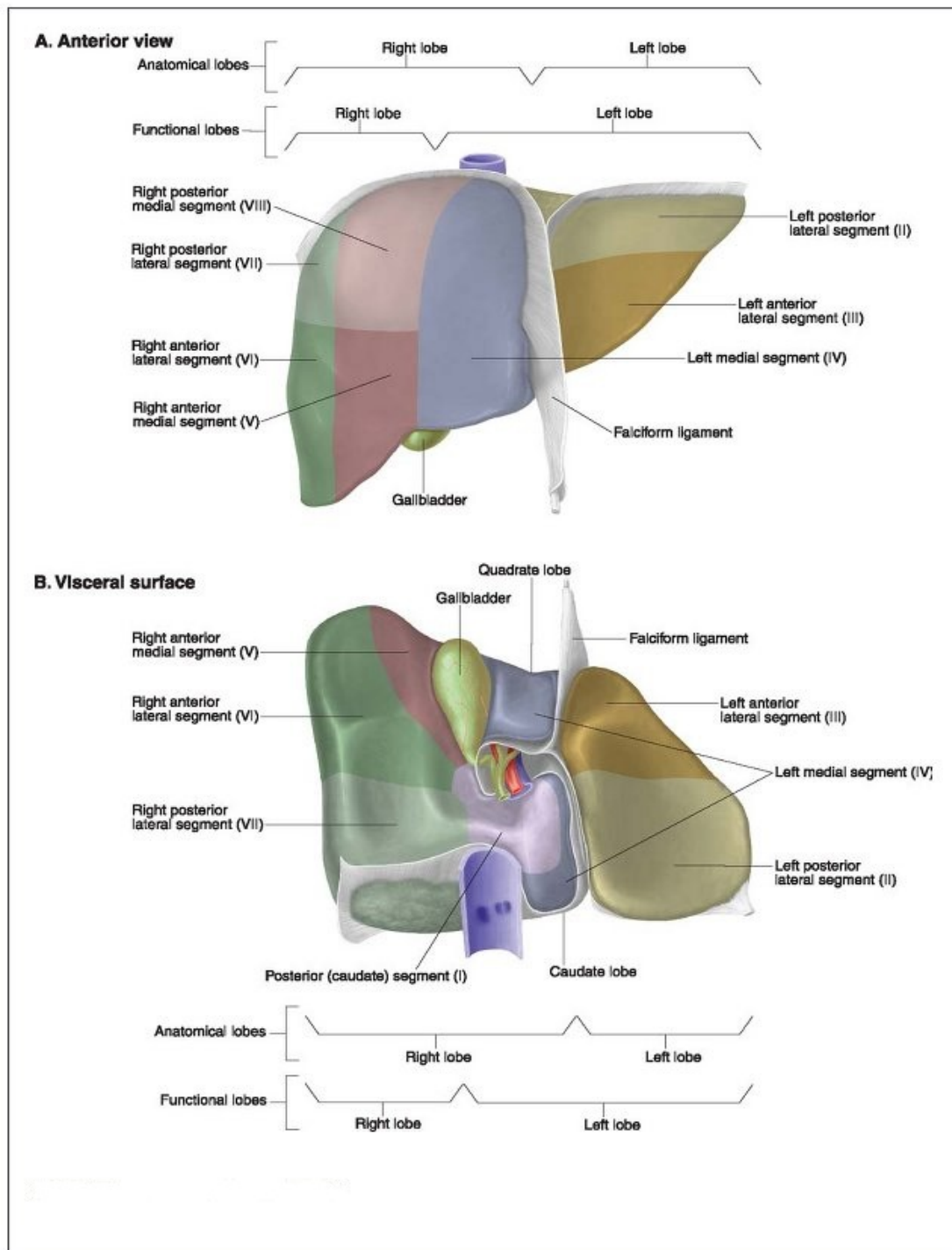


Figure (2): Liver lobes(Quoted from Williams & Wilkins, 2008).

B-Segmental anatomy of the liver:

Although a variety of definitions have been used to describe the anatomy of the liver segments, the most widely accepted clinical nomenclature is that described by Couinaud 1957, and Healey & Schroy 1953 the internal architecture of the liver is divided into segments, commonly referred to as Couinaud's segments. Couinaud based his work on the distribution of the portal and hepatic veins whilst Healey & Schroy studied the arterial and biliary anatomy (*Standring et al., 2005*).

The liver is divided by the 'principal plane' into two halves of approximately equal size. The principal plane is defined by an imaginary parasagittal line from the gallbladder anteriorly to the inferior vena cava posteriorly. The usual functional division of the liver into right and left lobes lies along this plane. The liver is further subdivided into segments, each supplied by a principal branch of the hepatic artery, portal vein and bile duct. Segments I, II, III and IV make up the functional left lobe, and segments V, VI, VII and VIII make up the functional right lobe. The right lobe can be further divided into a posterior and anterior section or sector. The right posterior section is made up of segments VI and VII, and the right anterior section is made up of segments V and VIII. The left lobe can also be divided into sections: segment IV is referred to as the left medial section, and segments II and III as the left lateral section. The

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hepatic veins lie in liver parenchyma between the sections. Segment I corresponds to the gross anatomical caudate lobe and segment IV to the quadrate lobe. (*Standring et al., 2005*).

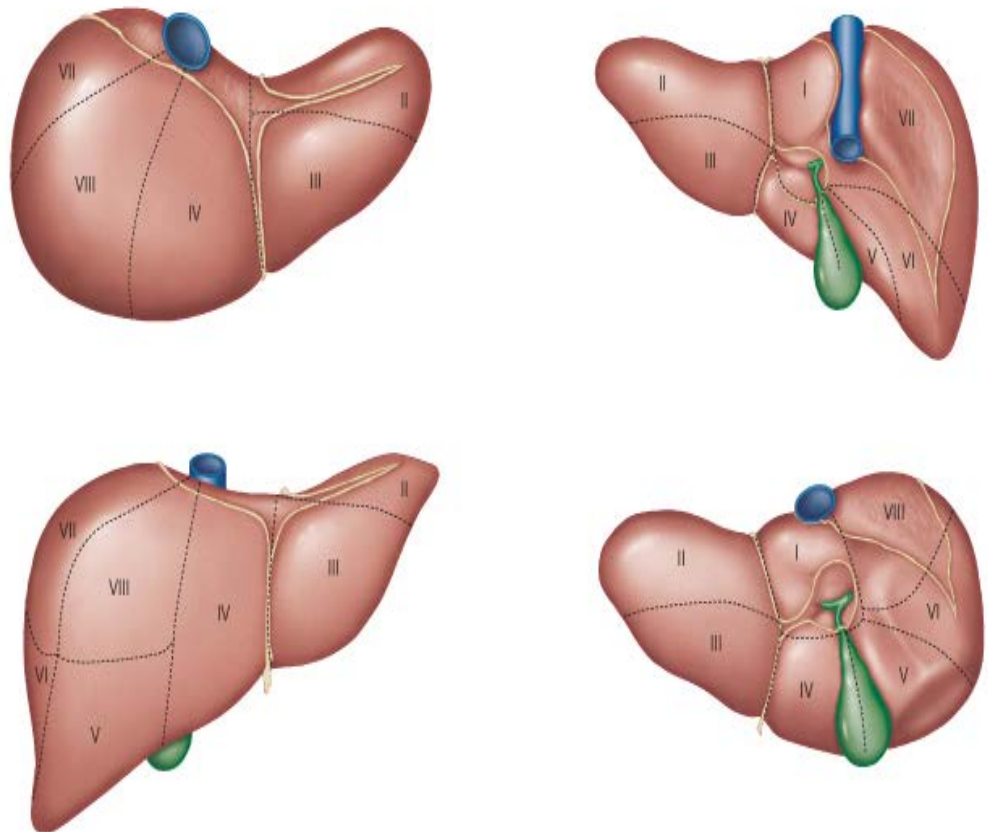


Figure (3): Segmentation of the liver-Couinaud. Top left, superior view; top right, posterior view; bottom left, anterior view; bottom right, inferior view. The segments are sometimes referred to by name - I, caudate (sometimes subdivided into left and right parts); II, lateral superior; III, lateral inferior; IV, medial (sometimes subdivided into superior and inferior parts); V, anterior inferior; VI, posterior inferior; VII, posterior superior; VIII, anterior superior. (*Quoted from Standring et al., 2005*)

VASCULAR SUPPLY AND LYMPHATIC DRAINAGE

The liver receives a dual blood supply from both the portal vein and the hepatic artery. Although the portal vein carries incompletely oxygenated venous blood from the intestine and the spleen, it supplies up to half the oxygen requirement of the hepatocytes because of its greater flow. This dual blood supply explains the low incidence of hepatic infarction (*Gosling et al., 2002*).

Hepatic artery:

In normal arterial anatomy, the common hepatic artery arises from the celiac trunk, from which the left gastric, gastroduodenal, and proper hepatic arteries arise, the latter dividing distally at the hilus into right and left branches (**Fig.4**) (*Torres et al., 2005*).

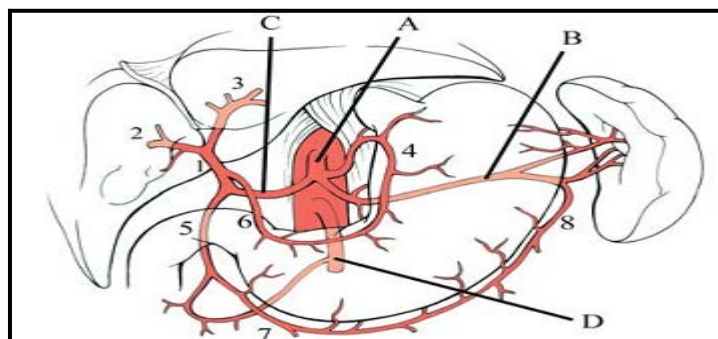


Figure (4): Normal anatomy of the celiac Artery. A: Celiac artery (CA). B: Splenic artery. C: Common hepatic artery. D: Superior mesenteric artery: (SMA). 1: Proper hepatic artery. 2: Right hepatic artery. 3: Left hepatic artery. 4: Left gastric artery. 5: Gastroduodenal artery. 6: Right gastric artery. 7: Right gastroepiploic artery. 8: Left gastroepiploic artery (*Quoted from Schneider et al., 2005*).

It almost always divides into an anterior branch supplying segments V and VIII, and a posterior branch supplying segments VI and VII. The anterior division often supplies a branch to segment I and the gall bladder. The artery to segment IV is usually considered a small branch from the left hepatic artery (*Johnson et al., 2005*).

Veins

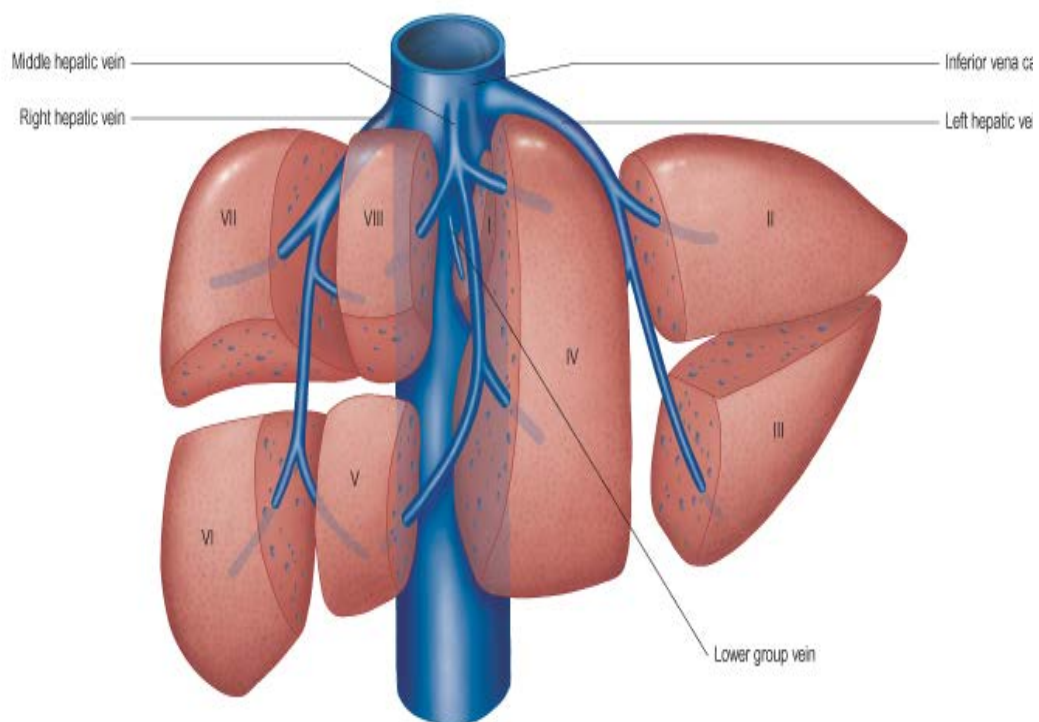


Figure (5): Arrangement of the hepatic venous territories. Multiple lower group veins may be present. Individual segments may drain into more than one hepatic venous territory (*Quoted from Standring et al., 2005*).

The liver has two venous systems. The portal system conveys venous blood from the majority of the gastrointestinal tract and

its associated organs to the liver. The hepatic venous system drains blood from the liver parenchyma into the inferior vena cava (*Adam et al 2008*)

Portal venous system

The portal system includes all the veins draining the abdominal part of the digestive tube with the exception of the lower anal canal, but including the abdominal part of the oesophagus. It also drains the spleen, pancreas and gallbladder.

The portal vein

The portal vein conveys the blood from these viscera to the liver, where it ramifies like an artery, and ends in the sinusoids from which vessels again converge to reach the inferior vena cava via the hepatic veins. The blood running through the portal system therefore passes through two sets of 'exchange' vessels, namely the capillaries of the gut, spleen, pancreas or gallbladder, and the hepatic sinusoids (*Standring et al 2005*).