Recent Modalities in Diagnosis and Management of primary Malignant Liver Neoplasms

Essay Submitted for the Partial Fulfillment of the Master Degree in General Surgery

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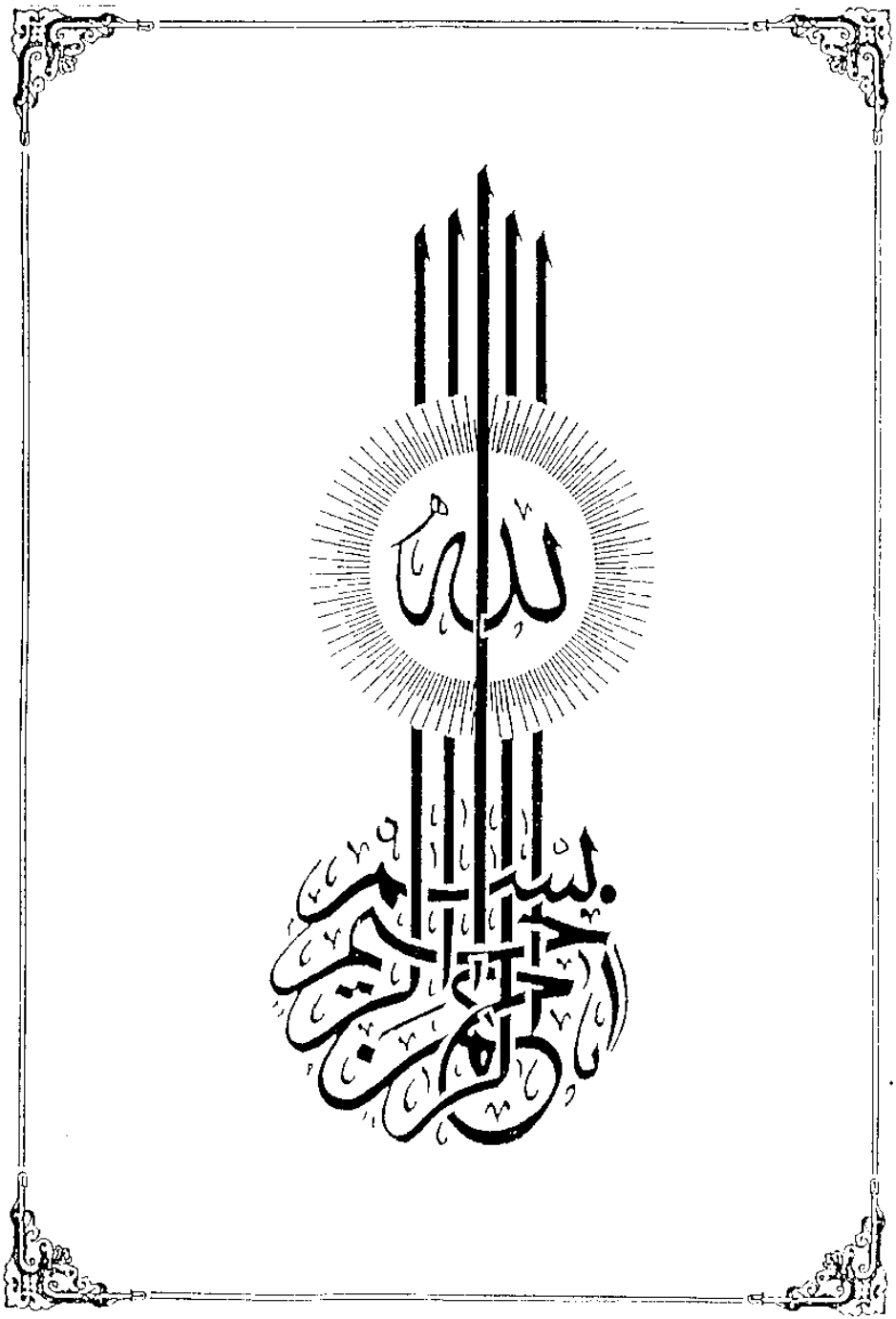

Anatomy

hepatic veins. Access to this area can be obtained by division of these ligaments *(Ger, 1989).*

The liver as it appears at laparotomy, is divided by the umbilical fissure and the falciform ligament into two lobes; the right lobe which is larger and the left lobe. At the inferior surface of the right lobe is the transverse hilar fissure which constitutes the posterior limit for this lobe.

The portion of the right lobe located anteriorly to this fissure is called the quadrate lobe, limited on the left by umbilical fissure and on the right by the gall bladder fossa. Posterior to the hilar fissure is a fourth lobe, the spigel lobe (caudate lobe). Thus the liver is composed of two main lobes and two accessory lobes, which are individualized by well visible fissures. This corresponds to the true identification of lobe "a part of parenchyma limited by fissures or grooves" *(Bismuth, 1986).*

The position of the liver is maintained by fibrous fixation of the bare area and to a major degree, by the attachment of the hepatic veins to the inferior vena cava as the hepatic veins are entirely intrahepatic in their course *(Last, 1984).*

Surgical anatomy

The surgical or functional anatomic division of the liver into segments is based on the distribution of the portal pedicles and the location of the hepatic veins. The three main hepatic veins divide the liver into four sectors (segments), each segment receives a portal pedicle, with an alternation between hepatic veins and portal pedicles. The four sectors individualized by the three hepatic veins are called portal sectors, for these portions of the parenchyma are supplied by independent portal pedicles. For the same reason, the scissura containing the hepatic veins are called portal scissura while the scissura containing the portal pedicles are called hepatic scissura; the umbilical fissure corresponds to a hepatic scissura *(Bismuth, 1986).*

The middle hepatic vein lies in the main portal scissura and separates the liver into a right and left liver, but there is no anatomic landmark. This main portal scissura (called Cantlie's line) follows an imaginary line extending from the middle of the gall bladder fossa anteroinferiorly to the left side of the vena cava posterosuperiorly, describing an angle of 75° with the horizontal plane opened to the left (Fig. 1) *(Scwartz et al., 1994).*

The right and left livers are themselves divided into two parts by other portal scissura. These four subdivisions are called sectors (segments).

The right portal scissura divides the right liver into two sectors; anteromedial sector and posterolateral or posteroir sectors. Along the right portal scissura runs the right hepatic vein, with the liver in its normal place in the abdominal cavity, the posterolateral sector is behind the anteromedial sector and the scissura is almost in frontal place.

The exact location of the right portal scissura is not well defined because it has no anatomical external landmark. It extends at the anterior surface of the liver midway between the right angle of the liver and the right side of the gall bladder's bed, to the confluence between the inferior vena cava and the right hepatic vein posteriorly describing an angle of 40^{o} with the transverse line (Fig. 1&2). This scissura follows a line parallel to the right lateral edge of the liver, three fingers breadth further anteriorly *(Bisthmus, 1986)*.

The left portal scissura divides the left liver into two sectors; anterior and posterior sector. This left portal scissura is not the umbilical fissure since this fissure is not a portal scissura (in a portal scissura, there is a hepatic vein, whereas in the umbilical scissura there is a portal pedicles). The left portal scissura is, in fact located posteriorly to the ligamentum teres and is found inside the left lobe of the liver where the left hepatic vein runs. Thus, the anterior sector of the left liver is composed of the part of the right lobe which is to the left of the main portal scissura and of the anterior part of the left lobe *(Bisthmus et al., 1988)*.

In conclusion, the liver appears to be divided into two livers by the main portal scissura where the middle hepatic veins run .

I. The right liver is divided into 2 sectors by the right portal scissura where the right hepatic vein runs. Each of these two sectors is divided by the plan of hilar plate into two segments:

a) The anterior sector is divided into segment V inferiorly and segment VIII superiorly.

b) The posterior sector is divided into segment VI inferiorly and segment VII superiorly.

II. The left liver is also divided into 2 sectors by the left portal scissura where the left hepatic vein runs:

a) The anterior sector is divided by the umbilical fissure into two segments:

. Segment IV medially, the anterior part of which is the quadrate lobe.

. Segment III laterally, which is the anterior part of the left lobe.

b) The posterior sector is composed of only one segment, segment II which is the posterior part of the left lobe.

III. The spigel lobe (segment) is an autonomous segment because its vascularization is independent of the portal division and of the three hepatic veins. It receives its vessels from the left and right branches of the portal vein and hepatic artery. Its hepatic veins are independent and end directly into the inferior vena cava *(Bisthmus et al., 1988).*

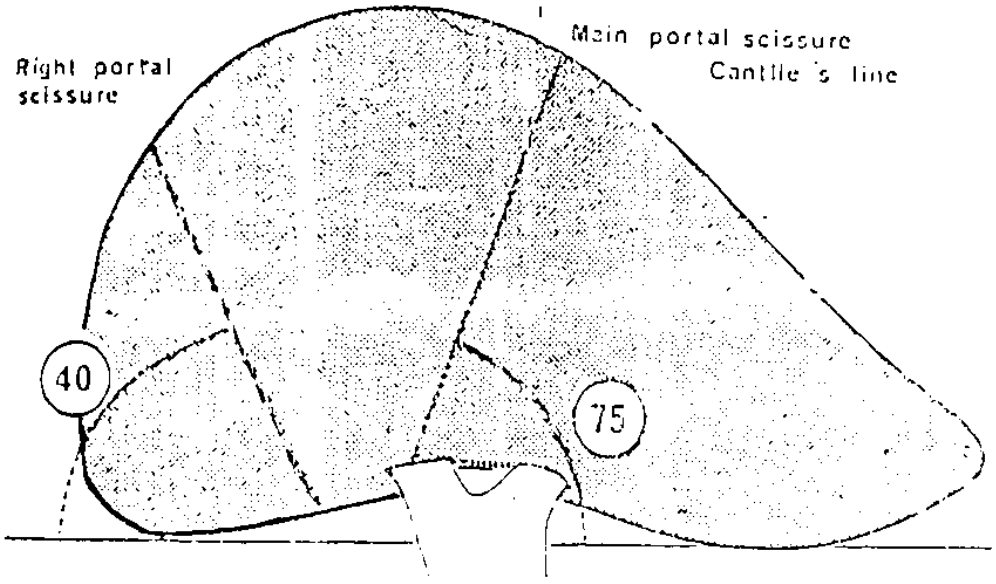

Fig. 1

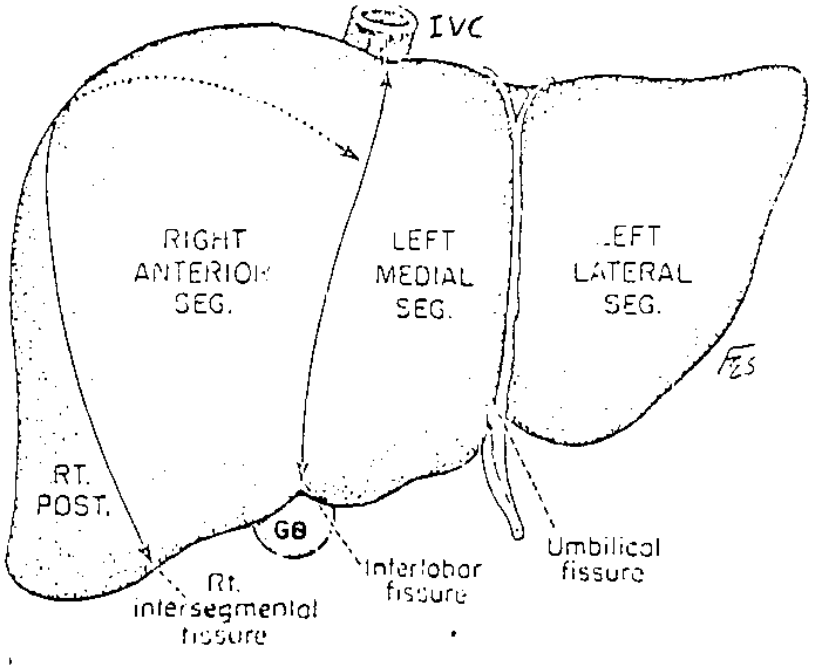

Fig. 2

Segmental anatomy

The division of the liver into segments which are delineated by fissures and the distribution of the vascular and ductal structures, had led to a much more aggressive approach to liver surgery. Of four fissures, only one is represented superficially, the portoumblical fissure. The other three fissures are related to the three large hepatic veins.

* Right fissure:

This fissure commences at the right margin of the inferior vena cava and follows the attachment of the right superior coronary ligament to about 3 to 4 cm from the junction of the latter with the right inferior layer. The fissure then curves anteriorly to a point on the inferior margin about midway between the gallbladder fossa and the right margin of the liver. Passing posteriorly, the fissure follows a line that runs parallel to the gall bladder fossa on crosses the caudate process to reach the right side of the inferior vena cava. Lying almost in the coronal plane, the fissure contains the right hepatic vein, with branches passing anteriorly to segments V and VIII and posteriorly to segments VI and VII. (Fig. 2) *(Last, 1994).*

* Median fissure:

This fissure passes from the gall bladder fossa to the left margin of the inferior vena cava. Posteriorly, the fissure is represented by a line from the gall bladder fossa to the main bifurcation of the hepatic pedicle (portal triad) and, thence, to the retrohepatic inferior vena cava *(Bisthmus, 1988).*

*** Left fissure:**

This fissure runs from the left side of the inferior vena cava to a point between the dorsal one third and ventral two thirds of the left margin of the liver. Inferiorly, the fissure passes to the commencement of the ligamentum venosum (Fig. 2) *(Ger, 1989)*.

*** Porto-umbilical fissure:**

The fissure is marked superficially by the attachment of the falciform ligament, which contains the ligamentum teres hepatis in its inferior border, angled less generously than the right fissure, it meets the inferior margin of the liver at an angle of about 50° *(Ger, 1989)*.

- *Segment I:* This segment, the caudate lobe and process, is situated on the postero-inferior surface of the liver posterior to the hilar plate (Fig. 3).

- *Segment II:* This segment is situated dorsally and it presents on the superior and inferior surface. It lies between the left margin of the liver on the left and between the portoumblical fissure supero-anteriorly and the fissure for ligamentum venosum postero-inferiorly on the right; anteriorly, it is limited by the left fissure. It receives blood from branches of the vessels of the hepatic pedicle (portal triad) that arise from the postro-lateral aspect of its left division, It is drained by dorsal branches that enter the left hepatic veins (Fig. 3).

- *Segment III:* This segment lies anterior to segment II and is bounded by the left fissure posteriorly, the portoumblical fissure medially, and the left margin laterally. It receives blood from the vessels of the left division

of the hepatic pedicle (portal triad). Shortly before the latter is joined by the round ligament (ligamentum teres hepatis). It is drained by the distal part of the left hepatic vein (Fig. 3).

- *Segment IV:* This large segment lies between the portoumblical and median fissures anteroposteriorly; inferiorly, it extends up to the hilar plate, which separates it from the caudate lobe and process (segment I). It is supplied by branches of the left branch of the hepatic pedicle (portal triad) that curves medially in a rightword direction. The dorsal drainage is by the middle hepatic vein and a dorsal branch of the left hepatic vein. Some divide this segment into dorsal and ventral portions (Fig. 3).

- *Segment V:* Lying anteriorly, this segment is limited by the median and right fissures on each side and dorsally by a plane passing through the hilum. It is supplied by descending branches of the anterior division of the right branch of the hepatic pedicle (portal triad). The segment drains into the right and median hepatic veins by anterior branches that pass rightword and leftword, respectively (Fig. 3).

- *Segment VI:* This segment lies to the right of the right fissure and is limited posteriorly by a plane passing through the hilum. Its blood supply is derived from the descending branch of the posterior branch of the vessels of the right hepatic pedicle (portal triad). Blood drains into branches that join the right hepatic vein from the right side (Fig. 3).

- *Segment VII:* This segment presents on the superior and posterior surface and is delineated by the right fissure and hilar plane, which

Vascular anatomy

Portal vein:

The portal vein carries approximately 75% of the blood supply to the liver. It is formed by the union of the superior mesenteric and the splenic veins behind the head of the pancreas. It is a valveless system with 8 cm long. It travels in an anterosuperior direction as the most posterior structures in the hepatoduodenal ligament, forming the roof of the foramen of Winslow. Anomalies are uncommon and consist of veins lying anterior to the pancreas and double portal veins *(Linder and Cady, 1980).*

The portal vein divides into left and right hepatic branches in the portal fissure (Fig. 4). The left portal branch is longer than the right, and enters the liver substance between the quadrate lobe (segment IV) and the left lobe (segment II and III) at the base of the umbilical fissure *(Guest and Blumgart, 1987)*, then it divides into 2 branches, the pars transversa and pars umbilicus. Two branches to the lateral segment of the left lobe usually arise from the pars umbilicus near the plane of the falciform ligament. The right branch of the portal vein has a short extrahepatic course and it divides into an anterior division and a posterior division. The anterior division gives an ascending and descending branches to segment V and VIII, while the posterior division of the right portal vein gives branches to segment VI and VII *(Ger, 1989).*

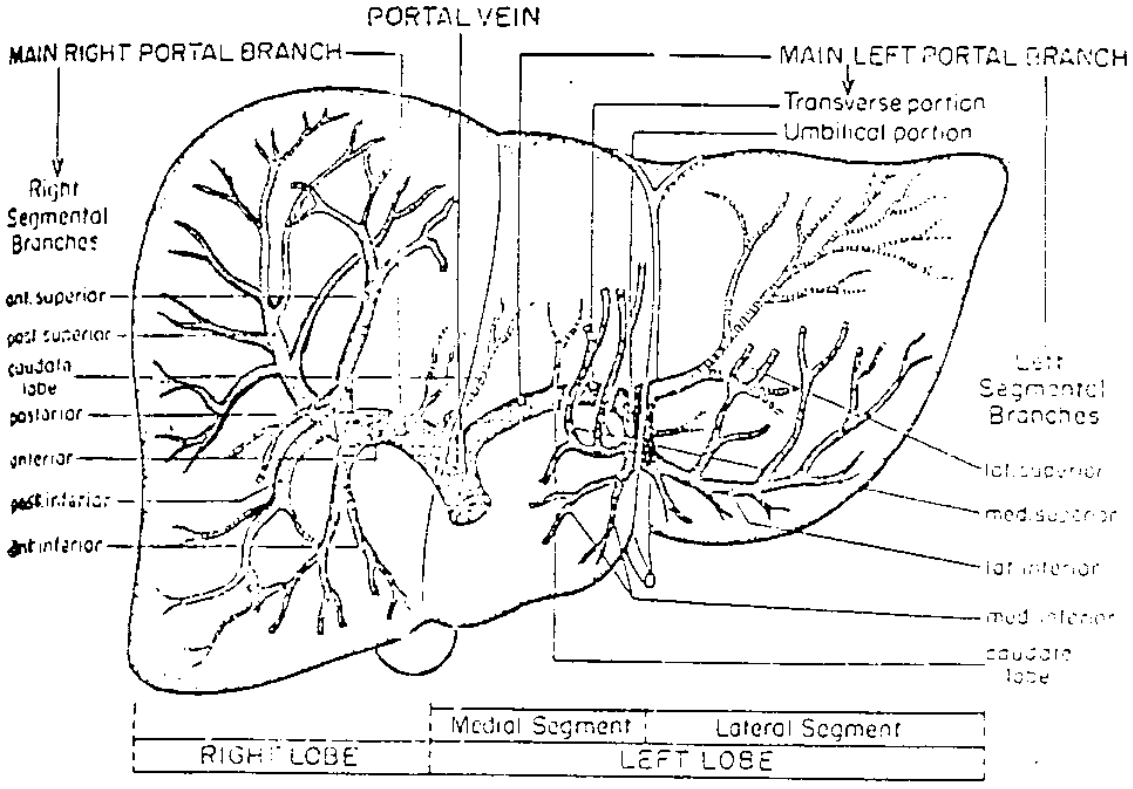

Fig. 4: Anatomic distribution of the portal vein and its branches

(Linder and Cady, 1980)

Hepatic artery:

The common hepatic artery usually arises from the coeliac axis and traverses medial to the common bile duct and anterior to the portal vein in the hepato-duodenal ligament. Division of the common hepatic into right and left arteries occurs at a variable points along its course, most often medial to the main lobar fissure *(Linder and Cady, 1980)*. These vessels follow the biliary ducts intrahepatically in their segmental distribution *(Healey et al., 1953)*.

Meyers, (1986) analyzed the arterial supply to the liver and biliary tract in 200 dissections. He found that, in 55 per cent of patients, the coeliac axis, gives rise to the common hepatic, left gastric and the splenic arteries. In 22% of his dissections, a portion of the arterial supply to the left lobe arise from the left gastric artery, and in 12% of those, it was replaced left hepatic artery, in that, it was the only blood supply to the left lobe.

Similarly, the superior mesenteric artery contributed to the blood supply of the right lobe in 27% of the time, and in 18%, the entire blood supply of the right lobe came from the superior mesenteric artery. In some instances, the entire hepatic arterial supply may arise from the superior mesenteric artery.

The less common arteries are often incorrectly referred to as "accessory" arteries. The term "replaced" hepatic artery is more accurate, in that these are end arteries supplying a definite area of the liver *(Linder and Cady, 1980)*.