Liver Anatomy: Portal (and Suprahepatic) or Biliary Segmentation

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Abstract

Background/Aims: In liver anatomy and surgery, is portal and hepatic vein segmentation (French segmentation) to be preferred over arteriobiliary segmentation (Healey and Schroy, North American segmentation)? *Methods:* Several embryological arguments and an analysis of anatomical data from a personal collection of 110 vasculobiliary casts were made. *Results:* Embryological arguments: Portal vein branching appears first, arteriobiliary branching secondly follows the portal vein distribution. Segment II (the left lateral sector) is the development of the right lateral embryological lobe. The umbilical vein enters the left portion of the middle embryological lobe, forming segment IV on the right and segment III on the left: this is the left paramedian sector. So the left portal fissure (between left and middle lobes) transversally crosses the classical left lobe, which is not a portal unit. Segment VI is a late secondary prominence of segment VII, reaching the anterior margin of the liver only in man. Anatomical arguments: hepatic vein segmentation must be added to portal segmentation; the academic left lobe is the left hepatic vein sector, and the left hepatic fissure separates the classical right and left lobes. Portal vein segmentation must be preferred: portal vein duplication of branches of first order occurs only in 23.5% of the cases, while arteriobiliary duplication of first-order branches is noted in 50% of the livers, portal segmentation being much simpler. *Conclusions:* Portal and hepatic vein segmentation seems to be much more accurate.

A quite interesting paper was recently published by Strasberg [1] about liver segmentation, criticizing the French segmentation.

Criticism of the French Liver Segmentation

The main argument is as usual against the partition of the left liver, particularly the left academic lobe. When the portal vein segmentation is adopted, there is no portal term to designate a resection passing by the obvious umbilical fissure. In the portal vein segmentation, partition of the left liver into a left lateral sector (segment II) and a left paramedian sector (segments III and IV) leads to quite unequal sectors, while on the right, the right lateral (posterior) sector is usually equal to the right paramedian (anterior) sector and the left portal fissure cuts the left lobe transversally with no surgical landmarks (fig. 1). In the biliary segmentation, on the left, partition between segment IV (US medial segment) and left lobe (segments II + III, US lateral segment) cuts the parenchyma into two
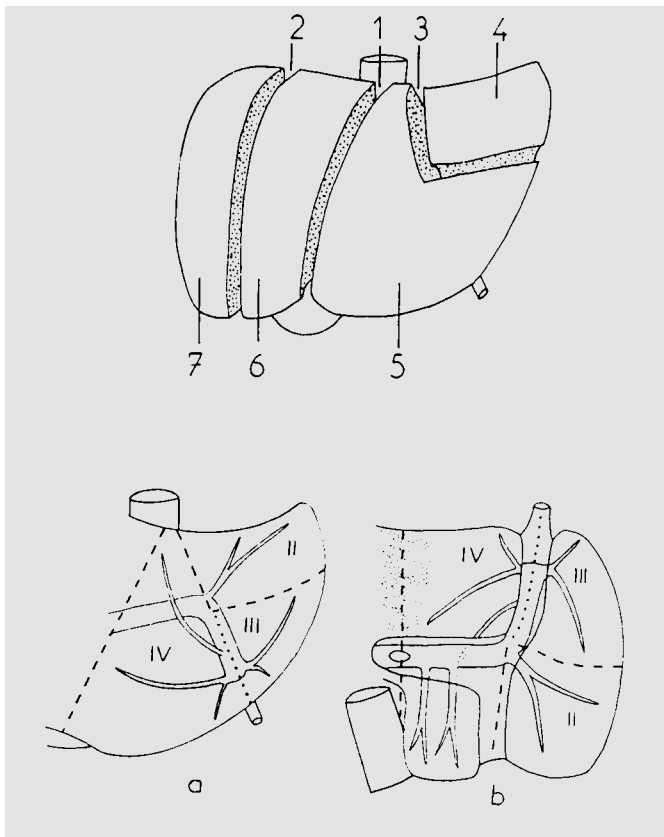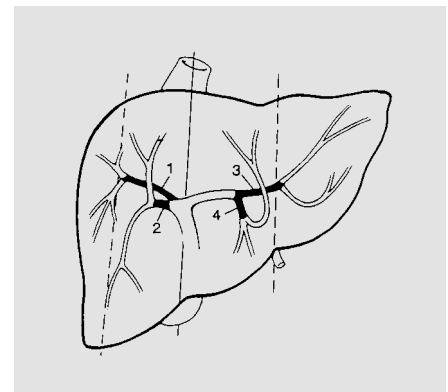
Fig. 1. Portal segmentation. *Upper panel:* The liver and the portal fissures. 1 = Main portal fissure; 2 = right portal fissure; 3 = left portal fissure; 4 = left lateral sector; 5 = left paramedian sector; 6 = right paramedian (anterior) sector; 7 = right lateral (posterior) sector. The segmentation is independent from the morphology of the liver. *Lower panels:* Left portal vein. On the left: upper surface; on the right: lower surface of the liver; in broken lines the portal fissures; in dotted lines separation between segments III and IV [data from 14].

Fig. 2. Biliary duct segmentation. 1 = Right lateral (posterior) duct; 2 = right paramedian duct; 3 = stem II + III; 4 = segment IV duct. The left duct gives a branch for segment IV, another is a stem II + III. Consequently, the left lateral sector becomes the left academic lobe, and the umbilical fissure the left portal fissure. A portal sector is then a morphological unit of the liver, which never happens in the portal segmentation [from 1, with permission].

nearly equal sectors; the left fissure is quite evident (umbilical fissure); resection of the left lobe, which is so easy, becomes a portal hepatectomy (fig. 2).

The fact that hepatic and portal veins are in different planes (fissures) is denied: for instance, a constant umbilical branch (tributary of the left hepatic vein) is found in the umbilical fissure, as well as Rex' recessus (left paramedian vein). So this umbilical fissure containing a hepatic vein is then considered as a portal fissure, and resection of the academic lobe becomes a portal resection.

The division of the left portal vein into a left lateral vein (segment II vein) and a left paramedian vein (III + IV) is criticized: segment II vein does not come from the left portal vein, but from the former umbilical axis, since this vein (Arantius) on the left portal vein (n = 10 livers), segment II vein, is just a collateral of the umbilical vein, as well as segment III and IV veins, which are absolutely similar (see Appendix for English and French terminology). Everything is solved if an arteriobiliary segmentation [2] is used: two equal sectors on the right (2 veins, 2 arteries, 2 bile ducts) and two equal sectors also on the left. Particularly on the left, it is important not to retain the

portal vein segmentation; the arteriobiliary segmentation, because it is made of two equal branches, must be adopted, and be the basis of the designation of the various hepatectomies.

Embryological Confutation

The author developed the embryological arguments in favour of the French segmentation in a book published in 1989 [3]. The main sources are Hugo Rex [4], Mall [5], Nettelblad [6], Hamilton Boyd et al. [7], and Severn [8].

Priority of the Development of the Portal System

The portal system first appears, arteries and biliary ducts develop subsequently. In hamster, Nettelblad [6] noted the first lobulation and the disposition of the vitelline and umbilical veins in his stage 3 (9th day, 6th hour). Arteries and biliary ducts appear at stage 12 (21st day, 5th hour), only when the portal branching is formed. In man, Lassau [9] found buds of the future right and left hepatic ducts in an 18-mm embryo (40–42 days, Streeter H = XX),

and Martin and Convert [10] detected right and left hepatic ducts in a 26-mm long embryo (44–46 days, H = XXII): the portal and hepatic vein systems are fully developed. Shah and Gerber [11] detected the first appearance of small ductal plate cells in the mesenchyma along the branches of the portal vein at the 4th week of gestational age.

Since the portal vein branching is first organized and since the biliary (and arterial) branching appears later and is *dependent* on the portal branches, portal vein segmentation should strongly be recommended.

Lobation

Lobated Liver

The work of Nettelblad [6] in hamster is exhaustive and quite explicit. Two lateral lobes, right and left, develop along the vitelline veins: they will become segments VII and II. A middle anterosuperior lobe forms around the cholecystic axis; the notch created by the biliary bud will be the origin of the main portal fissure, and divides the middle lobe into right and left paramedian sectors. Middle and lateral lobes are separated by interlobar fissures (the equivalent of right and left portal fissures in nonlobated livers). The left umbilical vein is external to the liver (ascending within the abdominal wall and the septum transversum). Later a right branch of this vein enters the *left portion* of the middle lobe (future left paramedian sector) bringing blood from the placenta to the heart through Arantius' vein (ductus venosus); this will hinder the building of the portal system of the left liver (fig. 3). So the entrance of the left umbilical branch into the main lobe indicates the discrimination of a segment IV on the right and a segment III on the left: both *belong to the left portion of the middle lobe* which will become the left paramedian sector. Segment II vein (Rex' ramus angularis) does not initially originate from the left umbilical axis, since this one appears later.

Nonlobated Liver: Man

There are two rather large lateral lobes united by a rather small bridge which represents the middle lobe. The branch of the left umbilical vein enters the *left portion of the middle lobe,* which will later be enlarged by the development of segment IV. So at the beginning, the umbilical vein enters the liver close to the cholecystic axis. The embryonic liver remains symmetrical for a long time, and the left umbilical vein stays for a long time in the median axis. It is the development of segment IV which will push the left umbilical axis leftward.

Many authors have noted that in embryo the inferior vena cava, the *umbilical vein,* and the ductus venosus are
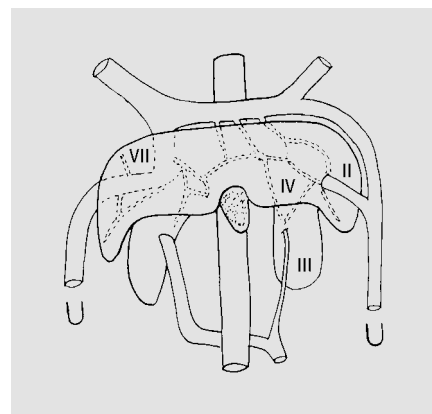

Fig. 3. Formation of the new left umbilical vein in hamster (Nettelblad's stage 6b). The development is more evident in a nonlobated liver. Two lateral lobes (future segments II and VII) from around the vitelline veins. A large middle lobe (future right and paramedian [posterior and anterior] sectors) from around the cholecystic axis; between the left lateral and the middle lobes is a left interlobar fissure (equivalent to the left portal fissure in nonlobated livers). A branch from the left umbilical vein *enters the left portion of the middle lobe* (left paramedian sector). The branch will partly irrigate the left liver and is located between segment IV on the right and segment III on the left [data from 3].

always imbedded within the parenchyma; this may persist in some adults.

The form of the liver is modified progressively: the left liver regresses though segment IV enlarges, the right liver expands, especially by development of posterior branches. A very interesting event was emphasized by Rex [4]: the development of segment VI, with lengthening of the VI veins. In nearly all Vertebrates, segment VI is quite small, the right paramedian (anterior) sector very large, and the right portal fissure (between segments VI and V) does not reach the anterior margin of the liver (fig. 4). In Primates, segment VI enlarges and the right fissure may reach the right anterior angle of the liver. Only in man does segment VI reach the anterior margin, except in some cases. So in a normal adult the right lateral (posterior) sector is large (made of two segments, VII and VI), whereas segment II remains small, with only a single apparent segment.

Hepatic Veins

In lobated livers, there is one portal and one hepatic vein for each lobe, with no fissural vessel. It has always been thought that disappearance of the interlobar fissure leads to fusion of the two adjacent hepatic veins into a common stem. Actually, evolution from the primitive si-
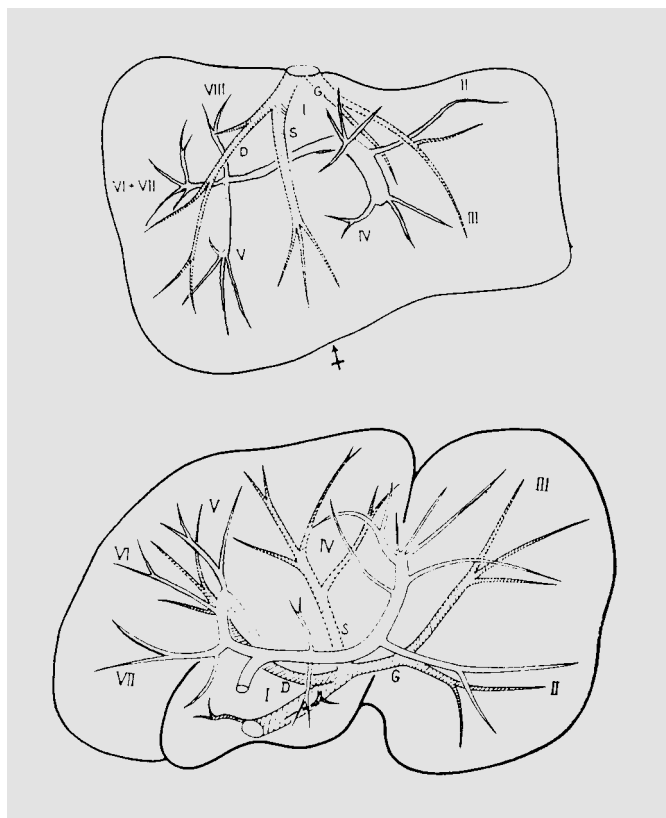
Fig. 4. Segment VI development. Rex [4] showed that segment VI is an enlargement of the anterior portion of segment VII, which appears progressively in the phylogenic development. *Upper panel:* Newborn Nilgal's liver *(Boselaphus tragomelus),* upper surface; the main portal fissure is indicated by the arrow. Segment VI is quite small, segments VII and VI are not much larger than segment II. *Lower panel:* Chimpanzee's liver, lower surface. Segment VI is larger in primates, but hardly reaches the anterior and right angle of the organ (only in man is segment VI fully developed and reaches the anterior margin of the liver) [data from 15]. D = Right, S = middle, G = left.

nusoids to the definitive portal and hepatic branches is quite complicated, especially for hepatic veins.

In a 9-mm-long human embryo [5], portal and hepatic branches show a polar disposition: caudal disposition of the portal branches and cranial disposition of the hepatic branches; they do not interdigitate. In a 11-mm-long embryo, hepatic veins are formed, in spite of direct porto-cardiac connection through the ductus venosus and a direct communication of the right vitelline vein with the heart. The three main hepatic veins come nearer to each other and enter the right hepatocardiac channel (the left channel disappears). At that time the caudate lobe (rather the dorsal sector) appears, and a posterior hepatic branch draining this sector will form the retrohepatic portion of

the inferior vena cava. The right hepatocardiac channel (of vitelline origin) will then form the upper portion of the vena cava, secondarily connected with the upper extremity of the large posterior dorsal vein. Consequently, the three main hepatic veins enter directly the vena cava at the upper extremity of the liver.

In 16.5- to 17-mm-long embryos, Lassau and Kamina [12] described the main hepatic veins: *they interdigitate with the main portal branches.*

We should always remember the tremendous alterations of the initial vessels. The liver parenchyma dissociates the vitelline and umbilical veins; sinusoids and trabeculae then appear, whereas two direct channels shunt the liver toward the heart. A higher pressure and larger flow create preferential ways, building the main branches of the liver, which, *in very few places only,* may correspond to the primitive vessels [13]. There are everlasting changes in the distribution of the vessels and it should not be forgotten that this development is operated at a microscopic scale: 30–32 days after conception (Streeter H = XV), the two lobes are just two hepatic lobules; at the 35th day (11-mm-long embryo, H = XX), Mall [5] found only 6 lobules; afferent twigs are caudal, efferent ones are cranial. Multiplication of the lobules requires multiplication of the veins (branches of second to sixth order): 700 branches in 20- to 24-mm embryos; portal and hepatic veins then interdigitate, 'telescope' to quote Mall [5].

Though coming both from the vitelline vessels, hepatic and portal veins are quite different. Hepatic veins receive main branches and a large number of small veins or twigs so the wall of the vessel is tethered to the parenchyma, and when dividing the liver, the hepatic vessels remain open. Whereas portal veins are within the walaean sheaths, separated from the parenchyma, and sending only main branches.

Anatomical Data

Two Segmentations

The main problem in the designation of hepatectomies is that the North American system retains *only one portal segmentation,* while the French system uses *two, portal and hepatic, segmentations.* This explains all the American endeavours to force into the portal segmentation units which belong obviously to the hepatic segmentation (for instance the academic left lobe).

Portal vein segmentation is the most commonly used, it is absolutely independent of the morphology of the liver, and has been thoroughly studied with Hyrtl's method

(corrosion). The main partition is the main portal fissure which can be located by quite evident landmarks.

Hepatic (hepatic veins) segmentation is also quite important. It is closely related to the outer form of the liver. The left lobe (academic ancestral lobe) is the territory of the left hepatic vein, the right lobe the territory of the right and middle hepatic veins, the caudate lobe the territory of the caudate veins (the quadrate lobe actually is not a lobe) (fig. 5). The main partition is also quite obvious: the umbilical fissure between the anatomical right and left hepatic lobes. The importance of this segmentation cannot be ignored.

The territories of these two segmentations are absolutely evident when substances of different colours are injected within the main portal or hepatic pedicles, as represented on the front page of the book the present author published in 1981 [14]. The identity of the left lobe (hepatic vein unit) cannot be refuted. It is evident that a sector of one segmentation overlaps two sectors of the other segmentation. I classified hepatectomies in three varieties [15]: (1) portal resections, when one or two portal fissures are opened; (2) hepatic vein resections, when one or two hepatic fissures are opened, and (3) mixed resections, when a portal and a hepatic fissure are opened.

The most frequent portal resections are the right and left hepatectomies, less frequently the right lateral and right paramedian sectoriectomies (US posterior and anterior segments). The most frequent resections based on the hepatic veins' distribution are the right and left lobectomies. The designation must absolutely be retained, since the wrong designation of 'lobectomy' for right and left hepatectomies is only about half a century old, while in anatomy the term 'lobe' has been used for centuries; the error is quite troublesome for anatomists; the conformity with the very old anatomical designation must absolutely be restored. The most frequent mixed resections are segment IV resection, and the middle hepatectomy (right paramedian + segment IV).

Existence of two different segmentations is a main anatomic fact, and this is the reason why the European designations belong both to the outer morphology and the inner anatomy of the liver. And the fact that in a fissure a main pedicle of the opposite segmentation is found is a great help for the surgeon.

Duplication and Main Variations of the Portal Elements

In a former paper, the author studied the duplications of the first-order branches of the portal elements [16]. Frequencies had been noted in a series of vasculobiliary casts;
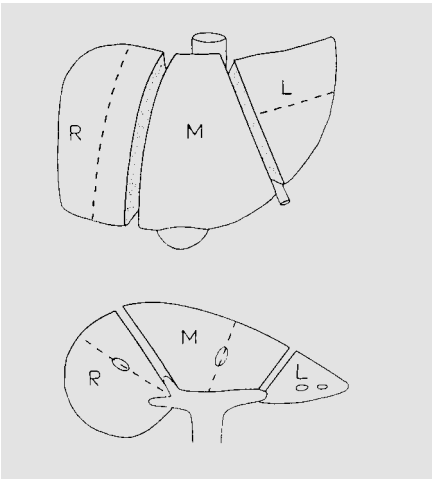

Fig. 5. Hepatic vein segmentation. *Upper panel:* The three suprahepatic sectors (R = right; M = middle, L = left), separated by the right and the left (umbilical) fissures. The left lobe is the territory of the left hepatic vein, the right lobe the territory of the right and middle veins. Broken lines indicate portal fissures. This segmentation follows exactly the morphology of the liver. *Lower panel:* Frontal section passing through the hilum [data from 14].

the total numbers are variable for each element because injection of arteries and biliary ducts is not always correct:

Portal vein	Right	26/110	23.63%
	Left	0/110	0%
	Total[a]	26/110	23.63%
Hepatic artery	Left	48/95	50.52%
	Right	2/95	2.10%
	Total[b]	48/95	50.52%
Biliary duct	Right	50/107	46.72%
	Left	10/107	9.34%
	Total[c]	53/107	49.53%

[a] One case with the portal bifurcation missing is excluded.
[b] The two right hepatic artery duplications are accompanied by left artery duplication, so the total of livers is 48.
[c] In 7 cases there is a duplication of both right and left biliary ducts, so the total of livers is 60 – 7 = 53.

If we consider the total of the three elements, we note: portal vein 26/110 (23.63%), hepatic vein 48/95 (50.52%), and biliary duct 53/107 (49.53%).

There is no statistical difference between artery and biliary ducts. The portal vein differs significantly (p = 2.2×10^{-6}). Both arterial and biliary duplications are

Fig. 6. Biliary duct variations. *Left panel I:* Variations of the right paramedian (anterior) duct. a = Normal; b = complete scission of the duct; c = V duct entering the upper biliary confluence; d = VIII duct entering the left hepatic duct; e = V duct entering the main biliary channel; f = V duct sliding to the VI duct; g = duplication of the right paramedian (anterior) duct; h = another type of duplication. *Left panel II:* Variations of the right lateral (posterior) duct. a = Scission of the duct; b = sliding of VI duct to the right paramedian (anterior) duct; c = sliding of VII duct to the left hepatic duct; d = sliding of VI duct to V duct; e = sliding of VI duct to the accessory biliary system. *Right panel III:* a = Distribution II + III and IV; b = distribution III + IV and II; c = IV duct entering the upper confluence; d = IV duct entering the main biliary channel; e = II duct entering the III duct; f = caudal duct entering the upper biliary confluence; g = partial sliding of IV duct to the III duct [data from 15].
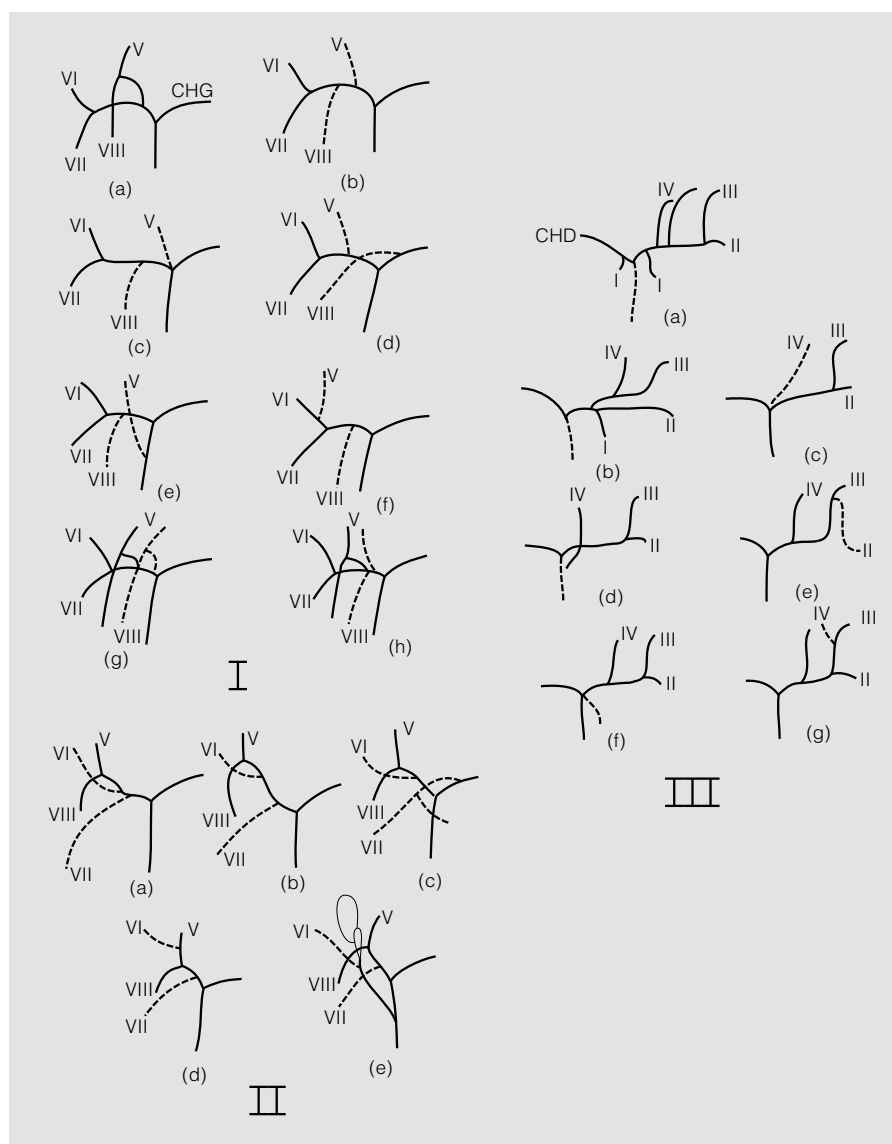
more frequent. Embryology of the portal vein is first established, later arteries and biliary ducts invade the liver following *approximately* the portal branches. So it seems that portal vein branching should be retained rather than anteriobiliary branching to establish the portal segmentation.

Biliary Duct Duplication
On the Right

Duplication of the right hepatic duct is quite frequent, there is a unique duct in only 53.27% of the cases of this series (fig. 6). The following classification has been retained:

b	Trifurcation of the upper biliary confluence (right paramedian (anterior) duct + right lateral (posterior) duct + left hepatic duct)	9
c	Caudal entrance of the lateral (posterior) duct into the main biliary duct (in 2 cases the right paramedian (anterior) duct enters the left hepatic duct)[a]	9
d	Caudal entrance of the right paramedian duct into the main biliary duct (in 6 cases the right lateral duct joins the left hepatic duct)	28
g + h	Three ducts (2 segmental and 1 sectorial channels)	3
j	Unclassified	1

[a] Three livers in which the right lateral duct enters the cystic duct have been included in this variety.

Dissection of the right portal pedicle is difficult: only a very short portion lies in the hilum; detachment of the hilar plate and, if necessary, opening of the main portal fissure allow a correct exposure. The branching of the biliary ducts occurs within the dense tissue of the hilar plate, making dissection difficult and dangerous. So, long ago, the author advised not to dissect the constituents of the portal pedicle, but to expose the walaean sheaths enveloping the pedicles and entering the liver: in a sheath, the surgeon will reach only the branches supplying the parenchyma entered by this sheath.

On the Left

In 107 casts, duplication is noted in 10 livers (9.34%), but the main problem is that the intrahepatic distribution is not constant. There are two different types of branching:

(1) A common stem (II + III) with a separate branch for segment IV, which corresponds to the partition into segment IV (US medial segment) and academic left lobe *(US lateral segment)* (branching corresponding to the North American segmentation): 88 cases (82.24%), total duplication 8 cases (9.09%).

(2) A common stem (III + IV) and a separate branch for segment II (branching corresponding to the French segmentation): 19 cases (17.75%), total duplication in 2 cases (10.52%).

To conclude, duplication occurs in 9.34% of the cases and in 17.75% the biliary branching is not similar to the *constant* portal vein distribution. So even on the left, adoption of the biliary segmentation which appears inconstant is questionable.

Hepatic Artery Duplication

Against selection of a segmentation based on arteries, first must be retained the fact that either the main hepatic artery (right and left arteries) or even sectorial or segmental branches may come from quite different sources: for example, the left gastric artery, the aorta or the superior mesenteric artery.

On the Right

The right hepatic artery is rather long: 23.09 ± 2.01 mm, range 8–47 mm. Moreover, it is one of the most constant vessels of the liver: only two duplications have been noted (2/95, 2.10%); only the left portal vein is more constant (no duplication at all).

On the Left

On the left, variations are quite numerous. There are two problems:

(1) *Left gastric branch and branch from the right hepatic artery:* In 31 cases (32.63%) there is a branch coming from the left gastric artery, running in the superior margin of the lesser omentum, and supplying various portions of the left liver:

a	Left liver	6/31	19.35%
c	Left lobe	17/31	54.83%
d	Segment II	8/31	25.80%

Consequently, in the varieties 'c' and 'd' there are two left arteries (25/31 = 80.64%). 64 livers have no left gastric branch, duplication occurs in 23 cases (35.93%). Another variety is the origin of segment IV artery from the right hepatic artery: 9/95 cases, 9.40%; in such eventuality there are also two left arteries.

(2) *Intrahepatic distribution of the left hepatic artery:* Arterial and biliary distribution are nearly similar. Arteries may be classified as follows:

a	Stem (II + III) with a collateral for segment IV (in 7 cases this collateral arises from the right hepatic artery, and once from the arterial plexus of the hilum)	78
b	Stem (III + IV) with a collateral for segment II	11
c	Three separate branches (II, III, IV); in 2 cases segment II artery comes from the left gastric artery; in 1 case segment IV artery comes from the right hepatic artery	55
f	Horizontal splitting with an inferior branch of the (II + III) type and a superior branch of the (III + IV) type (IVth from the right hepatic artery)	1

When the IVth artery comes from the right hepatic artery, the distribution is usually of the (II + III) type, and also when the left gastric artery supplies the left lobe (segments II + III); when this vessel supplies only segment II, there is a distribution (III + IV) and II.

The Healey and Schroy partition (II + III) and IV is noted in 78 livers (78/95 = 82.10%). But there is a single left hepatic artery in only 42 cases (42/95 = 44.21%), 42/78 = 53.84%). There are two arteries in 35 cases, i.e. in 18 livers the stem II + III comes from the left gastric artery and in 17 cases the IVth artery comes from the main hepatic artery or the bifurcation of the main hepatic artery. There are three arteries in 1 case: segment IV receives two branches, one from the main hepatic artery, the other from the right hepatic artery. The stem (II + III) is independent.

In the other livers there is a distribution (III + IV) and II in 11 cases, (II, III, IV) in 5 cases, and there is a horizon-
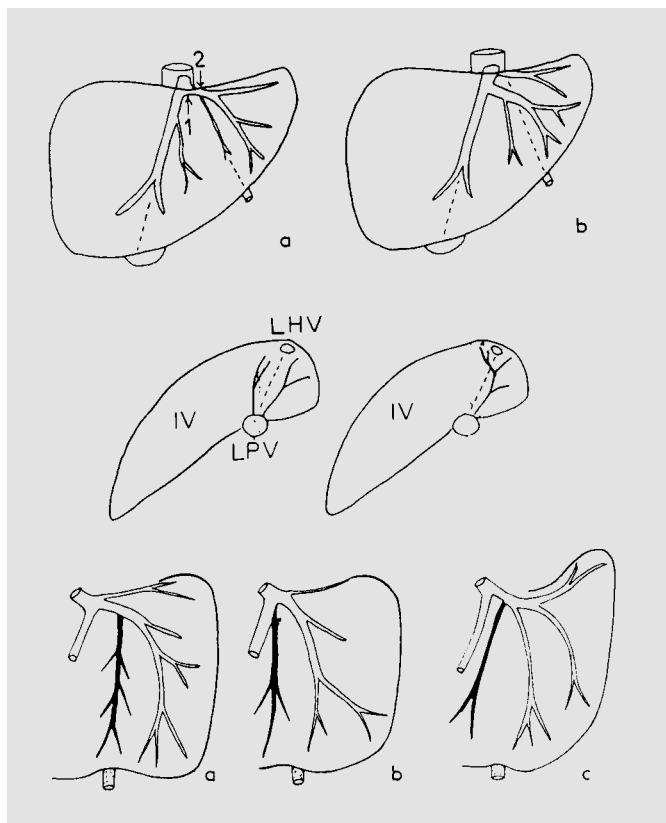
Fig. 7. Left hepatic vein. *Upper panel:* Terminal portion of the left hepatic vein. a = The left hepatic vein follows exactly the posterior margin of the liver. 1 = Portion between segments IV and I (in the quadrocaudal fissure); 2 = portion at the posterior extremity of the sulcus venosus. b = Duplication of the left hepatic vein. *Middle panel:* Sagittal section through segments IV and I. The segments are separated by the quadrocaudal fissure which is in prolongation of the left portal fissure. The left hepatic vein is usually at the superior extremity of the fissure. *Lower panel:* Major tributaries. a = Long tributary following the whole length of the umbilical fissure (29.16% of the cases). In the other livers the branch is short. b = Large segment IV branch entering the middle hepatic vein. c = Large segment IV branch entering the left portal vein [data from 3].

tal duplication of the left hepatic artery in 1 case. This represents 17 livers (17.89%). To conclude, it does not seem logical to retain a segmentation based on hepatic artery.

Left Biliary and Hepatic Artery Duplication or Distribution

Both arterial and biliary duplications occur in 4 cases. Arterial or biliary duplication is noted in 54 cases (n = 95). Distribution (III + IV) and II of the biliary and arterial branches appear also in 4 livers. This distribution in either the biliary tree or the arterial system occurs in 25 cases (25/96 = 26.04%). On the right there is a rather constant arterial distribution, but a quite variable biliary branching (46%). On the left the biliary distribution presents few duplications (9%), but many arterial duplications (50%). The portal vein segmentation must definitely be preferred.

Left Hepatic Vein

This vessel is a rather difficult problem because of the many embryological changes and the variable branching (The vein has been carefully described in books published by the author in 1957 [15] and 1989 [3]. The vein drains only the academic left lobe and is frequently made by the confluence in a span-like form of many branches in the posterior and right portion of the lobe; the medial ones are rather sagittal, the lateral ones oblique, the most posterior branches are transversal. The result is a very short stem first directed obliquely and posteriorly to the right, then nearly transversally to enter the middle hepatic vein (in 14 cases the vein enters the inferior vena cava directly). The stem is quite posterior, crossing the posterior extremity of the sulcus venosus (within the last 2 cm, quite often being the posterior margin of the sulcus) (fig. 7). It can be injured when dividing the left triangular ligament and often receives the inferior phrenic vein. After crossing the sulcus venosus the vein runs between segments I and IV, usually at the posterior margin of the liver; if it lies more anteriorly, a portion of segment I reaches the upper surface of the liver; this quadrocaudal portal fissure *is in prolongation of the left portal fissure between segments II and III.* The constant characteristic feature is that the main second-order branches of the vein are in the fissural plane between segments II and III, and the main trunk runs successively in the left portal fissure and the quadrocaudal portal fissure. Three varieties can be distinguished:

1	With a main branch coming from the anterior tip of the lobe	32
2	Two main branches (total duplication in 13 livers)	29
3	Posterior convergence of several equal branches	35

The left hepatic vein may receive collaterals which interdigitate with the portal branches.

Posterior Branch

Following exactly the posterior margin of the lobe, it is noted in 65/96 cases in the series; it may enter directly the vena cava.

Main Vein from Segment IV

In 53/96 livers, there is a more important segment IV vein which may enter:

The middle vein	anteriorly	14 livers
	posteriorly	1 liver
The left vein	anteriorly	11 livers
	posteriorly	13 livers
The junction left-middle veins		3 livers

Umbilical Vein

It is different from the former vessel. The umbilical vein is a main subject of discussion, because, if the umbilical fissure (actually a hepatic vein fissure containing a main portal pedicle) is considered as a portal fissure, it is necessary to find in it a main hepatic vein. Actually this cannot be retained, because obviously it is a collateral branch. The size is quite variable; only in 28 livers (29.16%) it follows the whole length of the umbilical fissure; in all the other livers the branch is rather short and even in 46 cases (47.91%) is a mere twig (I first considered it as missing, which was contested by some authors who declared that the vein could always be found). Moreover, it enters the left hepatic vein in only 42 cases (43.75%). An inconstant tributary entering the left vein in less than 50% of the cases cannot be considered as a main hepatic vein.

Appendix: English and French Terminology

English	French
Left hemiliver	Left liver
Left lobe	
Left lobectomy	Left hepatectomy
Right hemiliver	Right liver
Right lobe	
Right lobectomy	Right hepatectomy
Lateral segment	Left lobe
Lateral segmentectomy	Left lobectomy
Posterior + anterior + medial segments	Right lobe
Right trisegmentectomy	Right lobectomy
Segment	Sector
Posterior segment	Right lateral sector
Anterior segment	Right paramedian sector
Lateral segment (segment II)	Left lobe
Medial segments III + IV + II	Left lateral sector
	Segment IV
	Left paramedian sector
Umbilical portion of the left portal vein	Rex' recessus (left paramedian vein)

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