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Hepatovenous segments in the human liver

S. C. GUPTA, C. D. GUPTA AND S. B. GUPTA

Departments of Anatomy and Physiology, S.N. Medical College, Agra, U.P., India

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INTRODUCTION

Varied descriptions of the hepatovenous segments in the human liver occur in the literature. Gibson (1959) stated that the liver could be divided into five hepatovenous segments: right, middle, left, paracaval and caudate, which formed a constant pattern. His study was, however, confined to 15 livers only. Blount & Lachman (1966) described only 4 venous segments: left lateral, ventral middle, right dorsocaudal and dorsal middle. Healey (1954), Gans (1955), Rappaport (1969), Hardy (1972) and Schwartz (1974) described the areas of drainage of the hepatic veins in relation to the portobiliary segments but without giving a terminology to them. According to Faller & Ungvary (1964) the liver is divided into three hepatovenous lobes: right, intermediate and left, by right and left fissures. They described the hepatovenous segments according to the plane of fissures formed by major trunks of the portal triads instead of areas drained by the hepatic veins. Apart from Couinaud & Nogueira (1958), no workers have described the variations in the sizes of the hepatovenous segments in the human liver. The present study deals with observations on the patterns of the hepatovenous segments with special reference to variations from the normal pattern.

MATERIAL AND METHODS

The material for the present study comprised 95 human livers obtained within 24 hours of death from subjects of varying ages.

In 72 livers, corrosion casts of the hepatic veins were prepared by retrograde administration of 18 % butyl butyrate solution in acetone into the hepatic veins.

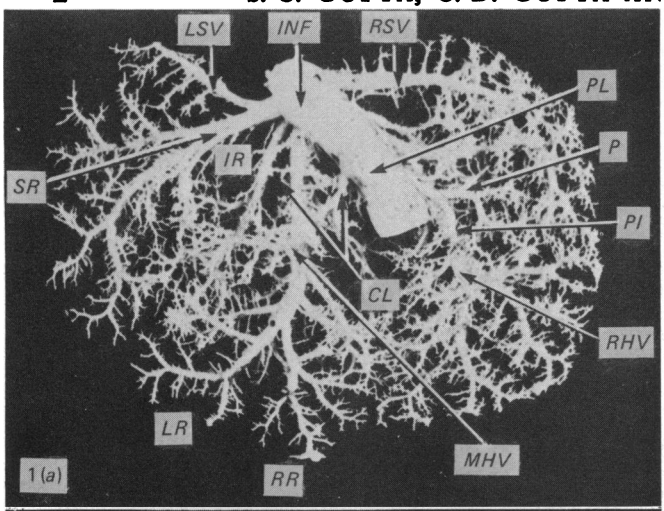
In 23 livers, radiographs of the hepatic veins were taken after the injection of barium sulphate.

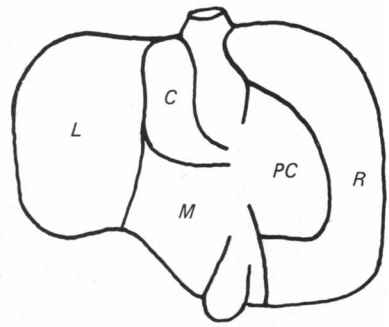
In each specimen hepatovenous segments were identified on the basis of the intrahepatic distribution of the veins.

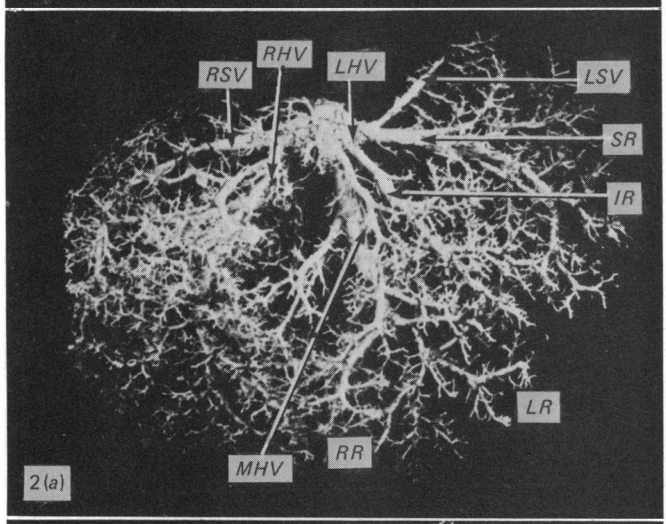
OBSERVATIONS AND DISCUSSION

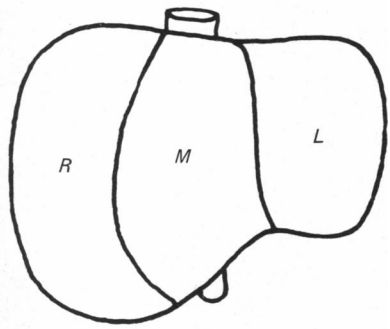
The venous drainage in all the livers showed five hepatovenous segments (Figs. 1, 2): left, middle, right, paracaval and caudate. Their relative sizes varied (Figs. 3–8).

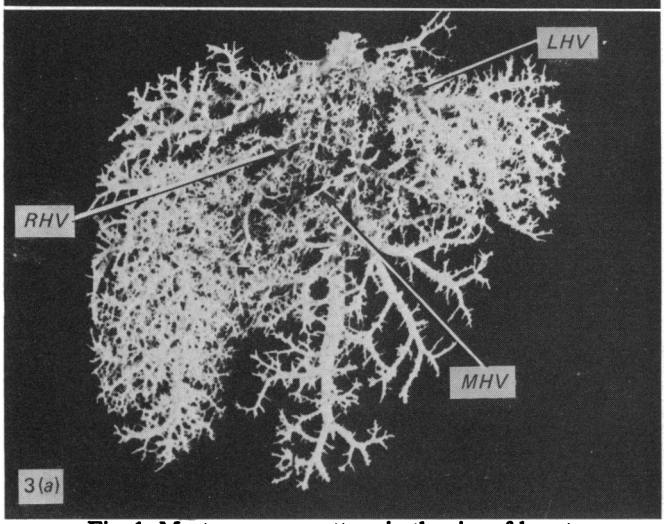
The left and middle hepatovenous segments were separated by a left segmental plane which corresponded to the site of attachment of the falciform ligament on the parietal surface and to the fissure for the ligamentum venosum and ligamentum teres on the visceral surface.











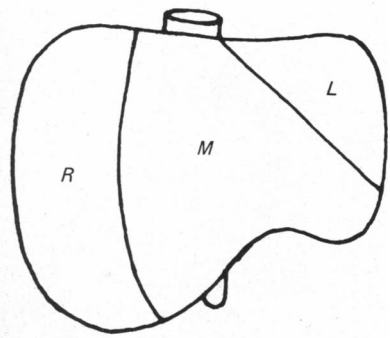
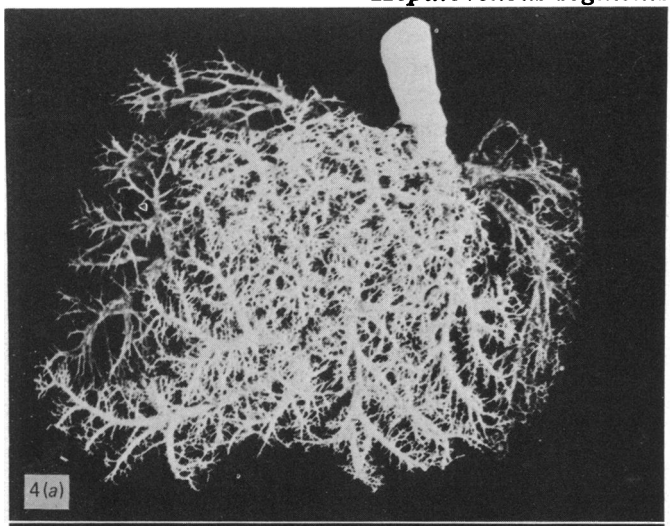
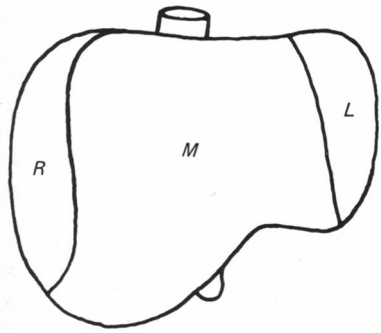


Fig. 1. Most common pattern in the size of hepatovenous segments on the visceral surface of the liver. (See p. 6 for all Figure abbreviations.)

Fig. 2. Most common pattern in the size of hepatovenous segments on the parietal surface of the liver.

Fig. 3. The middle hepatovenous segment is large at the expense of the left hepatovenous segment and extending to the left of the left segmental plane (parietal aspect).





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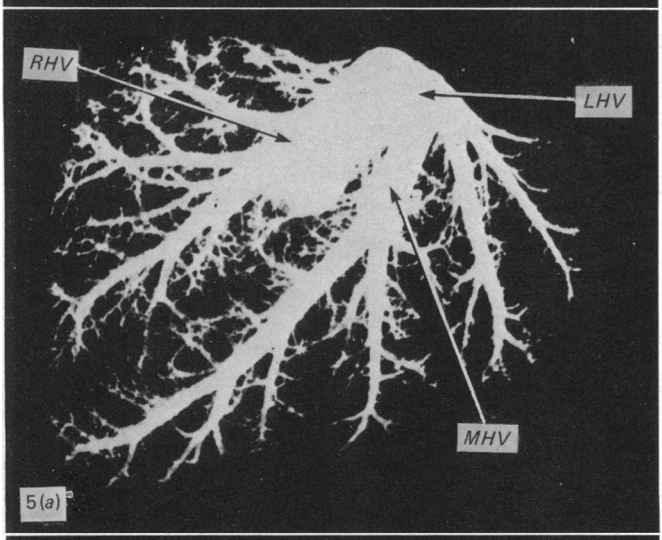

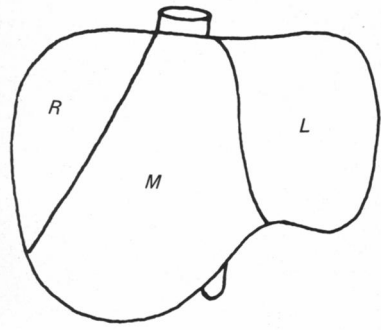

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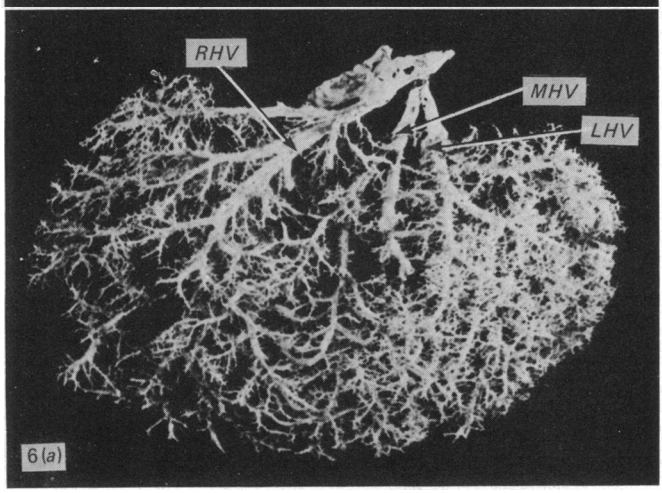
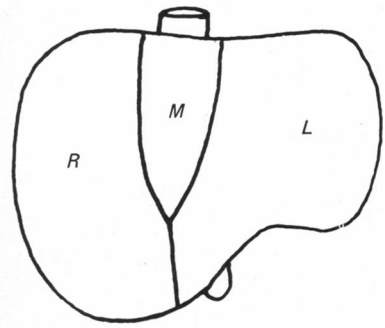


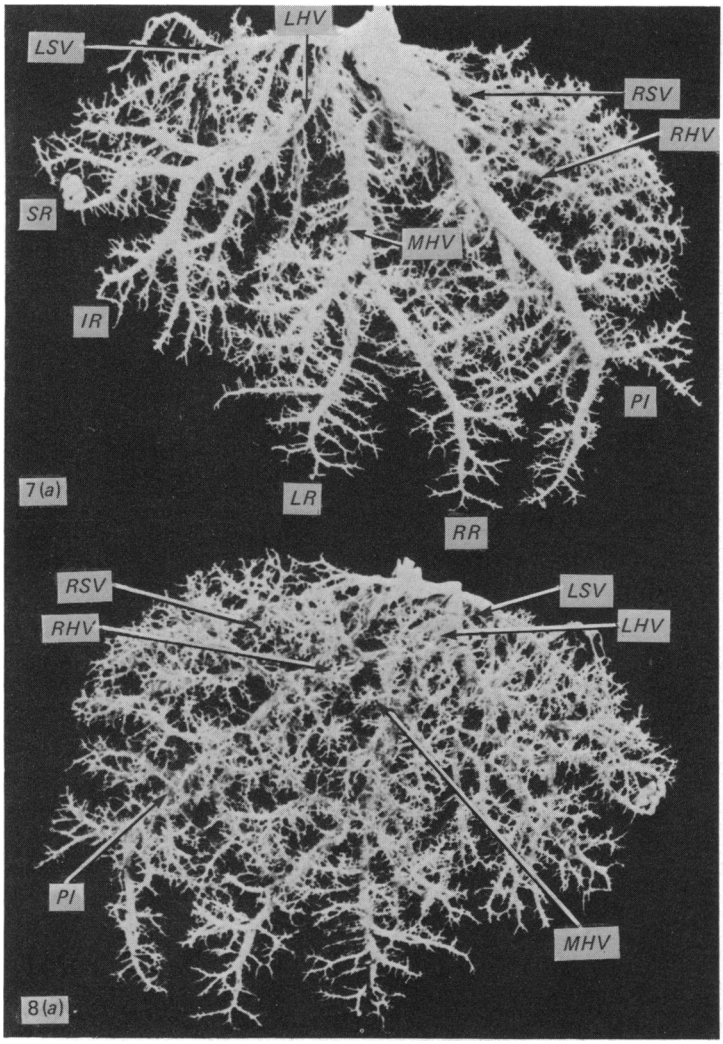


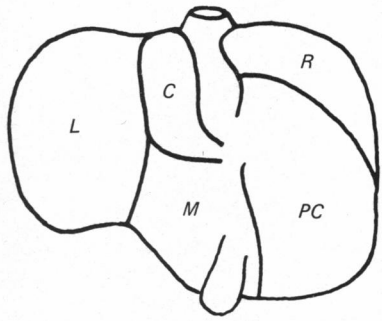
6(*b*)

Fig. 4. The middle hepatovenous segment is very large, replacing the right and left hepatovenous segments (parietal aspect).

Fig. 5. The right segmental plane terminates approximately at the junction of the posterior three quarters and anterior quarter of the right border of the liver, causing a large middle hepatovenous segment at the expense of the right hepatovenous segment (parietal aspect).

Fig. 6. The middle hepatovenous segment is very small, almost overtaken by the right and left hepatovenous segments (parietal aspect).





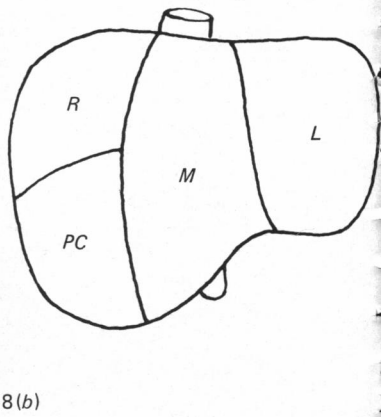


Fig. 7. The paracaval segment is very large, replacing most of the right hepatovenous segment on the visceral surface of the liver.

Fig. 8. The paracaval segment is also seen on the parietal surface at the expense of the right hepatovenous segment.

The middle and right hepatovenous segments were separated by a right segmental plane. This could not be seen on the surface of the liver but it extended posteriorly from midway between the orifices of the middle and right hepatic veins to the right of the fossa for the gall bladder anteriorly, cutting the inferior border of the liver.

The distribution pattern of these hepatovenous segments as described above was seen in 74 specimens (77·9 %), as shown in Figures 1*a*, *b* (visceral aspect) and 2*a*, *b* (parietal aspect). The major deviations in the relative sizes of the left, middle and right hepatovenous segments from the most common pattern are summarized in Table 1 (Figs. 3–6).

The size of the paracaval segment was constant in all except 6 specimens (6·3 %). In these the paracaval segment was very large at the expense of the right hepato-

Table 1. *Variations in the sizes of hepatovenous segments in the liver*

Number of cases	Fig. no.	Left hepato-venous segment	Middle hepato-venous segment	Right hepato-venous segment
4 cases (4·2%)	3*a*, *b*	+	+++	++
3 cases (3·1%)	4*a*, *b*	+	+++	+
7 cases (7·4%)	5*a*, *b*	++	+++	+
1 case (1·1%)	6*a*, *b*	+++	+	+++

++ = Size of the hepatovenous segments in the most common pattern.
+++ = Size of the hepatovenous segments larger than the most common pattern.
+ = Size of the hepatovenous segments smaller than the most common pattern.

venous segment on the visceral surface (Fig. 7*a*, *b*). The paracaval segment also extended on to the parietal surface where, normally, this segment would have been absent (Fig. 8*a*, *b*).

On comparing the terminology of venous segments of Blount & Lachman's (1966) study and the present study, the following resemblances are noted:

Blount & Lachman's study	Present study
Left lateral true segment	Left hepatovenous segment
Ventral middle true segment	Middle hepatovenous segment
Right dorsocaudal true segment	Right hepatovenous segment
	Paracaval segment
Dorsal middle true segment	Caudate segment

The right dorsocaudal true segment of Blount & Lachman's study included our own right hepatovenous and paracaval segments.

In each specimen, the liver was drained by the tributaries of three major hepatic veins – left, middle and right – and a number of minor veins: posterolateral, posterior, postero-inferior and short hepatic veins; superior and inferior caudate veins; and the vein of the caudate process. The most common pattern of hepatic veins is given schematically in Figure 9.

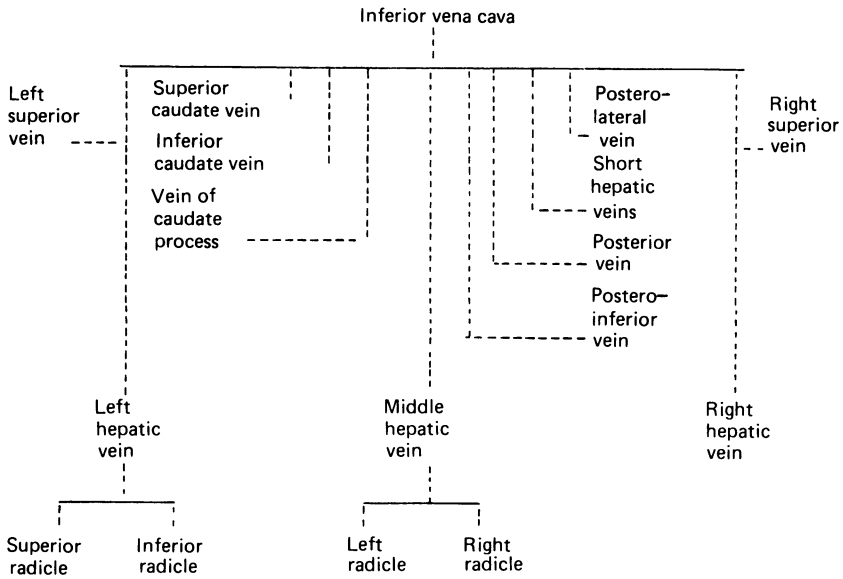


Fig. 9

The major hepatic veins (left, middle and right) drained the correspondingly named segments. Anastomoses between the tributaries of these major veins were sparse. This is in keeping with the findings of Goldsmith & Woodburne (1957) and of Gibson (1959), though at variance with those of Elias & Petty (1952) and Gans (1955) who reported frequent anastomoses between the tributaries of hepatic veins.

Posterolateral, posterior, postero-inferior and short hepatic veins drained the visceral surface of the right lobe situated to the right of the inferior vena cava. The area drained by these veins has been termed the paracaval segment.

Superior and inferior caudate veins drained the caudate lobe, with the caudate process possessing its own view. This hepatovenous segment has been named the caudate segment.

SUMMARY

The patterns of hepatovenous segments in 95 human livers have been studied after preparing corrosion casts of the hepatic veins in 72 specimens and taking X-rays of 23 livers after injecting barium sulphate into the hepatic veins. Five hepatovenous segments were seen in every specimen: left, middle, right, paracaval and caudate. The sizes of corresponding hepatovenous segments were similar in 77·9 % of livers; in the remainder increased or decreased size, at the expense of neighbouring segments, was observed.

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ABBREVIATIONS USED IN THE FIGURES

INF, Inferior vena cava; *RHV*, right hepatic vein; *MHV*, middle hepatic vein; *LHV*, left hepatic vein; *RSV*, right superior vein; *LSV*, left superior vein; *SR*, superior radicle of left hepatic vein; *IR*, inferior radicle of left hepatic vein; *RR*, right radicle of middle hepatic vein; *LR*, left radicle of middle hepatic vein; *PL*, posterolateral vein; *P*, posterior vein; *PI*, postero-inferior vein; *CL*, veins of the caudate lobe; *L*, left hepatovenous segment; *M*, middle hepatovenous segment; *R*, right hepatovenous segment; *PC*, paracaval segment; *C*, caudate segment.