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ORIGINAL ARTICLE

A STUDY OF ANGLES BETWEEN MAJOR HEPATIC VEINS IN HUMAN CADAVERS

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ABSTRACT: INTRODUCTION: "A good knowledge of the anatomy is a prerequisite for modern surgery of the liver."(1) Liver resections were first described centuries ago, but until the latter half of the 20th century, the majority of such resections were performed for management of either injuries or infections.(2) Today, these procedures are performed not only for treatment of acute emergencies (e.g., traumatic injuries or abscesses) but also as potentially curative therapy for a variety of benign and malignant hepatic lesions. As a result, the number of hepatic transplant centers, have increased dramatically. In spite of the remarkable standardization of the technique involved in this procedure, the operation remains a formidable technical challenge.(3) An attempt has been undertaken to study the relations of major hepatic veins, so that accurate mapping of major veins could be done, which is essential in graft retrieval. **MATERIALS AND METHODS:** The study was conducted on 60 specimens of liver from well embalmed cadavers in the department of Anatomy of Dayanand Medical College and Hospital, Ludhiana, Punjab and of Adesh Institute of Medical Sciences and Research, Bathinda, Punjab. Study was conducted by using Barium sulfate as contrast. X-rays were taken followed by dissection. **RESULTS:** The present study showed that in majority of cases, the angles were acute. Only in one liver the angle, between right and middle hepatic veins was 130 degrees. The measurement was not possible in one liver, as the alignment of the veins was such that they were overlapped. **DISCUSSION:** Preoperative mapping of hepatic vasculature is of paramount importance in dealing with life-saving surgeries like transplantations, tumours and trauma related hepatic injuries. The minimization of blood loss is the main objective during hepatic resection to minimize perioperative mortality and morbidity.(4)Therefore, in depth knowledge of liver anatomy is required. This knowledge is then built on with various radiological modalities. **CONCLUSION:** Liver is a complicated organ. Naming of the parts of this complex inner organ is still highly varied: parts, halves, lobes, divisions, sectors, segments, and sub-segments. Our understanding and explanation of liver composition are still defined differently among anatomists, surgeons, and radiologists, thus not only confusing less experienced specialists, but also increasing probability of mistakes. Such a lack of communication aggravates the design of an operation plan and its documentation, which frequently may even result in undesirable legal consequences.(5) Hence precise knowledge is a must for a successful procedure like living related transplantations, dealing with hepatic lesions like cholangiocarcinomas and trauma management.

KEYWORDS: Liver resections, transplantations, hepatic vasculature, Graft retrieval, benign and malignant hepatic lesions.

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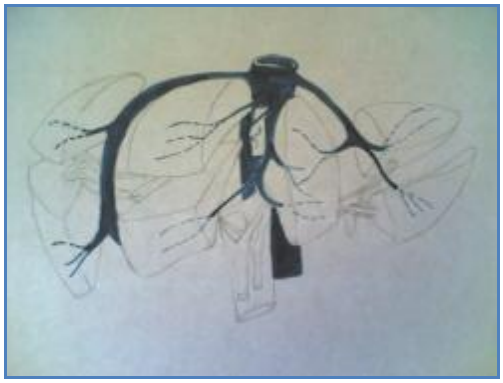

Fig. 1: Segments of liver

"In the strangely beautiful dynamism of embryology, the liver appears as a tree that grows out of the virgin land of foregut in order to increase its metabolic and digestive function".[6]

INTRODUCTION: The liver is the largest gland in the body which performs an astonishingly large number of tasks that impact all body systems. One consequence of this complexity is that hepatic disease has widespread effects on virtually all other organ systems. Understanding function and dysfunction of the liver, more than most other organs, depends on understanding its structure. The major aspects of hepatic structure that require detailed attention include:

The Hepatic Vascular System: It has several unique characteristics relative to other organs. Resection of the liver was started only at the beginning of the 18th century. In 1716, G. Berta performed the first partial liver excision. However, due to unstoppable bleeding and high mortality, surgeons feared to operate on this organ. Only in 1874, C. Langenbuch reported the first successful liver resection.[7]

Today, these procedures are performed not only for treatment of acute emergencies (e.g., traumatic injuries or abscesses) but also as potentially curative therapy for a variety of benign and malignant hepatic lesions.

Progress of diagnostic human's liver imaging (ultrasound, computerized tomography, magnetic nuclear resonance, etc.) stimulates development of modern liver surgery. Therefore, before and during the operation, surgeons and radiologists can determine the site and extent of liver damage, its relationship with blood vessels and ascertain which part of the liver should be resected.

For this reason, physicians have to know anatomical and clinical peculiarities of the liver.[1]
In spite of the remarkable standardization of the technique involved in this procedure, the operation remains a formidable technical challenge.

This study would thus, enable the surgeons to perform life-saving surgeries like Living-related liver transplantation and management of liver related injuries in trauma.

MATERIALS AND METHODS: The study was conducted in the Department of Anatomy, Dayanand Medical College and Hospital, Ludhiana, Punjab and Adesh Institute of Medical Sciences & Research, Bathinda, Punjab, after the approval by the Hospital Ethics Committee.

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The study was done on 60 specimens of liver from embalmed, apparently disease free adult cadavers, in the Department of Anatomy, Dayanand Medical College and Hospital, Ludhiana and Adesh Institute of Medical Sciences & Research, Bathinda, Punjab.

1. To begin with, the hepatic veins of the livers were cleaned. They were thoroughly washed with water, followed by normal saline. Suction machine was used to take out any remaining clots. This was done, till saline ran from the veins.
2. To put the liver in anatomical position, wooden stand which had a long and tapering wooden stick, fixed to a plain wooden platform was taken. A wooden stand was used as it hardly causes any shadow on X-ray films. The liver was placed on the wooden stand in such a way that the long stick of the stand was introduced into the inferior vena cava. Thus, liver stood independently on the stand with inferior vena cava vertical (as shown in the photograph).

A freshly prepared emulsion of 125 gm of barium sulfate mixed in 180 ml of water was used. The consistency of emulsion was such that it was neither too thin nor too thick.

1. A 200cc syringe was used to fill major hepatic veins with emulsion.
2. Barium sulphate emulsion took 15-20 minutes to gravitate slowly down the veins and its tributaries. After this time-interval, the cephalic portion of the hepatic veins became empty and this was refilled. The extra amount was cleaned with wet cotton to avoid any unwanted shadow on X-ray films.
3. The X-rays were taken in different views. The machine was movable and the stand with liver was stationary. The different views were:
    1. Antero-posterior view
    2. Supero-inferior view
    3. Right lateral view

The following parameters were studied in the radiographs:

a. Angle between right and middle hepatic vein.
b. Angle between middle and left hepatic vein.

The livers were subsequently dissected under bright illumination.

Using X-rays as a rough guide, the dissection was started along the Cantlie's line for middle hepatic vein.

Gross angles between the right and middle hepatic vein and middle and left hepatic vein was measured after putting thin iron wires (0.960 mm calibre) along the medial edge of the vein, up to a distance of 2.5 cm. The angles were measured using goniometer. The wires were non-malleable and non–ductile to prevent errors in measurement.

The observations were then tabulated and analyzed using appropriate statistical methods.

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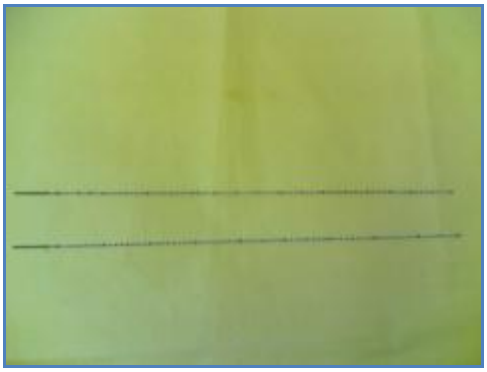

Fig. 2: Iron wires (for measuring angles)

Fig. 3: Wooden stand

Fig. 4: Anterior surface of liver

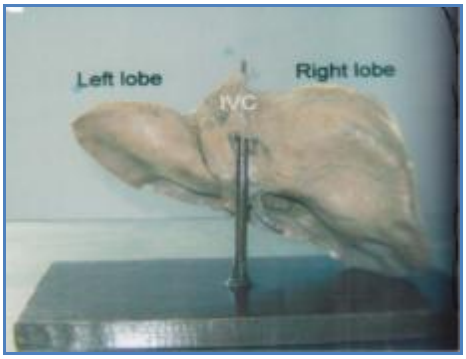

Fig. 5: Wooden stand with liver Showing stick in Inferior Vena Cava

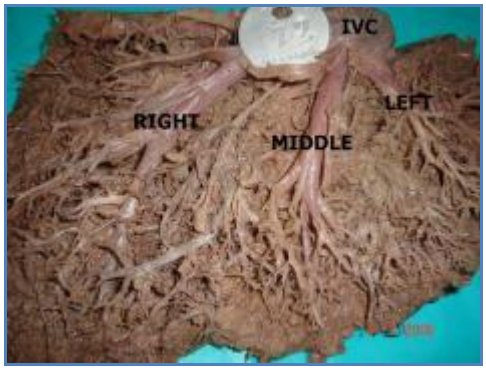

Fig. 6: Piecemeal dissection of Liver

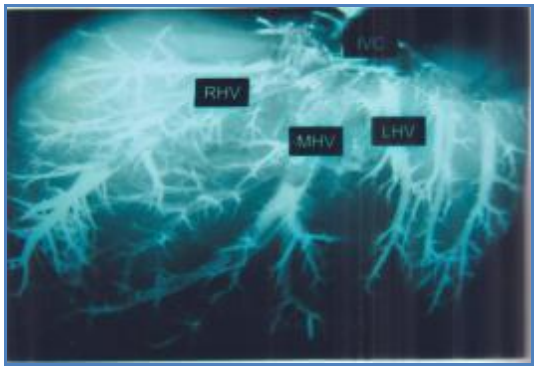

Fig. 7: X-ray of Liver showing the major veins

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Fig. 8: According to the mathematical principle of diagonal equation Angle A= Angle B. IVC- inferior vena cava; MHV- middle hepatic vein; LHV- left hepatic vein; RHV- right hepatic vein.

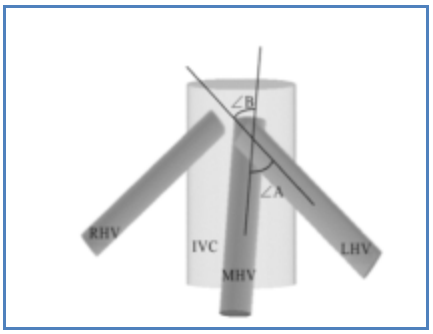

Figure 8

Fig. 9: Axial diagram of the liver at the level of the confluence of the hepatic veins shows the dotted lines drawn from the confluence of the middle hepatic vein (MHV) or right hepatic vein (RHV) and the IVC straight through each hepatic vein. These lines indicate the imaginary boundary, which are considered to be the longitudinal scissurae.[11]

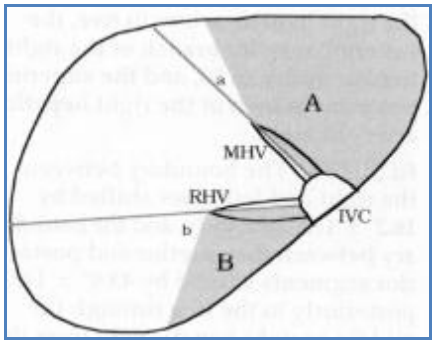

Figure 9

Fig.10: Goniometer for measuring angles

RESULTS: Angle between middle and right hepatic veins were measured. Mean on dissection was 31.857±8.996 and on X-rays, was 26°±11.97°. Angle between middle and left hepatic veins were measured.

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Mean on dissection was 74.0±19.383, on X-rays was 41.267°±11.97° The angles between right and middle hepatic veins and the angles between middle and left hepatic veins were acute in most of the cases. Only in one liver the angle between right & middle hepatic vein was 130 degrees in gross. In one liver, the angle between the major veins could not be measured. This was so because of the alignment of the veins was such that they overlapped.

DISCUSSION: The results corresponded to some extent with those of Shao et al (8). He did not measure the angles between the middle and right hepatic veins. The angle between the middle and right vein, in present study, ranged from 20-45^{o} (mean 31.857±8.996). No reference was found regarding this parameter.

Segall[9] stated that the angles formed by the junctions of the larger vessels are acute (15^{o} – 40^{o}). No specification is made regarding the names of the vessels.

Peschaud et al[10] has reported that the right hepatic vein entered the vena cava at an acute angle in 100% cases.

The angle between right hepatic vein and inferior vena cava was not measured in the present study.

Author	Year	Between left and middle hepatic vein	Between middle and right hepatic vein
Shao et al	2003	65-115 (91±18.3°)	-
Present Study Dissection		65-130° (74±19.383)	20-45° (31.857±8.996)
Radiology		15-70° (41.267±11.97°)	5°-45° (26.0±11.970)

Table 1: Comparison of angles of present study with those of previous studies

CONCLUSION: Liver is a complicated organ. Naming of the parts of this complex inner organ is still highly varied: parts, halves, lobes, divisions, sectors, segments, and sub-segments.

Our understanding and explanation of liver composition are still defined differently among anatomists, surgeons, and radiologists, thus not only confusing less experienced specialists, but also increasing probability of mistakes.

The prognosis of patients not only is dependent upon timely management but also the precise knowledge of position and architecture of hepatic veins. This study would help the surgeons to access the area and control the hemorrhage. These are the major problems confronting the surgeon undertaking the removal of hepatic tumours and cysts.

It should be kept in mind that the present study had a smaller number of livers so, it is worthwhile to perform a similar study on more number of livers for its theoretical and practical importance in coming years.

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