

ORIGINAL ARTICLE

A Cadaveric Study of Retro Hepatic Segment of Inferior Vena Cava and Ostia Venae Hepaticae

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ABSTRACT

Aim of study: 1) Morphology, morphometry and anatomical variations of retro hepatic segment of IVC. 2) Number, location and morphometry of ostia of major hepatic veins and number of minor openings.

Introduction: Inferior vena cava (IVC) is the largest vein in human body and a main channel for venous return from lower limb, pelvis and abdominal viscera. Retro hepatic part lies in a groove in posterior surface of liver. Variations of IVC are important clinically. Hepatic veins drain into IVC near upper end. Variations in number, size and drainage pattern of hepatic veins is important. In surgery knowledge of the openings is relevant in treatment of hepatic trauma with avulsion of hepatic veins and resection of parts of diseased liver. Live donor liver transplantation (LDLT) is an emergency option in patients with end stage liver diseases needs knowledge of IVC and hepatic veins.

Materials and methods: Study was done in Adichunchanagiri Institute of Medical Sciences for a period of 6 months from July 2025 - December 2025. 30 Liver specimens were collected from dept of anatomy from the eviscerated liver from cadavers used for undergraduate students. Posterior wall of IVC was cut longitudinally and length was measured from lower border at caudate process to upper border of IVC. Width of IVC was taken at midpoint of length using vernier calipers. Number and location of major hepatic veins (upper group) openings were noted. Measurement of ostia of opening was taken vertically. Number and location of minor openings were noted.

Results: The average length of retro hepatic segment of IVC was 7.66 cm (range 5-10) and width in the midpoint was 8.65 mm (range 0.3 – 26 mm). The openings of hepatic veins were analysed as major openings in the upper part and minor openings in lower part of anterior wall of IVC. The number of major ostia were

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- Right Hepatic Veins (RHV) 38, Left Hepatic Veins (LHV) 42, Middle Hepatic Veins (MHV) 2. The mean vertical diameter of ostia were as follows - RHV 8.71 mm (range 0.28 - 18), LHV 6.75 mm (range 0.04 -14) and MHV 0.19 - 18mm. Total number of major openings 82 (RHV 38 +MHV 2+ LHV 42). Total number of minor openings were 183.

Conclusion: The present study showed the length of retro hepatic segment was 7.66 cm. Number of major hepatic veins openings were (82). The detailed knowledge of morphometry of IVC and hepatic vein openings is important in surgical procedures

KEYWORDS

• Vernier Calipers • Morphometry of Inferior Vena Cava • Hepatic Veins

INTRODUCTION

Inferior vena cava (IVC) is the largest vein in human body and a main channel for venous return from lower limb, pelvis and abdominal viscera to right atrium of heart. IVC is formed in front of L5 vertebra by union of right and left common iliac veins. Anatomically it is divided into infra renal, suprarenal, retro hepatic and suprahepatic segments. Retro hepatic part lies in a groove in posterior surface of liver. Hepatic veins drain into IVC before it passes through the diaphragm. Variations in number, size and drainage pattern of hepatic veins influence the surgical approach and outcome.¹

Blood enters liver from two sources portal vein and hepatic artery.² Portal vein and hepatic artery pour blood into sinusoids of liver. Central vein receives blood from hepatic sinusoid. Central veins drain into sublobular veins which drain into interlobular veins. These veins drain into hepatic veins. The hepatic veins beginning in liver has no valves. The adventitia of hepatic veins binds to the walls of traversing passages, so bleed when there is damage to the liver.³

Hepatic veins are large intraparenchymal veins drain deoxygenated blood from liver into IVC. They are 3 major veins - right hepatic vein (RHV), middle hepatic vein (MHV), left hepatic vein (LHV). Apart from 3 major veins small accessory veins drain directly into IVC.⁴

Hepatic veins are divided into upper group and lower group. Upper group include major hepatic veins (right, middle and left), lower minor openings vary in number and size directly open in to IVC. They are extensively placed in anterior wall of IVC.^{2,3} The minor openings of small veins draining in to IVC from Couinaud's segment I, occasionally from VII, VIII.²

The openings of hepatic veins into retro hepatic segment of IVC are not only structures playing a part in controlling the hepatic circulation but are also important during catheterisation to determine hepatic and sinusoidal pressure and in selective hepatic venography. They are also relevant in resection of part of diseased liver and removal of long segment of IVC during liver transplant.⁵

Openings of hepatic vein are important because of sphincteric mechanism. In surgery knowledge of the openings is relevant in treatment of hepatic trauma with avulsion of hepatic veins and resection of parts of diseased liver.⁶

Live donor liver transplantation (LDLT) is an emergency option in patients with end stage liver diseases, due to scarcity of liver donors. LDLT involves 2 major procedures - portion of liver removed from the live donor and transplanted to recipient and hepatic veins reconstruction and anastomosis are done. In right lobe transplantation hepatectomy line passes approximately 1 cm to right side of middle hepatic vein 2. LDTA for paediatric recipients involve removal of 20% of liver. Couinaud's segment II and III for adults LDTA donor age 18 - 60 yrs, 55 - 70% of right lobe of liver is removed.⁷

The detailed anatomical knowledge of hepatic veins variations is clinically relevant when dealing with liver transplant.⁴

Aim of study:

1. To study the morphology, morphometry and anatomical variations of retro hepatic segment of IVC.
2. To study the number, location and morphometry of ostia of major hepatic veins and number of minor openings.

MATERIALS AND METHODS

Study was done in Adichunchanagiri Institute of Medical sciences for a period of 6 months from July 2025 - December 2025. 30 Liver specimens were collected from dept of anatomy from the eviscerated liver from cadavers used for undergraduate students. Liver specimens were well preserved in formalin containers.

Inclusion criteria:

1. Livers with intact lobes and intact IVC.
2. Adult liver specimens from cadavers of unknown gender

Exclusion criteria:

1. Livers damaged during evisceration

2. Livers without segment of IVC

3. Diseased liver specimens

Specimens were cleaned properly. Posterior wall of IVC was cut longitudinally.

Parameters:

1. IVC - length (L) and width (W) in midpoint in cm.
2. Hepatic veins - Major group RHV and LHV vertical diameter

Minor hepatic veins - location and number

Length of IVC was measured from lower border at caudate process to upper border of IVC. Width of IVC was taken at midpoint of length using vernier calipers.



Figure 1: Showing length of IVC in cm - L

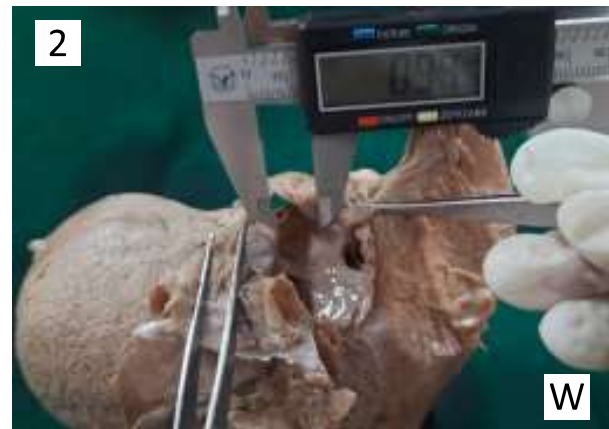


Figure 2: Showing width of IVC in midpoint in cm - W

Number and location of major hepatic veins (upper group) openings were noted. Measurement of ostia of each opening was

taken vertically. Number and location of minor openings were noted.



Figure 3: Showing measurement of vertical diameter of right hepatic vein in mm



Figure 4: Vertical diameter of left hepatic vein

RESULTS

Study was done on 30 liver specimens collected from dept of Anatomy. The

specimens were well preserved in formalin filled containers. The average length of retro hepatic segment of IVC was 7.66 cm (range

5-10) and width in the midpoint was 8.65 mm (range 0.3 – 26 mm). The openings of hepatic veins were analysed as major openings in the upper part and minor openings in lower part of anterior wall of IVC. The number of major ostia were - RHV 38, LHV 42, MHV 2. The mean vertical diameter of ostia - RHV 8.71 mm (range 0.28 – 18), LHV 6.75 mm (range 0.04 – 14) and MHV 0.19 – 18mm. Total number of major openings 82 (RHV 38 +MHV 2+ LHV 42). Total number of minor openings - right 81, left 69, middle 33 and total 183. One of the specimens showing part of caudate lobe covering middle of IVC.

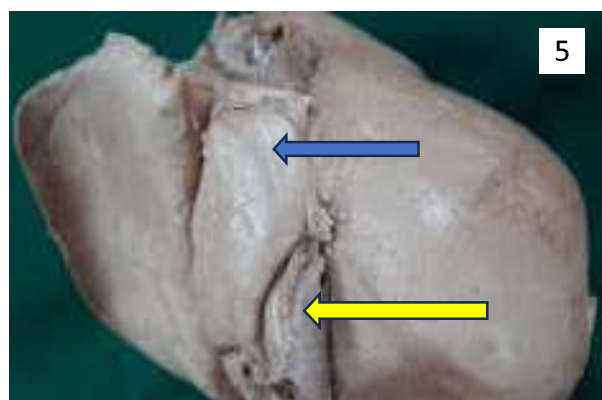


Figure 5: Liver specimen partly covered by caudate lobe

Table 1: Showing the number and size of major hepatic vein openings

Veins	Number	Average size	C
RHV	38	8.71 mm	0.28-18
MHV	02	—	0.19-18
LHV	42	6.75 mm	0.04-14
Total	82	—	—

DISCUSSION

Retro hepatic segment of IVC is one of the most challenging vascular regions, because of deep location and proximity to

Table 3: Showing comparison of number of major hepatic vein with other studies

Study	Right	Middle	Left	MH+ LH	RH+LH +MH	Total
Chang <i>et al</i> ⁵	58	7	7	17	-	125
S Raad <i>et al</i> ⁶	21	1	1	21	4	114
Veena <i>et al</i> ³	45	-	44	-	-	89
Present study	38	2	42	-	-	81

There were 183 minor openings in present study. S Raad *et al*⁶ reported 308 and Veena *et al*³ reported 45 minor openings and Chang *et al*⁵

liver parenchyma. It is important also due to multiple hepatic vein openings.¹ The present study might provide valuable data among South Indian population. The length and diameter of IVC varies based on posterior surface of liver and depth of groove.

The length of IVC among 30 specimens in the present study range from 5-10 cm and average is 7.66 cm. The value is in par with other studies reported by Chang *et al*⁵, Veena *et al*³ and Malar D.⁶ Keshav Krishna⁸ reported 6.47 cm and S Raad reported 6.7 cm. Retro hepatic liver segment covering half of length of IVC was seen in one of the specimens in our study (3.3%). Chang *et al*⁵ reported 6.7% and 30% in S Raad *et al*⁶. Width of IVC at the midpoint in our study range from 0.3 – 26 mm with mean 8.65mm. Width was reported 1.0 cm by S Raad *et al*⁶ and 1.2 cm by Chang *et al*⁵.

According to a study done by observing 500 CT scans by Binit *et al*⁴ length of IVC was 6.7 cm

Table 2: Showing comparison of measurements of IVC with other studies

Study	Sample size	IVC - L cm	IVC - W mm
Veena <i>et al</i> ³	60	7.1	1.2
Chang <i>et al</i> ⁵	45	7.2	—
S Raad <i>et al</i> ⁶	30	7.4	—
Brahmanand <i>et al</i> ⁷	20	6.41	—
Gowri Shankar <i>et al</i> ¹	35	—	16.84
Present study	30	7.66	8.64

Hepatic vein openings are divided in to major or upper group and minor or lower group. In the present study there were total 82 openings. According to Chang *et al*⁵ more number of RHV openings compared to other studies. Veena *et al*³ study shows number of RHV and LHV are same. In the present study more number seen on left side.

*al*⁵ reported 236 minor openings.

Table 4: Showing comparison of number of major and minor openings of hepatic veins with other studies

Study	Major	Minor	Total
Chang <i>et al</i> ⁵	236	236	472
S Raad <i>et al</i> ⁶	114	308	422
Veena <i>et al</i> ³	89	45	134
Malar D ⁸	129	193	322
Present study	82	183	264

Binit *et al*⁴ reported study of 500 CT scan, single RHV in 458, 2 RHV in 36 and 3 RHV

in 3 scans. Early branching of RHV in 185 appear as accessory veins. Small RHV and well developed MHV seen in 6 scans. Common trunk of MHV and LHV seen in 405 scans. Independent drainage was seen in 95 scans.

CONCLUSION

The present study showed the length of retro hepatic segment found be in par with other studies. Number of major hepatic veins openings were less than other studies. The detailed knowledge of morphometry of IVC and hepatic vein openings is important in surgical procedures such as LDLT and catheterisation to know hepatic and sinusoidal pressure. IVC length and width are better visualised in cadaveric studies. Anatomical study adds to this knowledge even though CT studies show branching of hepatic veins better.

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