Original article

The Retrohepatic segment of inferior vena cava and the ostia venae hepaticae in a Northwest Indian population

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Abstract

The study has been undertaken to provide the morphological data regarding the retrohepatic segment of inferior vena cava (RHIVC), the prevalence of caudate lobe over the RHIVC (pons hepaticus) and openings of hepatic veins (ostia venae hepaticae) The knowledge is essential in determining hepatic circulation, selective venography, causes of posthepatic portal hypertension and locating the membranous obstruction in Budd-Chiari syndrome. The preliminary study was done on 100 livers (age range 50-95 years) from Northwest Indian population.The inferior vena cava was divided transversely at the level where it pierced the diaphragm superiorly and at the lower limit of caudate lobe inferiorly. Then the RHIVC was opened posteriorly and its internal surface was divided into 16 chambers to investigate the ostia vena hepaticae. Average length of RHIVC in 100 cadaveric livers was found to be 65.6 mm. Direction of axis of RHIVC in relation to the axis of the liver was vertical in 8, oblique towards left in 18 and curved towards left in 74 livers. The total no. of openings of ostia venae hepaticae were 800 and the extension of caudate lobe was found complete in 4 livers (pons hepaticus) and partial in 48 livers. The results of this study clarify the anatomy of RHIVC and sites of ostia vena hepaticae are essential to recognise while treating Budd-Chairi syndrome, partial hepatectomies and liver transplants.

Keywords: hepatic veins, Retrohepatic segment of inferior vena cava, Pons hepaticus, Budd-Chairi syndrome, partial hepatectomies, liver transplants.

1 Introduction

The knowledge of anatomy of retrohepatic segment of inferior vena cava (RHIVC) and pattern of ostia venae hepaticae is very important in determining the site of thrombosis and membranous obstruction in Budd-Chiari syndrome. Budd-Chiari syndrome is a manifestation of hepatic venous outflow obstruction founded by Budd (1845) and expounded by Chiari (1899) which usually occurs at the level of inferior vena cava and hepatic veins. The hepatic outflow obstruction usually occurs at the level of the inferior vena cava (IVC); the hepatic veins; and, depending on the classification and nomenclature, possibly at the venule level (VALLA, 2009; PLESSIER and VALLA, 2008; HOEKSTRA and JANSSEN, 2008). In this syndrome, hepatic venous occlusion causes increased sinusoidal pressure, leading to a delay or reversal of portal venous blood inflow, ascites, and morphologic changes in the liver that result in abnormal liver function tests. Therefore, the pattern of ostia vena hepaticae determined in present study is envisaged to be useful in carrying out safe decompression of hepatic vasculature or transjugular intrahepatic portosystemic shunt procedure in portal hypertension (ONG, SANDS and YOUNOSSI, 2000). The morphology and distribution of the hepatic veins determine the hepatic circulation and the hepatic connection between portal and systemic venous circulation. Gibson (1959) reported that the openings of the hepatic veins are important in the control of the hepatic circulation because of their sphincteric mechanism. In surgery, knowledge about these openings is relevant in the treatment of hepatic trauma with hepatic vein avulsion and also in the resection of parts of diseased livers (KENNEDY and MADDING, 1977; NAKAMURA and TSUZUKI, 1981). They also have a great significance in removal of diseased part of the liver and in removal of part of IVC during liver transplantation. With apparent inoperable hepatic cell carcinoma, knowledge of adequate venous outflow from tumour-free liver tissue permits extensive resection with long survival (WILLIAMS and PETERSON, 1976). The smaller hepatic veins have gained great importance in the practice of a caudate lobectomy for hilar bile duct cancer and in split liver for expanding donor pool for liver transplantation (YU, LEE, JIN et al., 2003). Therefore, this study has been undertaken to provide the morphological data regarding the retrohepatic segment of inferior vena cava, pons hepaticus and ostia venae hepaticae.

2 Material and methods

The study on the retrohepatic segment of inferior vena cava was conducted on 100 northwest Indian cadaveric livers. The age of the cadavers ranged between 50 to 95 years and the livers used were free from major gross pathological changes. Before the commencement of the study, the cadavers were embalmed with the mixture of formalin – 2 L, glycerine – 200 mL, potassium acetate – 250 gm, potassium carbonate – 250 gm, phenol – 250 mL, lead oxide – 150 gm and methylene spirit – 250 mL. With the abdominal wall

opened, the Inferior vena cava was found and divided transversely at the level where it pierces the diaphragm, superiorly and at the inferior border of the liver, inferiorly. All the attached ligaments and vessels were incised to remove the liver from the cadaver. This was followed by washing the liver in running cold water. To study the retrohepatic segment of inferior vena cava (RHIVC), it was levelled superiorly at the upper limit of the liver and inferiorly at the lower limit of caudate lobe. The length of RHIVC was measured initially by the use of silk thread and then measuring scale. The orientation of RHIVC was recorded in relation to the vertical axis of the liver and was categorised into vertical, oblique towards the left and curved towards the left. Also, the number of RHIVC covered by partial and complete extension of caudate lobe was noted.

The RHIVC was removed by separating the connections of hepatic veins carefully and its posterior wall was opened by a midline vertical incision. The RHIVC was washed to remove the blood clots in order to visualise the features of ostia venae hepaticae. The number, size and nature of ostia venae hepaticae were determined. On some occasions, the RHIVC was found to be covered by the extension of caudate lobe which was recorded.

In order to count the total number of ostia venae hepaticae, a table of four columns and four rows was drawn on the internal surface of IVC with the help of marker and measuring scale. Thus the number of hepatic openings in the 16 chambers of IVC was recorded. It was done by inserting the probe carefully at the level of hepatic openings.

The sizes of the openings were determined, with the help of silk thread and the measuring scale. The openings of the hepatic veins were grouped into 3 categories.

- Large openings with diameter equal to or greater than 0.7 cm;
- Medium opening with diameter between 0.3-0.69 cm; and
- Small openings with diameter = 0.01-0.3 cm.

It was found that the nature of openings of the hepatic veins on RHIVC were different in nature. So the types of the large openings were also recorded to determine whether they were single, double or triple.

3 Results and discussion

Average length of RHIVC in cadaveric livers was found to be 65.6 mm. Direction of axis of retrohepatic segment of IVC in relation to the axis of the liver was determined and categorised into vertically oriented (Figure 1), oblique towards left (Figure 2) and curved towards left (Figure 3). From 100 RHIVC, 8 were oriented vertically, 18 oblique towards left and 74 curved towards left.

The values determined by other authors are depicted in Table 1.

The total no. of openings of ostia venae hepaticae came out to be 800. The largest diameter of hepatic opening in the present study came out to be 1.6 cm. The number of superior large openings, inferior large openings, medium openings and small openings of ostia venae hepaticae were 206, 52, 150 and 392 respectively. The comparison of total number of openings amongst different populations is depicted in Table 2.

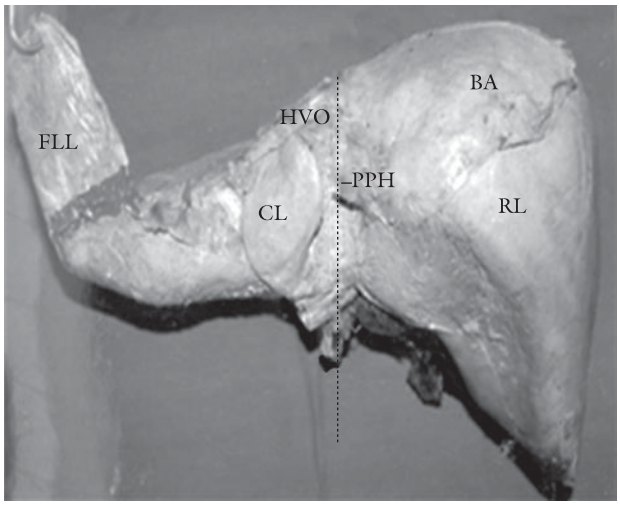

Figure 1. Retrohepatic segment of inferior vena cava (groove) oriented vertically. (Abbreviations: RL - right lobe, CL - caudate lobe, PPH - partial pons hepaticus, BA - bare area, FLL - flapped part of left lobe and HVO - hepatic venous opening)

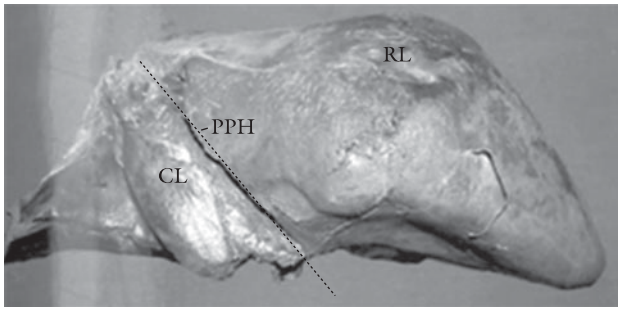

Figure 2. Retrohepatic segment of inferior vena cava (groove) oriented obliquely towards the left. (Abbreviations: RL - right lobe, CL - caudate lobe, PPH - partial pons hepaticus)

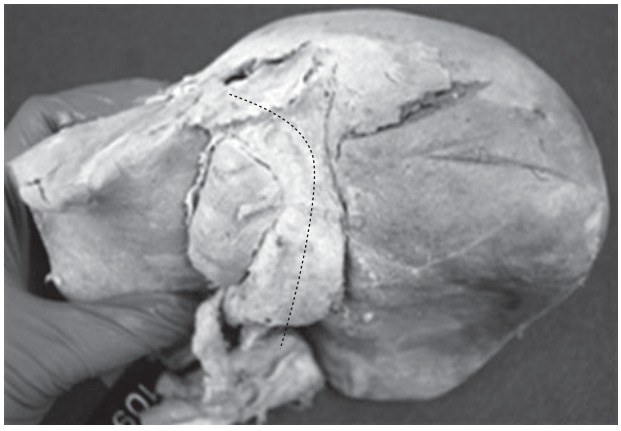

Figure 3. Retrohepatic segment of inferior vena cava oriented curved towards left.

Out of the 206 superior large openings 2 were single (Figures 4 and 5), 90 double (Figure 5) and 8 triple (Figure 6).

The comparison of the types of superior large openings is depicted in Table 3.

Table 1. Comparison of length and orientation of retrohepatic segment of inferior vena cava (RHIVC).

Authors	Year	No. of livers	Mean length of retrohepatic segment of (RHIVC)	Orientation of RHIVC with respect to the liver		
				Vertical	Oblique towards left	Curved towards left
Chang, Shan-Quan and Yen	1989	60	71 mm	5	10	45
Camargo, Teixeira and Ortale	1996	30	67 mm	4	22	4
Mehran, Schneider and Franchebois	2000	30	68 + 10 mm	-	-	-
Sahni, Harheet and Inderjit	2006	500	72.4 + 11.8 mm (males) 70.5 + 9.5 mm (females)	0	332	168
Present study	2009	100	65.6 mm	8	18	74

Table 2. Comparison of total no. of ostia vena hepaticae.

Authors	Year	No. of livers	Total no. of ostia vena hepaticae/no. of openings per liver	No of total large sized openings		No. of total medium sized openings	No. of total small sized openings	No. of total minimum openings
				Superior large	Inferior large			
Chang, Shan-Quan and Yen	1989	60	492/8.2	125	32	99	236	-
Camargo, Teixeira and Ortale	1996	30	442/14.7	52	9	53	20	308
Yu, Lee, Jin et al.	2003	33	537/16.27	88		50	70	329
Sahni, Harheet and Inderjit	2006	500	4000/8	-	-	-	-	-
Present study	2009	100	800/8	206	52	150	392	-

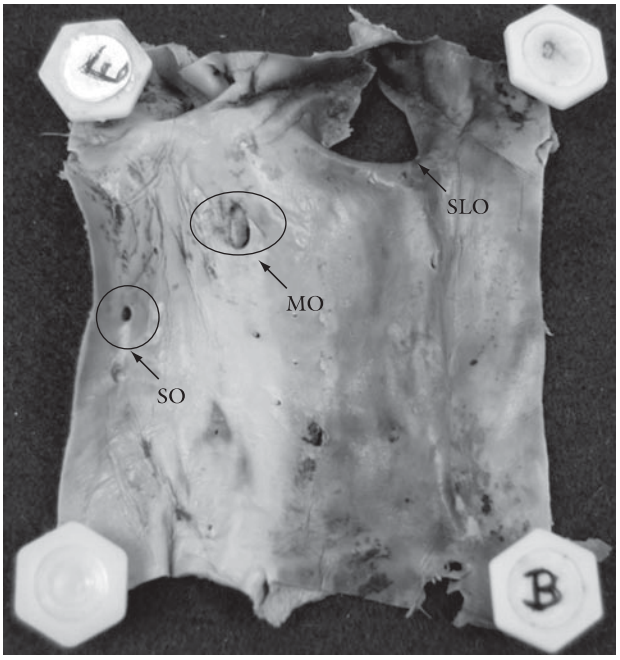

Figure 4. The different sized ostia vena hepaticae. (Abbreviations: SLO - superior large opening, MO - medium sized opening and SO - small sized opening).

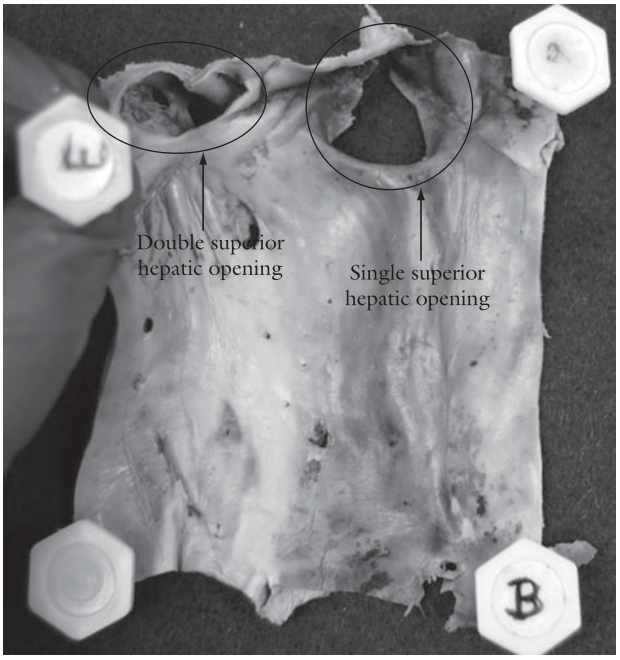

Figure 5. Single and double type opening of superior large ostia vena hepaticae.

The table of four columns and rows drawn on the internal surface of IVC was utilized to calculate the number of hepatic openings in the 16 chambers of IVC. Table 4 depicts the total no. of ostia vena hepaticae found in Northwest Indian population. The corresponding values obtained for the Chinese population (CHANG, SHAN-QUAN and YEN, 1989) are represented in Table 5.

The pattern of highest number of ostia vena hepaticae found in Northwest Indian population(highlighted in Table 4) and Chinese (highlighted in Table 5) was different. Ostia vena hepaticae were found to be highest in the pattern similar to alphabet 'Z' in northwest Indians (Present study, 2009) and 'STEP'-pattern in Chinese population (CHANG, SHAN-QUAN and YEN, 1989).

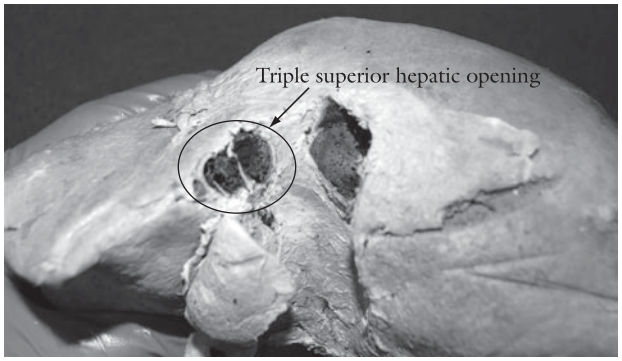

Figure 6. The triple type opening of superior large ostia vena hepaticae.

Table 3. Comparison of types of superior large openings.

Combination types of superior large opening	Chang, Shan-Quan and Yen (1989)	Camargo, Teixeira and Ortale (1996)	Present study (2009)
Single opening	1.7	27	2
Double opening	88.3	16	90
Triple opening	10.0	7	8
Quadruple opening	-	2	-

Table 4. Total number of ostia vena hepaticae in Northwest Indians.

86	92	24	8
10	94	16	10
14	104	22	16
10	98	100	96

Table 5. Total number of ostia vena hepaticae in Chinese population.

2	12	6	9
10	40	19	4
7	61	39	21
3	39	58	37

2% of RHIVC was found to be covered completely by the extension of caudate lobe and in 24% partially by the extension of caudate lobe. For Chinese, Chang, Shan-Quan and Yen (1989) found the percentage of partial extension cases to be as high as 93.33% and complete extension 6.67% cases. Therefore there are few similarities and dissimilarities found in the RHIVC in two different populations.

So, a complete and thorough knowledge of surgical vascular anatomy of liver has become an important and integral component of donor harvesting as well as recipient operations (TARANIKANTI and DHAR, 2003). A prior knowledge of the possible variations and vascular morphogeny typical to populations can avert inadvertent traumas and unforeseen bleeding to a great extent. To conclude, this report re-emphasizes on the vitality of the knowledge of the varied pattern of retrohepatic segment of inferior vena cava, pons hepaticus and ostia venae hepaticae in facilitating an accurate and better designed road map for the surgeon.

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