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Anatomy

ANOMALOUS HEPATIC VEINS: AN ANATOMICAL DESCRIPTION WITH CLINICAL SIGNIFICANCE

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ABSTRACT The current report highlights the accessory hepatic veins draining into the retrohepatic part of inferior vena cava (RHIVC) after traversing significant length of extrahepatic course. We have also tried to endue knowledge of surgically significant tributaries of right hepatic vein (RHV). While performing devisceration of abdominal cavity we encountered a liver harbouring multiple anomalous hepatic veins. Three of them emerged from the posterior surface of liver drained independently into the RHIVC after traversing measurable length of extrahepatic course. Other two variant veins drained into RHV just proximal to its aperture in the wall of inferior vena cava (IVC). The RHIVC was curved towards left and partially covered by caudate lobe. The existence of the anomalous hepatic veins must be acknowledged by hepatobiliary surgeons performing liver surgeries, obtaining living donor graft or split liver graft in order to avoid vascular accidents.

KEYWORDS : Hepatic vein, variation, transplantation

Introduction

Standring (2016) citated the work done by Claude Couinaud in 1957 who first gave the idea of anatomical division of liver and divided liver into eight surgical segments. These segments are independent functional units having their own hepatic artery, portal vein, and bile duct. The hepatic vein is intersegmental in location. These segments are numbered from I to VIII. The veins draining blood from liver parenchyma are categorized into- Superior and Inferior groups. The superior group of veins includes three major hepatic veins- Right, Middle and Left hepatic vein, drain into suprahepatic part of inferior vena cava (IVC). The inferior group of veins are the smaller veins which are variable in number and location, drain into RHIVC. They are refered by Shilal and Tuli (2015) as "Accessory veins". Each major hepatic vein drains more than one hepatic segment. Each hepatic segment is surgically independent unit hence during hepatectomy an individual segment can be removed without damaging other segments (Standring, 2016). The variations among the hepatic veins is commonly encountered and has been reported.

To understand the anatomy of vascular and ductal system of a parenchymatous viscera mentioned in standard textbooks, corrosion cast technique had been a great tool. Researchers like Hossler (1998), Mishra et al (1998), Trotovsek et al (2006) worked on this technique to describe the vascular anatomy of liver in depth. In the present report, tool of study is dissection to describe the segments drained by accessory hepatic veins.

Case Report

During routine medical undergraduate dissection sessions of the abdominal cavity, variant venous drainage pattern of liver was noticed in a 68 years old 10% formalin embalmed Indian male cadaver. The work was performed in Department of Anatomy, Maulana Azad Medical College, New Delhi, India after considering all the ethical guidelines. The aim of this case report is to document multiple accessory hepatic veins with their morphological details. We also noted the length and axis of RHIVC. These findings are vital for surgeons performing hepatic surgeries. All the measurements were taken with vernier calipers with 0.05mm precision, strong inelastic thread and measuring tape.

During evisceration of the liver, we came across two anomalous veins (V_{P1}, V_{p2}), which connected the posterior surface of liver with the IVC in situ (Figure 1). The IVC was excised to extrude the liver from the abdominal cavity. Next, in vitro examination of RHIVC was performed. It was ascertained that, from the posterior surface of liver apart from V_{P1} and V_{P2} a third accessory veins (V_{P3}) emerged from the hepatic parenchyma. V_{P1} and V_{P2} came forth from the inferior part of posterior surface whereas V_{P3} from the superior part of posterior surface {Figure 2(a),2(b)}. These accessory veins (V_{P1}, V_{P2}, V_{P3}) drained independently into the RHIVC. The morphometric analysis of these veins was done which included the length, diameter and distance at which these veins drained into IVC from the RHV (Table1).

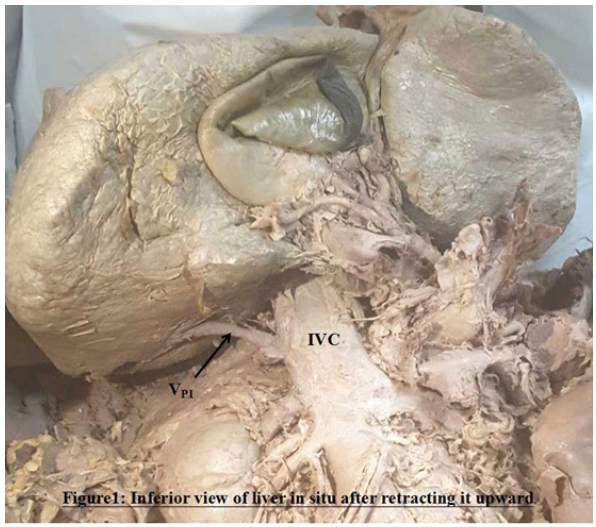

Figure1: Inferior view of liver in situ after retracting it upward

Captions

Figure 1: Showing insitu accessory hepatic vein (V_{P1}) connecting posterior surface of liver with IVC after traversing extra-hepatic course

IVC: Inferior Vena Cava
V_{p1}: Accessory hepatic vein

Accessory vein	Length	Diameter	Distance from hepatocaval junction of right hepatic vein
V_{P1}	5.5cm	6mm*	5.5cm
V_{P2}	2.1cm	5.125mm*	6cm
V_{P3}	1.5cm	3.125mm	2cm
X±SD	3.03±1.76	4.75±1.2	4.5±1.779

* implies clinically significant

Next, the lumen of IVC was inspected for any variant opening. We

observed two veins (middle and left hepatic vein) openings on the left and one large aperture (RHV) on the right side. From the lumen of IVC, openings of two additional veins (V_1, V_2) were seen terminating into RHV, within the distance of 1cm from the hepatocaval junction of RHV, which is surgically important (Nakamura and Tsuzuki, 1981) {Figure2(a),2(b)). The maximum diameter of V_1, V_2 measured to be 3.5mm, 5.125mm respectively.

Table1: Morphometry of accessory hepatic veins (V_{P1},V_{P2},V_{P3})

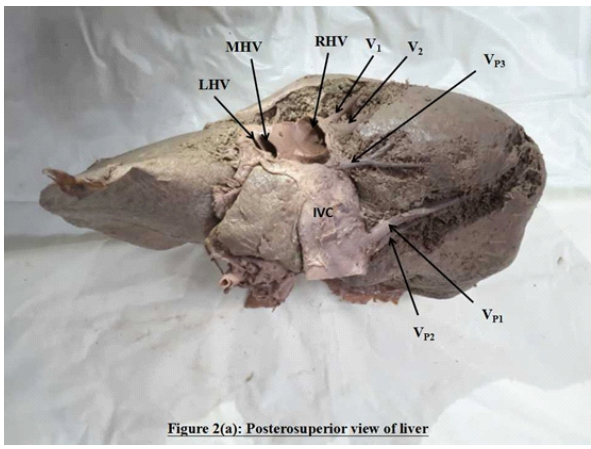

Figure 2(a): Posterosuperior view of liver

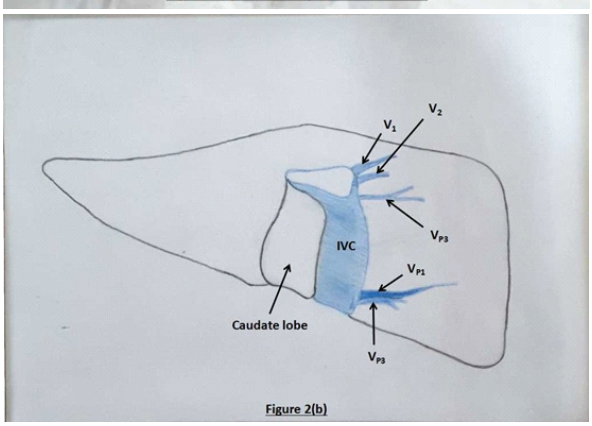

Figure 2(b)

Caption

Figure 2(a), 2(b) showing all three accessory hepatic veins, two tributaries draining into RHV within 1cm of hepatocaval junction of RHV and curved IVC partially covered by caudate lobe

LHV:Left Hepatic Vein
RHV: Right Heapatic Vein
MHV: Middle Hepatic Vein
V_1, V_2: Tributaries of RHV draining within 1cm of it's hepatocaval junction
V_{p1}, V_{P2}, V_{P3}: Accessory hepatic veins

To see the hepatic segments drained by these five anomalous veins, careful piece meal dissection of liver was performed. V_{P1}, V_{P2}, V_{P3} were found to be draining segment VII whereas V_1, V_2 drained the blood from segment VII and VIII. The presence of an additional accessory vein draining a segment directly into IVC is expedient clinically. The RHIVC measured 6.1cm in length and had curved axis with concavity towards left. The IVC was partially covered by caudate lobe of liver.

Discussion

Several morbid hepatic conditions like autoimmune liver disorders, traumatic disorder and far more the primary malignancy in liver are now cured surgically (Shilal and Tuli, 2015). During hepatectomy massive haemorrhage may result due to laceration of undiagnosed variant accessory hepatic veins. Such venous rupture may also lead to air embolism or cardiac arrest (Brasfield, 1972). The accessory veins highlighted in current report traversed significant extrahepatic course, as a result they were prone towards inadverent lacerated tear during hepatic surgery or any procedure involving hepatic manipulation. These accessory veins served an additional passage for venous blood from hepatic segments during blockage of the main hepatic vein. Moreover, the surgeon performing hepatic surgery must be conversant with the existence of accessory hepatic veins, as their preservance would favour the retention of extra hepatic parenchyma (Shilal and Tuli, 2015)

According to Nakamura et al. (1981) during hepatic surgery, vascular pedicle stump length must be atleast 1cm left after hepatic vein ligation to prevent slipping of the ligature. This necessitates preoperative evaluation of the distance between hepatocaval junction and first tributary. In the current case, our result demonstrate the RHV with two tributaries within 1cm of hepatocaval junction. This should warant the surgeon to ligate all such tributaries separately before excising the RHV.

Previously, Xin, Li., Xu Xuesong and Gong Jianping (2016) grouped accessory hepatic veins on the basis of the side they terminated in IVC. The veins draining from right side were called as Inferior right hepatic veins(IRHVs). Previously investigators [2,5,9-10] reported the diameter of IRHV in different ethnic groups as 4.3 ± 0.12mm in Chinese (Hai-quan et al., 2007), 7.0 ± 2.1mm in Europeans (Trotovsek et al., 2006), 6.2 $\pm$ 2.7mm in Koreans (Hwang et al., 2014), 10 ± 1.85mm in Indians (Shilal et al., 2015). Our finding is unique as we have reported IRHV with caliber 4.75 ± 1.2mm smaller than that reported in Indian population.

According to Sugawara et al. (2003) the diameter of hepatic vein must be >5mm for successful venous reconstruction because of technical reasons. Hence out of the five, two veins (V_{P1}, V_{P2}) may have surgical relevance.

The extrahepatic length of IRHV was reported by Hai-quan and team (2007) as 3.3 to 6.7cm. These dimensions facilitate surgeons to excise hepatic tumor with wide margins leaving behind appropriate volume of normal functioning hepatic parenchyma (Hai-quan, 2007). In the present case we have reported extrahepatic length of accessory hepatic veins to be 6mm, 5mm, 3.125mm, 3.5mm and 5.125mm. Our findings are in accordance with the previously reported surgically significant dimensions.

Shilal et al. (2015) studied in Indian population the morphometry of RHV and accessory hepatic veins named after the area drained by them as "right posterosuperior vein", "right anterosuperior vein". They classified RHV into four types on the basis of length of stump (L_S) i.e. distance between hepatocaval confluence of RHV and first tributary draining into RHV. In the current report, we have reported a rare case of Type I(b), TypeII(b), Type IV nailed by Shila et al. According to Shilal et al. (2015) Type Ib (3.32% cases), L_S>1cm, right posterosuperior vein drained into inferior vena cava close to RHV. Type IIb (6.64% cases), L_S <1cm, right anterosuperior vein drained into RHV with 1cm of hepatocaval junction. Type IV (11.66% cases), right posterosuperior vein drains into IVC and right anterosuperior vein into RHV or vice versa

Shilal et al. (2015) described accessory vein as the vein joining IVC inferior to the opening of RHV. Likewise we are reporting three accessory hepatic veins. They observed the distance between IRHV and RHV to be 23-53mm however in present case it is 20mm, 55mm and 60mm, which are at higher side than what was reported earlier in Indian population (Shilal et al., 2015).

The topographic relation of hepatic parenchyma with the IVC is pivotal for radiologist and surgeons planning diagnostic or therapeutic interventions on IVC. The left curvature of RHIVC partially covered by caudate lobe reported in our study correlates with Type IV of Nayak et al. (2016). The procedures like IVC cannulation may get complicated because of the curved RHIVC (Nayak, 2016).

To understand these anomalies of the hepatic veins an embryological correlation is essential. In embryo of 23 somites stage, vitelline veins traverse the septum transversum, splits into sinusoids because of developing hepatic cords. Few of the sinusoids dilate to form hepatic veins which drain the blood from developing liver into right hepatocardiac channel. Unusually dilated sinusoids may explains the occurance of variant hepatic veins detected by researchers from time to time (Hill, 2017).

Therefore in the current case report, the accessory hepatic veins reported may be due to variation from usual developmental sequence.

Conclusion

The existence of accessory veins may act as a boon for the cases with Budd-Chiari Syndrome. Anatomical cognition about the opening of the accessory veins in RHIVC assist the surgeons to locate and treat the site of obstruction of these veins Shankar and Kulkarni, 2014). The comprehensive knowledge about the variant accessory hepatic veins is essential for the radiologist to make correct diagnosis during pre-operative venography and intraoperative ultrasound. The number and pattern of the openings of hepatic veins in IVC play a significant role during shunt surgeries for portal hypertension (Shankar and Kulkarni, 2014).

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