NUMBER AND PATTERN OF HEPATIC AND ACCESSORY HEPATIC VEINS

Anatomy

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ABSTRACT

Introduction: Liver receives dual blood supply from hepatic artery and portal vein. Venous blood from Liver to inferior vena cava is drained by three hepatic veins. The number, pattern and mode of termination of hepatic veins into inferior vena cava is not always same. Variations in number, pattern and positions of the hepatic veins and their mode of termination do exist which significantly influence surgical interventions on liver especially during transplantation.

Materials And Methods: 28 wet formalin preserved specimens were taken for the present study. A longitudinal incision was given in the inferior vena cava to observe the number, pattern and arrangement of hepatic veins openings into inferior vena. The specimens were preserved after routine dissection classes. **Result:** 19 livers of 28 (67.86%) were found to be drained by three major hepatic veins, whereas 9 livers out of 28 (32.14%) presented with accessory hepatic veins in addition to major hepatic veins. The number of accessory veins ranged from 1-3. Out of the nine specimens with accessory hepatic veins seven (77.77%) presented with three plus one pattern (3 major hepatic veins 1 accessory hepatic vein). Three plus two and three plus three pattern was observed in one specimen each (11.11%). The arrangement of three major veins from left to right was left hepatic, middle hepatic and right hepatic. The openings of all accessory veins were found below the openings of major hepatic veins.

Conclusion: A sound knowledge of Accessory hepatic veins and their pattern is essential for Radiologists and also for liver transplant surgeons to reduce postoperative complications.

KEYWORDS

Accessory hepatic vein, Liver transplantation, Major hepatic Veins, Right hepatic Vein

INTRODUCTION

There are two venous systems in liver, the portal and the hepatic veins. The portal veins supply 75 percent of blood loaded with nutrients to liver.

The hepatic veins carry blood from the liver to the inferior vena cava.¹ The tributaries arise within the parenchyma of the liver and have a thin tunica adventitia which binds them to the walls of their canals within the liver. They are a major source of bleeding following open liver injury since they are less able to collapse sufficiently to allow hemostasis to occur. The veins commence as interlobular veins, which drain the sinusoids and lead to sub lobular veins, which eventually unite into hepatic veins. These emerge from the posterior hepatic surface to open directly into the inferior vena cava in its groove on the posterior hepatic surface. Hepatic veins are arranged in upper and lower groups. The upper group are usually large veins and commonly referred to as the right, middle and left hepatic veins. The right hepatic vein drains segments V, VI, VII and VIII. The middle hepatic vein lies between segments IV and VIII and drains both these segments and segment V. The left hepatic vein drains segments II and III with some drainage from segment IV. The lower group vary in number and extent of distribution. They are small veins draining directly into the inferior vena cava from segment I and occasionally from segments VII and VIII. The hepatic veins have no valves. The caudate lobe often has small veins draining directly into the inferior vena cava and therefore may hypertrophy in conditions involving thrombosis of the large hepatic veins, e.g. Budd- Chiari syndrome. The middle hepatic vein (MHV) is often used as landmark in radiological and sonographic studies as it divides the liver into the right and left physiological (true) lobes.

Generally three hepatic veins drain Liver. However, there may be few accessory or minor hepatic veins which are smaller vessels. Thus, the number of hepatic veins is highly variable. These small veins may need recognition and respect in diseases and disorders of liver. The severity of which depends on the number of hepatic veins that are affected. Partial or complete Occlusion of these veins results in diminished blood flow from the liver to inferior vena cava which is a manifestations of portal hypertension²

Hepatic veins constitute a principal link between portal and systemic circulation. Their numerical and positional variations are therefore desirable to be familiar before performing any medical treatments and surgical procedures involving the liver. The present study is aimed to study the number and pattern of hepatic veins opening in inferior vena cava. The observations, results and the data so obtained may prove useful for Gastroenterologists, hepatobiliary surgeons and radiologists.

MATERIALS AND METHODS

The present study was conducted by observing 28 formalin preserved wet specimens of liver. These specimens were taken out of the cadavers during routine dissection classes along with intrahepatic part of inferior vena cava. The specimens were preserved in formalin. A longitudinal incision was given in inferior vena cava to see the total number of openings of hepatic veins in it and also the pattern of these veins that is their arrangement within inferior vena cava was also noted. Hepatic veins with largest lumen diameter measuring greater than or equal to 1.5 cm was taken as major hepatic vein as classified by Camargo *et al* in 1996¹⁵ and those with the lumen diameter of 0.5-1cm were considered as minor hepatic veins. Photographs were taken and labeled as shown in figs:(1-6).

RESULTS

In our present study 28 dissected and formalin preserved livers were used. The aim of this study was to see the number and pattern of hepatic veins opening into inferior vena cava by observing the number of openings. All openings were counted and divided into groups of major and minor or accessory hepatic veins based on their diameter. In nineteen specimens out of 28 (67.86%), there were only three major hepatic veins opening inside inferior vena cava as shown in fig 1 and 2. They were arranged in a queue from left to right. In nine specimens out of 28 (32.14%), we found small openings inferior to the major openings. The number of these openings (accessory hepatic veins) ranged from 1-3. Out of the nine specimens seven (77.77%) presented with three plus one pattern (3 major hepatic veins & 1 accessory hepatic vein) as shown in fig : 3 and 4. Three plus two and three plus three pattern of hepatic veins was noted in one (11.11%) specimen each as shown in fig: 5 and 6 respectively. In all specimens the openings of accessory hepatic veins were found inferior to openings of major hepatic veins as shown on figures: 1-6.

DISCUSSION

Many studies have been done to observe the number and the pattern of hepatic veins but most of them were done on living. In our present study we observed the total number of hepatic veins opening into inferior vena cava after dissecting out liver during routine dissection. Both major and accessory hepatic veins were observed numerically and pattern and arrangement of these inside inferior vena cava was noted. In the following discussion we have compared our observations with the observations made by earlier workers.

A sound knowledge and understanding about number, pattern and mode of termination of hepatic veins into inferior vena cava is imperative for the safe and successful liver surgery involving surgical resection and liver transplantation as well as in the management of hepatic injury following trauma¹. Both resection and transplantation require special attention on veins draining each segment of liver. Maintaining adequate hepatic venous drainage post operatively reduces complications resulting from the venous obstruction that frequently involves delayed hemorrhage, deranged liver function, and also bile leakage.⁴ An adequate maintenance of hepatic venous drainage is also important as there are only few venovenous shunt between hepatic venous systems.⁵ It has been postulated that clinical symptoms and signs in the postoperative period are correlated with the adequacy of hepatic venous drainage⁶.

Fersia and Dawson in their study reported the persistence of hepatic veins ranging from 4 to 15 in number. Among this, about 22.2% each of occurrences was attributed to 7 and 8 hepatic veins which were followed by 11.1% each for having 4 and 6 hepatic veins. In our present study we observed 32.14% livers had accessory hepatic veins. The number of accessory veins ranged from 3-6. The commonest pattern observed was three plus one (three main hepatic veins plus one accessory hepatic vein) seen in 77.77% percent of livers with accessory hepatic veins and three plus two and three plus three pattern was observed in 11.11% percent of livers with accessory hepatic veins.

Thus the number of accessory hepatic veins observed in our study are far less (1-3) than those observed by Fersia and Dawson in their study, however the percentage of accessory hepatic veins with three plus one pattern (11.11%) is same in the both studies.

Orguc *et al.*, in their study found that 47% livers with accessory right inferior hepatic vein among the living liver donors. Among which, 13% were multiple in number. In contrast in our present study we reported lower prevalence (32.14%) of accessory hepatic veins. The studies conducted in the past suggested that presence of accessory hepatic veins may not be contradictory for liver donation, but prior knowledge of such numerical variations helps in altering the surgical management, reducing postoperative complications and improving patient outcome⁷.

Many studies have been done to observe the number and the pattern of hepatic veins but most of them were done on living in contrast to our present cadaveric study.

Chi-Hua *et al.* in their study reported the formation of a common trunk

by middle hepatic vein (MHV) and left hepatic vein (LHV) in 61% of cases, whereas remaining 39% cases had independent venous drainage of all three major hepatic veins. In the same study, 39% cases had remarkably smaller right hepatic vein (RHV) that was compensated by other veins such as a right inferior hepatic vein, an accessory RHV and/or MHV.⁸ In contrast in our study we observed the number and the pattern of hepatic veins opening into inferior vena cava which included main and accessory hepatic veins. Thus observations made in our study are different from those made by earlier workers where we observed the mode and pattern of termination of hepatic veins rather than formation.

An MRI (magnetic resonance imaging) based study reported the presence of 3 hepatic veins in only 20% of individuals with the existence of common trunk for LHV and MHV. Whereas 80% of subjects had nine accessory hepatic veins.⁹ In the present study we are reporting that accessory hepatic veins are present in 32.14% and the number of accessory veins ranged from 1-3. Thus the observations made in our study are totally discordant with the observations made by earlier worker⁹ both in the number and pattern of hepatic veins. It has been observed that the partial occlusion of hepatic veins can be symptomless and might not often lead to severe clinical manifestations either due to portal venous backflow or spontaneous intrahepatic venovenous shunt mechanism.^{6,10} However, complete or near complete occlusion of hepatic veins may be fatal as it could lead to variety of pathological conditions of liver such as veno-occlusive disease, Budd-Chiari syndrome, and congestive hepatomegaly.¹¹ Parenchymatous dissection during hepatectomy and segmental resection of the liver done in malignant cases require the ligation of main hepatic veins ensuring the maintenance of segmental venous drainage.¹²

Accessory hepatic veins are the smaller vessels of the liver, which ensure the effective venous drainage of the liver. Variants of accessory hepatic veins such as accessory right hepatic veins (RHV), significant accessory hepatic veins, accessory suprahepatic veins, and large accessory hepatic veins have also been reported in the literature.¹³ Marcos *et al.*,¹⁴ have reported the presence of minor hepatic veins in 40% of livers; In contrast we found accessory hepatic veins in 32.14% of livers. This variation in the number of accessory hepatic veins reported by earlier workers may be due to genetic and regional variation of different populations. Taranikanti *et al.*,¹³ reported that large accessory hepatic veins are present in 5% of individuals and these veins belong to inferior group. In contrast we reported accessory hepatic veins in 32.14 percent of livers but all of them were of small caliber. It has been documented that importance is also given to the pattern of openings of the hepatic veins in the management of hepatic trauma associated with hepatic vein avulsion and also in resection of the diseased part of the liver to prevent postoperative complications.³ Camargo *et al.* in 1996¹⁵ Classified hepatic veins opening into inferior vena cava based on the luminal diameter. The openings with the diameter of 1.5-2 cm were classified as major hepatic veins whereas the hepatic veins of the lower group with the diameter of 0.5-1.0 cm are classified as accessory hepatic veins.¹⁵ In our study we found openings of hepatic veins arranged in two groups, superior group includes openings of major hepatic veins with diameter ranging from 1.5-2cm and in the inferior group of accessory hepatic veins whose number varies from 1-3. The three plus one pattern was the commonest pattern (77.77%) followed by equal percentage of three plus two and three plus three pattern (11.11%).

Thus our observations are similar to those made by earlier workers¹⁵ as far as pattern and diameter of hepatic veins is concerned.

CONCLUSION

Variations in the number and pattern of the hepatic veins have been reported in many studies. Most of these studies were conducted in living and are MRI based in contrast to our present cadaveric study. One thing is common in all these studies that variations in the number and the pattern of the accessory hepatic veins have been reported in all of them though there are variations in the number and pattern of accessory hepatic veins which may be explained on genetic basis. From all these studies we conclude that accessory hepatic veins are very common and important surgically. A sound knowledge of these veins is very essential to lessen postoperative complications after surgical resection and liver transplantation.

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