

A Study On The Variations Of Structures Passing Through The Porta Hepatis Of Liver

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Abstract

Background: The porta hepatis is a deep transverse fissure on the inferior surface of the liver, between the quadrate lobe anteriorly and the caudate process posteriorly. The major structures traversing in it are the portal vein, the hepatic artery and the hepatic duct. There are a lot of variations in the arrangement of structures passing through porta hepatis. Having knowledge of these variations becomes important to help in the existing knowledge so as to avoid complications during surgical and radiological interventions. The present study was carried out to study the arrangement and number of structures passing through porta hepatis and to report any variation thereof.

Materials and methods: 40 formalin fixed adult cadaveric livers obtained from the Department of Anatomy, JNIMS, Imphal were studied. Porta hepatis was carefully dissected to observe a) arrangement, b) number of structures (artery, vein and duct) and c) the combination of the above structures.

Results: There was consistent arrangement of the structures in porta hepatis with ducts, arteries and veins antero-posteriorly in all the livers studied. The most common finding had the combination of 1 vein, 2 arteries and 1 duct seen in 16 specimens (40%). Maximum number of arteries observed was 4 in 1 specimen (2.5%), vein was 2 in 3 specimens (7.5%) and duct was 2 in 7 specimens (17.5%). Various combinations of structures were observed and the porta hepatis with maximum number of structures passing through had the combination of 2 veins, 3 arteries and 2 ducts seen in 1 specimen (2.5%).

Conclusion: The present study highlights the various combinations of the structures at the porta hepatis and will be therefore useful for the radiologists and surgeons dealing with this region.

Keywords: Liver, porta hepatis, portal vein, hepatic artery, hepatic duct.

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I. Introduction

The liver is the largest of the abdominal viscera, occupying a substantial portion of the upper abdominal cavity. It occupies most of the right hypochondrium and epigastrium and frequently extends into the left hypochondrium as far as the left anterior axillary line. As the liver is involved in majority of the metabolic activities in the body, it is more likely to get affected by various pathological conditions.

The porta hepatis is a deep transverse fissure on the inferior surface of the liver situated between the quadrate lobe anteriorly and the caudate process posteriorly. Although porta hepatis is non-peritoneal, its margins give attachment to lesser omentum. It contains the portal vein, hepatic artery and hepatic nervous plexuses as they ascend into the parenchyma of the liver and the right and left hepatic ducts and some lymph vessels that emerge from the liver.¹

Prevalence of variations of the structures passing through the porta hepatis is high. Having knowledge of these variations becomes important to help in the existing knowledge so as to avoid complications during surgical and radiological interventions.² Thus, considering the significance of anatomical knowledge of this area, the present study was carried out with the aim to study the arrangement and number of structures passing through the porta hepatis and to report any variation thereof.

II. Materials And Methods

40 formalin fixed adult cadaveric livers of unknown age and sex obtained from the department of Anatomy, JNIMS, Imphal, Manipur were studied. Liver specimens with gross anomalies, diseases and surgical resections were excluded from the study. Porta hepatis was carefully dissected to observe a) arrangement, b)

number of structures (artery, vein and duct) and c) the combination of the above structures. Photographs were taken and statistically analysed.

III. Results

There was consistent arrangement of structures in the porta hepatis. The ducts were anterior, arteries in the middle and veins were posterior in porta hepatis of all the livers studied. The number of structures varied from one to four for arteries, where 47.5% of specimens showed two arteries, being most common; one to two for veins where 92.5% of specimens showed only one vein and 7.5% showed 2 veins, and one to two for ducts where 82.5% showed only 1 duct and 17.5% showed 2 ducts. Maximum number of arteries observed was 4 in 2.5% of specimens, vein was 2 in 7.5% and duct was 2 in 17.5% of specimens. Details for the number of structures passing through porta hepatis and frequency of their occurrence are shown in table 1.

Table 1: Number of veins, arteries and ducts passing through the porta hepatis and frequency of their occurrence

Number of structures	No. of veins		No. of arteries				No. of ducts	
	1 vein	2 veins	1 artery	2 arteries	3 arteries	4 arteries	1 duct	2 ducts
Number of specimens	37	3	13	19	7	1	33	7
% of specimen	92.5	7.5	32.5	47.5	17.5	2.5	82.5	17.5

Structures passing through porta hepatis showed high variation in terms of their number and combination. Most common combination of structures was observed to be 1 vein, 2 arteries and 1 duct seen in 16 specimens (40%), followed by the combination of 1 vein, 1 artery and 1 duct seen in 10 specimens (25%) and 1 vein, 3 arteries and 1 duct in 4 specimens (10%). The porta hepatis with maximum number of structures passing through had the combination of 2 veins, 3 arteries and 2 ducts seen in 1 specimen (2.5%). Table 2 showed various combinations of structures passing through porta hepatis and frequency of their occurrence.

Table 2: Various combinations of veins, arteries and ducts passing through the porta hepatis and frequency of their occurrence

Combination	Number of specimens (n=40)	Percentage of specimen (%)
1V 2A 1D	16	40
1V 1A 1D	10	25
1V 3A 1D	4	10
1V 1A 2D	3	7.5
1V 2A 2D	3	7.5
2V 3A 1D	2	5
1V 4A 1D	1	2.5
2V 3A 2D	1	2.5

Abbreviations: V-vein, A-artery, D-duct

Various combinations of veins, arteries and ducts passing through the porta hepatis are shown in the following figures 1-6.



Fig.1: Porta hepatis with 1 vein, 2 arteries and 1 duct (40%)

Fig.2: Porta hepatis with 1 vein, 1 artery and 1 duct (25%)



Fig.3: Porta hepatis with 1 vein, 3 arteries and 1 duct (10%)



Fig.4: Porta hepatis with 1 vein, 1 artery and 2 ducts (7.5%)

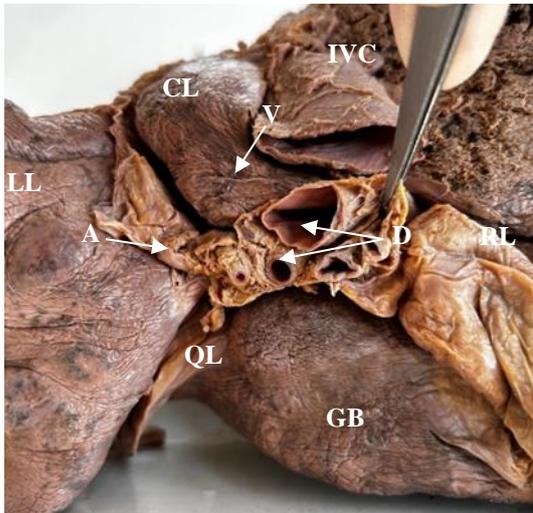


Fig.5: Porta hepatis with 1 vein, 2 arteries and 2 ducts (7.5%)



Fig.6: Porta hepatis with 2 veins, 3 arteries and 1 duct (5%)

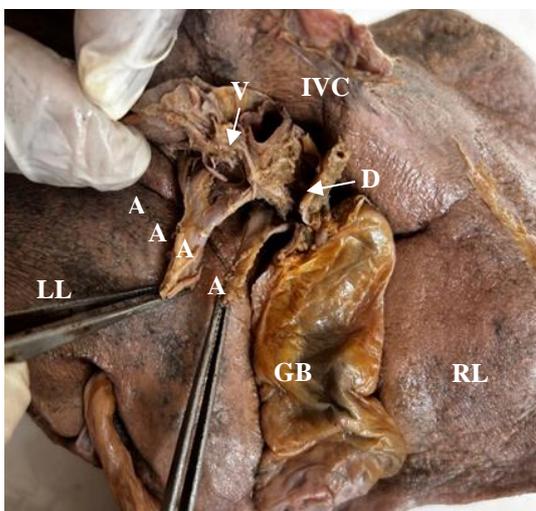


Fig.7: Porta hepatis with 1 vein, 4 arteries and 1 duct (2.5%)

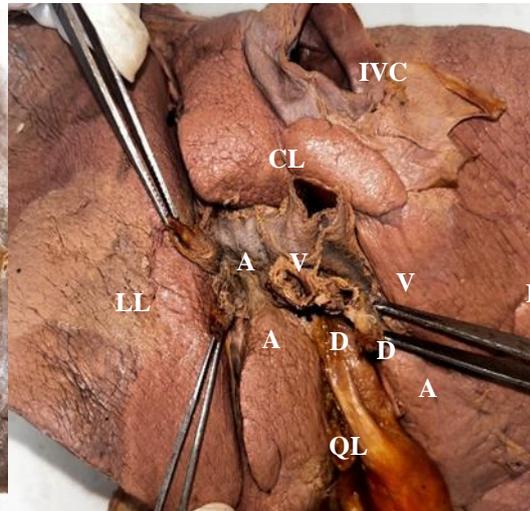


Fig.8: Porta hepatis with 2 veins, 3 arteries and 2 ducts (2.5%)

Abbreviations: LL- left lobe, RL- right lobe, CL- caudate lobe, QL- quadrate lobe, GB- gall bladder, IVC- inferior vena cava, CD- cystic duct, V- vein, A- artery, D- duct.

IV. Discussion

Porta hepatis acts as the gateway of liver through which important structures entry and exit, namely, the portal vein, hepatic artery and hepatic duct. The number and arrangement of structures in the porta hepatis can vary greatly and it is important for surgeons and radiologists to be informed about the variations. Though there are many studies on the variations of biliary system, hepatic artery and portal vein, the studies on the number and arrangement of the structures at the porta hepatis are lacking.

The present study was conducted on forty formalin preserved liver specimens of both sexes to evaluate the gross anatomy of this region and attempted to record the various combinations of ducts and vessels at the porta hepatis.

Table 3: Comparison of observations of the present study with other studies

Observation	Present study	Sapna et al	Gupta et al	Neginhal et al	Saha et al	Ravikaran et al
Number of specimens	40	59	25	50	110	87
Most common combination	1V 2A 1D (40%)	1V 2A 1D (25.4%)	1V 2A 1D (32%)	2V 2A 1D (36%)	1V 2A 2D (23.6%)	1V 2A 1D (34.5%)
Max no. of arteries	4	4	5	5	6	4
Max no. of veins	2	3	3	4	4	3
Max no. of ducts	2	3	3	1	3	3

The number of structures and their arrangement in the porta hepatis with various combinations were observed by different authors. Details of comparison of observations of the present study with other studies are given in table 3. Sapna et al³, Gupta et al⁴ and Ravikaran et al⁷ reported the most common combination of structures to be 1 vein, 2 arteries and 1 duct in 25.4%, 32% and 34.5% of specimens respectively. Whereas, Neginhal et al⁵ found 2 veins, 2 arteries and 1 duct in 36% of specimens; Saha et al⁶ observed 1 vein, 2 arteries and 2 ducts in 23.6% of cases and in the present study, the most common combination was found to be 1 vein, 2 arteries and 1 duct in 40% of specimens.

According to Sapna et al³ and Ravikaran et al⁷, the number of structures passing through porta hepatis varied from one to four for arteries and one to three for both veins and ducts. Gupta et al⁴ found the number of structures to vary from one to five for arteries and one to three for both veins and ducts. Neginhal et al⁵ reported the number to vary from one to five for arteries, one to four for veins and only one duct. According to Saha et al⁶, the number varied from one to six for arteries, one to four for veins and one to three for ducts. However, in the present study, the number varied from one to four for arteries and one to two for both veins and ducts and the porta hepatis with maximum number of structures passing through had the combination of 2 veins, 3 arteries and 2 ducts seen in 2.5% of specimens.

In the present study, the arrangement of the structures in the porta hepatis was found to be consistent. The ducts were anterior, arteries in the middle and veins were posterior in porta hepatis of all the livers studied. Our findings were similar to many authors³⁻⁸. However, in a study conducted by Gaikwad et al on 30 liver specimens, variation was found in 3.3% that the left side hepatic artery was posterior to the portal vein⁹.

Number of arteries found in porta hepatis in the present study was from one to four; two arteries were seen in 47.5% of specimen, three arteries in 17.5% and four arteries were seen in 2.5% of the liver. The branching pattern of hepatic artery and its accessory arteries were mostly reported by many authors¹⁰⁻¹².

In our study, single duct was observed in 82.5% and two ducts in 17.5%. Anatomical and radiological studies had shown the presence of accessory hepatic ducts at different levels of the biliary tree and also observed the absence of right and left hepatic ducts¹³⁻¹⁴. Because of these anatomic variations, it becomes very much important to have knowledge about these hepatic duct variations of accessory hepatic ducts and also about their position.

V. Conclusion

The number and arrangement of structures in the porta hepatis can vary greatly and knowledge of these variants is required by the general practitioners to reduce iatrogenic complications in hepatobiliary surgeries, surgical management of liver trauma, aneurysm of hepatic artery, portal vein embolization, complex hepatectomy, liver transplant surgery and other such surgeries of this complex anatomic region. Hence, the findings in this study will therefore be useful for the anatomists, radiologists and surgeons dealing with this region.

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