Original Research Article

Morphometry of liver and its clinical implications

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Abstract

Background: The liver is the largest abdominal viscera occupying the upper abdominal cavity. The liver has four lobes. Historically, the gross anatomical appearance of the liver has been divided into the right, left, caudate and quadrate lobes by the surface peritoneal and ligamentous attachments. Anomalies in the size and shape of the liver are common but accessory lobes are less common. Abnormalities are usually discovered during routine radiological examination or during surgical intervention. Hence the aim is to reduce intra-operative complications that could arise due to these variations which the operating surgeons should be aware of. **Materials and methods:** The study consisted of 30 formalin fixed cadaveric liver of unknown age and sex selected from the department of anatomy, Bowring and Lady Curzon Medical college, Bangalore **Results:** The mean measurement across the vertical dimension is 6.35 inch and transverse dimension is 8.1 inch. Fissures were seen in the caudate, quadrate, right and left lobe of liver. Accessory lobes were seen in 3(10%) liver specimen. Absence of the lobe were seen in 3 specimens all 3(10%) being the absence quadrate lobe **Conclusion:** Our study is expected to serve as a guide for proper interpretations of liver images using various imaging modalities. It will also be useful to the operating surgeons to be aware of the frequently-occurring morphological variations on the liver surface.

Key Word: Morphometry of liver.

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Email: kavs_084@yahoo.co.in
Received Date: 19/10/2019 Revised Date: 15/11/2019 Accepted Date: 08/12/2019
DOI: https://doi.org/10.26611/10011234

INTRODUCTION

The liver is responsible for a wide range of vital functions including blood detoxification and purification, synthesis of plasma proteins, production of bile, and the metabolism of carbohydrates, fats and proteins. In man, the liver is essential for survival since there is currently no artificial organ or equipment that can compensate for the absence of liver function[1]. Historically, the gross anatomical appearance of the liver has been divided into the right, left, caudate and quadrate lobes by the surface peritoneal and ligamentous attachments. Demarcation of the right and left lobes anteriorly is along the line of attachment of the falciform ligament. Posteriorly, it is along the fissure for ligamentum venosum, and inferiorly, along the fissure for ligamentum teres. The caudate lobe on the posterior surface and the quadrate lobe on the inferior surface lie to the right of these two fissures, separated from each other by the porta hepatis. Towards the left, the caudate and quadrate lobes are bounded by the groove for the inferior vena cava and the gall bladder fossa, respectively. The classification of the liver, depending on the internal architecture, differs from the above description. The most widely-accepted nomenclature is that described by Couinaud (1957) and Healy and Schroy (1953). According to these classifications, an imaginary "principal parasagittal plane" passing through the gall bladder fossa, divides the liver into functional right and left lobes. Segments I, II, III, and IV make up the functional left lobe, and segments V, VI, VII, and VIII make up the functional right lobe. This classification is also accepted by the Federative Committee on Anatomical Terminology[2]. Anomalies in the size and shape of the liver are common but accessory lobes are less common. Abnormalities are usually

How to cite this article: Kavya, Balakrishnan R, Krishna Kishore, Sharmada KL. Morphometry of liver and its clinical implications. *MedPulse – International Journal of Anatomy.* December 2019; 12(3): 72-74. http://www.medpulse.in/Anatomy

discovered during a routine radiological examination or surgical intervention. Improvement in the field of surgical technique success of liver transplantation points towards an increase in liver operations in the future. Procedures like laparoscopic hepatectomy and laparoscopic thermal ablation for patients with primary liver disease and metastatic liver disease have been increasing recently. In any operative procedure involving the liver, a surgeon's knowledge of hepatic anatomy is vital in determining the patient's outcome. The variations in the surface morphology of this organ were observed very frequently during the routine dissections in this department. Hence, this comprehensive study was conducted to observe and note the variations on the external surface of the liver[3].

Embryology: It is believed that the mammalian liver consists essentially of three main lobes that develop about the liver veins. The right lobe with its processuscaudatus and processusspigelii grows along the right omphalomesenteric vein and the left lobe along the left omphalomesenteric vein. The cause of the fissures in the liver has not been fully a possibility of mesodermic septa separating the liver into lobes at an earlier embryonic period[4]. Variations in the liver are common but not clinically significant, accessory hepatic ducts and duplication of gall bladder are also common and usually asymptomatic [5].

MATERIALS AND METHODS

The study consisted of 30 forma line fixed cadaveric liver of unknown age and sex selected from the department of anatomy, Bowring and Lady Curzon Medical College and Research Institute, Bangalore. Morphological features of the liver were studied and discussed under the following parameters. All the measurements are taken in inches using a measuring tape. Vertical and transverse diameters of Right lobe, left lobe, caudate lobe, quadrate lobe of the Liver was taken. Fissure, accessory lobe and external surface of the liver were observed in detail and variations were noted.

The measurements for the right and left lobe were taken as follows: vertical- 1-inch lateral to porta hepatis, Transverse- at the level of porta hepatis

The measurements for the caudate and quadrate lobe were taken as follows: Vertica- at the level of porta hepatis, transverse- ½ inch above and below the porta hepatis respectively.

The measurements for the liver was taken as follows: Vertical-at the level of porta hepatis from the superior to the inferior surface, Transverse- at the level of porta hepatis from the lateral to the medial border.

RESULTS

These were the Measurements in the vertical and transverse (minimum, maximum, average, mean) of each lobe of the liver.

Table 1: Measurements of the right lobe, left lobe, caudate lobe, quadrate lobe, and the whole liver

	Measurements of the right lobe of the liver		Measurement of the left lobe of the liver		Measurement of the caudate lobe of the liver		Measurement of the quadrate lobe of the liver		Measurement of the entire liver	
	vertical	transverse	vertical	transverse	vertical	transverse	vertical	transverse	vertical	transverse
Minimum	4.3	2.6	3.0	2.5	1.0	0.5	1.0	1.0	4.5	6.1
Maximum	7.5	4.8	5.4	4.8	3.8	2.0	3.1	2.7	8.2	10.1
Average	6.15	3,7	4.2	3.65	2.4	1.25	2.05	1.85	6.35	8.1
Mean	5.65	3.59	4.41	3.52	2.75	1.16	2.37	1.35	5.79	7.93

Fissures were seen in the caudate, quadrate, right and left lobe of the liver. Caudate lobe- 11(36.66%), Quadrate lobe- 5(16.66%), right lobe-3(10%), left-2(6.66%). Accessory lobes were seen in 3(10%) liver specimens. The absence of the lobe was seen in 3 specimens all 3(10%) being the absence of quadrate lobe. Accessory bridging was seen in 1(3.33%) liver specimen in the inferior aspect of the quadrate and left lobe. The fossa for inferior vena cava was buried deep inside 3(10%) liver specimen.

DISCUSSION

The time when liver surgery was confined to atypical hepatectomies or wedge resection, according to location or volume of a lesion, belongs to the past. At present, liver resection is based upon the precise knowledge of the natural lines of division of the liver which define the anatomical surgery of liver[6]. In the present study, fissures were observed in 21(70%) specimens of which 36.66% were seen in caudate lobe, 16.66% in quadrate lobe,10% in the right lobe and 6.66% in the left lobe. Accessory lobes were observed in 3 specimens and amounts to 10% Absence of a lobe all being the quadrate lobe amounts to 10% Accessory bridging was seen in 1 specimen and amounts to 3.33% In a study conducted by Shilaja.et.al[7]the prominent vertical grooves were observed on the anterosuperior surface of 24% of the liver, accessory lobes were present in 6% of the liver In a CT study conducted byYong.et.al[8]accessory fissures were observed in 25% of cases and were equally common in men and women. The incidence of occurrence of fissure increased from 13% to 33% in patients aged between 17

to 60 years and 61 to 84 years respectively and in 7 patients aged between 81 to 84 years accessory fissures were noted in 71% of cases. The accessory lobes of the liver are usually small and in the undersurface of the liver[8]. In a case report a 41-year-old male with past history pulmonary tuberculosis, during a routine physical examination an abdominal mass was discovered. A firm mass, 12 cm. in diameter. was palpable in the right upper quadrant. The mass was movable, it could be separated from the liver edge, and it shifted with changes in position, is palpable in the right lower quadrant when the patient sat up. The authorCharls G. Fraser, has presented a case of alarge, movable accessory lobe of the liver which presented itself as an unexplained abdominal mass until exploration uncoveredits true nature[8]. The absence of the hepatic lobe is a rare anomaly of liver development. In a study conducted on 54 cadaveric liver specimen by Aktan.et.al the quadrate lobe anomalies were the highest and accounting to 29.63%[16] the followed by the left lobe 16.66% [9] then by the right lobe 14.81% [8] and the least anomalies were observed in the caudate lobe 11.11%.[6,9]

CONCLUSION

Our study is expected to serve as a guide for proper interpretations of liver images using various imaging modalities. It will also be useful to the operating surgeons to be aware of the frequently-occurring morphological variations on the liver surface.

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Source of Support: None Declared
Conflict of Interest: None Declared