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Original Research Article

MORPHOLOGICAL STUDY OF ADULT HUMAN CADAVERIC LIVER

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ABSTRACT

Background: The liver is the largest of the abdominal viscera, occupying a substantial portion of the upper abdominal cavity. It is essential to have knowledge of the normal and variant liver anatomy.

Objective: Objective of the present study was to study morphology of liver and its variations.

Materials and Methods: The hundred liver specimens available in the department of Anatomy were studied. The liver specimens were numbered and photographs were taken along with proper documentation. Caudate and quadrate lobes of the liver were studied in detail for the size, shape, accessory fissures, and accessory lobes. For each of the parameters, the mean, standard deviation (S.D.) and range (minimum value-maximum value) was calculated.

Result: The mean length of the caudate lobe was 5.33±1.01, breadth 2.75 ±0.65 and depth 1.93±0.55 while length of the quadrate lobe was 5.91±1.18 and breadth 3.00±0.80. The mean length of the right lobe was 13.62±2.23, breadth 8.13±1.45 while length of the left lobe was 12.20±2.12 and breadth 7.65±1.51. Morphological variations like caudate process, accessory fissures, Pons Hepatis, lingual process, papillary process, accessory lobes and variations in shapes of caudate and quadrate lobes were observed and reported.

Conclusion: This study highlights some of the variations in the lobes and fissures of the liver. Various shapes of the caudate lobe and quadrate lobe were encountered. Knowledge of anatomical and morphological variations of liver is important for anatomist as well as for radiologist and hepatobiliary surgeons.

KEY WORDS: Liver, Morphology, Quadrate, Caudate, Variations.

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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, epigastrium, and frequently extends into the left hypochondrium as far as the left lateral line. The liver has been considered to be divided into right, left, caudate and quadrate lobes by the surface peritoneal and ligamental attachments [1]. It is essential to have knowledge of the normal and variant liver anatomy as it is a prerequisite to having a favorable surgical outcome and commonly occurring variations assumes even more significance in the era of diagnostic imaging and minimally invasive surgical approaches. Hepatic

imaging is usually performed to search for primary or metastatic liver diseases [2]. The major fissures are important landmarks for interpreting the lobar anatomy and locating the liver lesions. Variations can have a clinical presentation or indicate an underlying pathological condition. Detailed studies of the macroscopic anatomy of cadaveric livers can still contribute to the identification of important anatomical variations. With this background in mind the present study was carried out on cadaveric liver to study morphology and its variations.

MATERIALS AND METHODS

The study was approved by Institutional Ethical Committee. The 100 liver specimens were obtained from adult human embalmed cadavers during routine dissection in the department of anatomy at a tertiary care teaching hospital. They were preserved in 10% of formalin. Cadaveric liver in good state were utilized for study and those which are damaged were omitted from study. The liver specimens were numbered and photographs were taken along with proper documentation. Caudate and quadrate lobes of the liver were studied in detail for the size, shape, accessory fissures, and accessory lobes. Following measurements were recorded on caudate and quadrate lobe of the liver.

1. Length of caudate lobe
2. Breadth of caudate lobe
3. Depth of caudate lobe
4. Length of quadrate lobe
5. Breadth of quadrate lobe
6. Length of right lobe
7. Breadth of right lobe
8. Length of left lobe
9. Breadth of left lobe

Thread, scale and vernier caliper were used for measurement. Variations, if any, were observed, recorded and photographed.

Statistical analysis: For each of the parameters, the mean, standard deviation (S.D.) and range (minimum value-maximum value) was calculated.

RESULTS

The hundred liver specimens available in the department of Anatomy were studied. The mean length of the caudate lobe was 5.33±1.01, breadth 2.75 ±0.65 and depth 1.93±0.55 while length of the quadrate lobe was 5.91±1.18 and breadth 3.00± 0.80.

Table 1: Measurements of lobes of the liver.

S. No	Measurements	Mean.	S.D	Range
1	Length of Caudate Lobe	5.33	1.01	2.4-8
2	Breadth of Caudate Lobe	2.75	0.65	1-4.7
3	Depth of Caudate Lobe	1.93	0.55	0.7-3.3
4	Length of Quadrate Lobe	5.91	1.18	3.6-9.8
5	Breadth of Quadrate Lobe	3	0.8	1.4-5.2
6	Length of Right Lobe	13.62	2.23	8.5-18.9
7	Breadth of Right Lobe	8.13	1.45	May-16
8	Length of Left Lobe	12.2	2.12	5.5-17.4
9	Breadth of Left Lobe	7.65	1.51	3.4-12.3

The mean length of the right lobe was 13.62±2.23, breadth 8.13±1.45 while length of the left lobe was 12.20±2.12 and breadth 7.65± 1.51. (Table1) Six liver specimens were having right lobe smaller than left lobe and superficial veins on the surface of liver were observed in 15% of specimens.

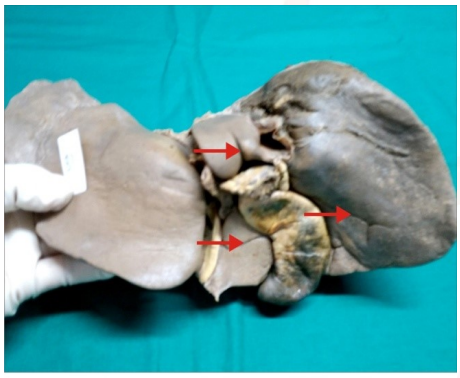
Table 2: Morphological features/ Variations.

S. No	Morphological features	No (%)
1	Caudate process	52(52)
2	Accessory fissure on inferior margin of caudate lobe	20(20)
3	Quadrate lobe- accessory fissure along the middle of fissure for ligamentum teres	34 (34)
4	Accessory Fissure on the liver surface extending from the right margin of porta hepatis into the inferior surface of the right lobe	19 (19)
5	Fissure present along center of quadrate lobe	5(5)
6	Papillary process	5(5)
7	Accessory lobes	5(5)
8	Accessory multiple fissures on right lobe on inferior surface	3(3)
9	Pons Hepatis- Left lobe connected to quadrate lobe	13(13)
10	Lingual process	10(10)
11	Diaphragmatic or costal grooves	2(2)
12	Appendix of liver	1(1)
13	Absent caudate lobe	1(1)
14	Absent quadrate lobe	2(2)

The Morphological features/ variations of liver can be seen in Table 2.These data suggest a high incidence of anatomical variation in the human liver. Caudate process was observed in 52%. Accessory fissure on inferior margin of caudate lobe was seen in 20% and accessory fissure along the middle of fissure for ligamentum teres

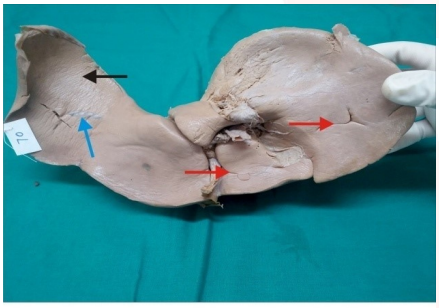
in 34% of quadrate lobe. Accessory Fissure on the liver surface extending from the right margin of porta hepatis into the inferior surface of the right lobe was observed in 19%. [Fig.1-6]. Pons hepatis (PH) was found in 13%. [Fig.4-6] Accessory lobes were present in 5% of specimens. [Fig.6-7] Lingual process was found in 10% [Fig 2 & 8]. Papillary process was present in 5% of specimens [Fig 9]. Other variations noted were appendix of liver in one specimen, an absence of quadrate lobe in 2 and caudate lobe in one liver specimen and diaphragmatic or costal grooves in 2 specimens [Fig 10, 11 and 12].

Fig. 1: Fissures of the liver.



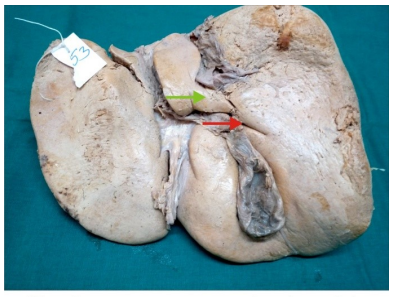
Showing fissure running from inferior surface of caudate lobe & transverse fissure dividing quadrate lobe into superior & inferior quadrate lobe.

Fig. 2: Lingular process of left lobe of liver , notch and fissure on inferior surface



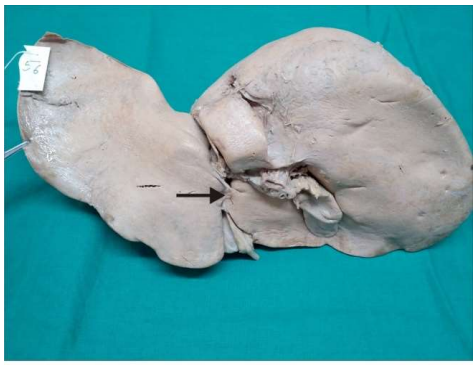
Showing black arrow-lingular process of left lobe with blue arrow- superficial vein & Red arrow-notch extending along fissure for ligamentum teres with fissure on inferior surface of right lobe

Fig. 3: Caudate process and fissure extending from Porta Hepatis.



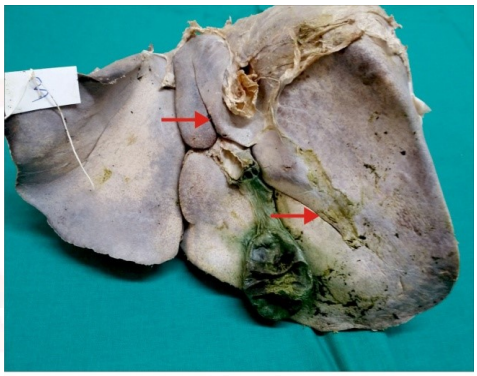
Showing green arrow-prominent caudate process & red arrow-fissure extending from porta hepatis to inferior surface

Fig. 4: Pons Hepatis on upper one third of fissure for ligamentum teres .



Showing black arrow-pons hepatis on the upper one third of fissure for ligamentum teres

Fig. 5: Fissure extending from porta hepatis to inferior surface of liver.

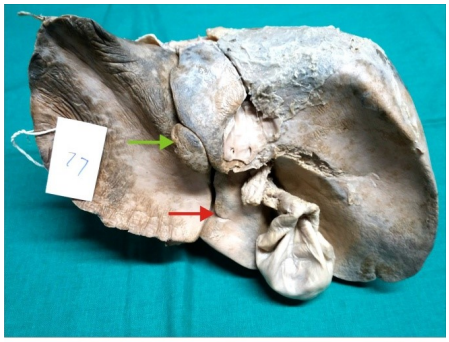


Showing fissure extending from porta hepatis to inferior surface of Liver

Fig. 6: Accessory lobe of caudate lobe and Pons Hepatis.

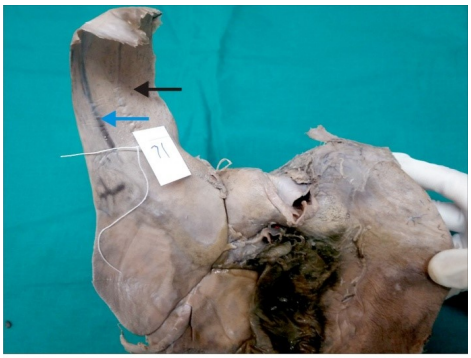
Showing green arrow-Accessory lobe of caudate lobe & black arrow-pons hepatis

Fig. 7: Accessory lobe.



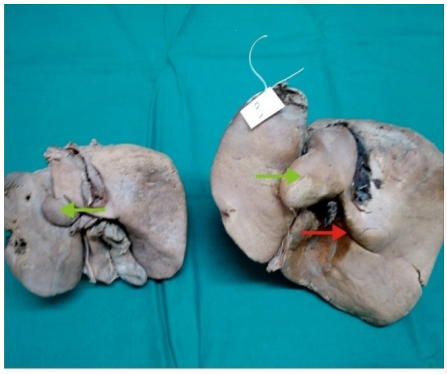
Showing green arrow-seperate accessary lobe from caudate lobe & red arrow-notch on quadrate lobe.

Fig. 8: Lingular process of left lobe of liver.



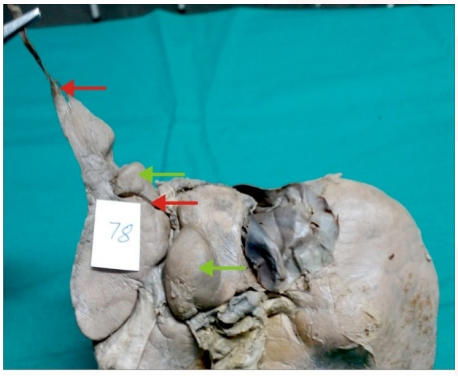
Showing black arrow-lingular process of left lobe of liver & blue arrow-superficial vein

Fig. 9: Papillary process.



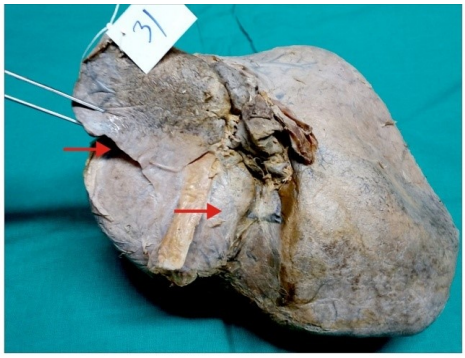
Showing prominent paplliary process

Fig. 10: Appendix of liver and fissure separating accessory lobe at the top of left lobe.



Showing appendix of liver & fissure separting accessory lobe at the top of left lobe

Fig. 11: Absence of quadrate lobe.



Showing absence of quadrate lobe with no fissure for ligamentum teres & is passing superficially on inferior surface & fissure separating left lobe into two

Fig . 12: Costal grooves on the right surface.

Showing costal grooves on the right surface

Table 3: Shapes of the Quadrate and Caudate Lobes of the liver.

S. No	Shape	Quadrate lobe (n=98)	Caudate lobe (n=99)
1	Rectangular	68(68)	74(74)
2	Triangular	16(16)	9(9)
3	Pear shaped	4(4)	5(5)
4	Leaf shaped	1(1)	-
5	Cuboidal	4(4)	3(3)
6	Squared	2(2)	3(3)
7	Elongated	3(3)	5(5)

The shapes of the caudate lobe and quadrate lobe showed wide range of variations. The caudate lobe was rectangular in 68%, triangular in 16%, pear shaped and cuboidal in 4%. The quadrate lobe was rectangular in 74%, triangular in 9%, pear shaped and elongated in 5 % (Table 3).

DISCUSSION

The mean length of the caudate lobe was 5.33±1.01, breadth 2.75 ±0.65 and depth 1.93±0.55 while length of the quadrate lobe was 5.91±1.18 and breadth 3.00± 0.80. Sahni et al reported length 4-7.2 cm and width 1.8-4.1 of caudate lobe.[3] In a study by Reddy et al the average height of caudate lobe was 4.78 cm (Range 2.4-7.8 cm) and the width was 2.54 cm (Range 1.1- 3.2 cm). The average height of the quadrate lobe was 5.48 cm (Range 2.38 - 9.1 cm) and the width was 2.84 cm (Range 1.57-6.3 cm) [4].

In the present study, the caudate process was present between the porta hepatis anteriorly and the fossa for the inferior vena cava posteriorly in 52% of specimens. Sahni et al found that the caudate process was present in 119 (59.5%) specimens [3]. Accessory fissure on inferior

margin of caudate lobe was seen in 20% while accessory fissure along the middle of fissure for ligamentum teres in 34% of quadrate lobe. Joshi et al reported an incidence of 30% [5]. Sunitha et al reported an incidence 15.5% of accessory fissure on quadrate lobe [6]. Auh et al reported that the accessory hepatic fissures are potential sources of diagnostic errors during imaging such as; collection of fluid in these fissures may be mistaken for a liver cyst, intrahepatic haematoma or liver abscess. [7] Accessory fissures can be caused by gastric volvulus, diaphragmatic hernia, portal hypertension, obstructive pulmonary disease, hypertrophic diaphragmatic bundles or rarely by the pressure of adjacent organs and structures (due to the fact that adjacent structures usually leave an impression but not a fissure) [5, 8, 9].They can be markers of hepatic "weak zone" – an area with low vascularization which can be useful during resection[10, 11]. These fissures are also important in today's laparoscopic minimally invasive techniques and segmental resection of liver.

Pons hepatis was found in 13% of specimens. Saritha et al [12] have reported the incidence of pons hepatis in 4% of livers while Patil et al [13] found it in 10% of specimens examined. Joshi et al found a higher incidence (30%) of Pons hepatis [5]. Prominent papillary process was observed in 5(5%) of the livers. Joshi SD et al have reported prominent papillary process in 33% of the livers in their study [5]. In present study, there was an absence of quadrate lobe in 2 and caudate lobe in one liver specimen. Aktan et al observed an absence of the caudate lobe with 7.41% of the 54 livers studied [14]. Ebby et al reported a case of complete absence of quadrate lobe [15].

In present study, the caudate lobe was rectangular in 68%, triangular in 16%, pear shaped and cuboidal in 4%. The quadrate lobe was rectangular in 74%, triangular in 9%, pear shaped and elongated in 5 %. Sahni et al reported that 94.5 of specimens were rectangular, 9(4.5%) pyriform and 2 (1%) irregular[3]. Joshi et al observed that out of 90 specimens studied, 58% were rectangular, 20% bicornuate, and rest 22% caudate lobe had different shapes, i.e. pear-shaped, quadrate, triangular, elongated, heart-shaped, square and inverted pear-shaped. The shape of quadrate lobe was rectangular in 66% and in 6% of the cases, the quadrate lobe was very narrow [5]. Sarla et al (2015) in their study found rectangular shape in 58%, pear shape in 10%, irregular in 20%, and triangular in 8% [16]. Lingular process was observed in 10% of the livers. Ranjana Singh et al reported tongue like projection of left lobe in 9 livers (15%) [17].

CONCLUSION

This study highlights some of the variations in the lobes and fissures of the liver. Occurrence of accessory fissures is very common. Various shapes of the caudate lobe and quadrate lobe were encountered. Knowledge of anatomical and morphological variations of liver is important for anatomist as well as for radiologist and hepatobiliary surgeons.

Conflicts of Interests: None

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