Assessment of Morphological Variations in Human Liver in Tertiary Healthcare Institute: A Cross Sectional Study in Maharashtra

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ABSTRACT

Introduction: Liver is the largest gland of the body. It is situatedunder the right dome of the diaphragm and mainlyoccupies the right hypochondriac and epigastric regions. In man, the liver is essentialfor survival since there is currently no artificial organ orequipment that has the capacity to compensate for theabsence of liver function. Hence knowledge of variation in liver anatomy is required for good surgical outcome, diagnostic imaging and minimally invasive surgical procedures.

Material and Methods: The present study was conducted in 160 human livers from embalmed cadavers in the Department of Anatomy, KIMS, Karad, during the study duration of July 2017 to August 2018. The liver specimens were removed from adult human cadavers during routine dissection for medical undergraduate students and then preserved in 10% of formalin.

Results: We analyzed 160 livers, with its morphological characteristics and structural variations. Mean weight of the liver was reported to be 1.05 Kg (Minimum 0.461 and Maximum 2.137 Kg) with SD of 0.34 Kg. Mean breadth of liver was reported to be 18.44 cm (Maximum 25.5 cm and Minimum 2.4 cm) with SD of 2.45 cm. Mean thickness of liver was reported to be 10.52cm (Maximum 18.3 and Minimum 3.4) with SD of 1.82 cm.

Conclusion: The present study focuses upon the frequent occurrence of morphological variations on the surface of the liver.

Keywords: Human Liver, Anatomy, Morphological Variations, Fissures, Lobes

INTRODUCTION

Liver is the largest gland of the body. It is situatedunder the right dome of the diaphragm and mainlyoccupies the right hypochondriac and epigastric regions.It is divided into anatomical right and left lobes by theline of attachment of falciform ligament, fissure forligamentumvenosum and fissure for ligamentumteres. Ithas caudate and quadrate lobes as the parts of rightanatomical lobe. The hilum of the liver or portahepatis issituated on its visceral surface and it transmits the bloodvessels and nerves of the liver. The fossa for gall bladderis situated on the inferior surface of the right lobe of theliver and the gall bladder is situated in it. The fundus ofthe gall bladder usually projects beyond the inferior borderof the liver.[1] It has caudate and quadrate lobes as the parts of the right anatomical lobe. The fossa for the gall bladder is situated on the inferior surface of right lobe of the liver and gall bladder is situated in it. The fundus of the gall bladder usually projects beyond the inferior border of the liver.[2]

In terms of gross anatomy, the liver may be divided intofour lobes based on surface features. The falciform ligament,which is visible on the anterior side of the liver, dividesthe organ into the left and right anatomical lobes. Twoadditional lobes may be observed on the visceral surface,these being the superior caudate lobe and below this thequadrate lobe. From behind, the lobes are divided by theligamentumvenosum and the ligamentumteres (anythingto the left of these constitutes the left lobe), whilst thetransverse fissure (or portahepatis) separates the caudatefrom the quadrate lobe, and the right sagittal fossa (overwhich runs the inferior vena cava) separates these two lobesfrom the right lobe. Each of the lobes is made up of lobules,veins from the centre of which join the hepatic vein and carryblood out from the liver. Various ducts, veins and arteriesare present on the surface of the lobules that allow theinflow and outflow of fluids. Morphological variations of the liver are common like one or more accessory lobe, liver cyst, atrophy of liver and absence of one of the lobes.[3,4]

The liver is responsible for a wide range of vital functionsincluding blood detoxification and purification, synthesis ofplasma proteins, production of bile, and the metabolism ofcarbohydrates, fats and proteins. In man, the liver is essentialfor survival since there is currently no artificial organ orequipment that has the capacity to compensate for theabsence of liver function. Hence knowledge of variation in liver anatomy is required for good surgical outcome, diagnostic imaging and minimally invasive surgical procedures.[5]

The present study was conducted with the objectives to study the various morphological and structural variations in the anatomy of the liver.

MATERIAL AND METHODS

The study was conducted on **160** cadaveric liversafter

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obtaining the ethical clearance from Research Board of KIMS Karad,during the study duration of July 2017 to August 2018 As number of sample is huge these specimens were obtained from different colleges. Prior permission from higher authorities of our college and other colleges was taken. Names of these colleges are mentioned below

1. Krishna Institute of Medical Science, Deemed To be University Karad.
2. Government Medical College, Miraj.
3. Bharti Vidyapeeth Deemed University And Hospital, Sangli.
4. D.Y.Patil Medical college, Kolhpur.
5. Rajarshi Chhatrapati Shahu Maharaj Government College, Kolhapur.
6. Shrimati Kashibai Navale Medical College And Hospital, Narhe, Pune.
7. Bharti Vidyapeeth Deemed University And Hospital, Pune.

The liver specimens were removed from adult human cadavers during routine dissection for medical undergraduate students and then preserved in 10% of formalin. The lobes of the liver, right lobe, left lobe, caudate lobe and quadrate lobe were studied in detail for their morphological features and classified according to Netter's classification.

Measurements of the liver

1. **Weight of Liver:** It is measured by electronic weighing machine.
2. **Height of the Liver**: It is measured by soft tissue measurement board, by keeping the liver in normal anatomical position. Height is measured from lowermost part of right lobe till highest convexity of superior surface of liver. We have measured the vertical height.
3. **Breadth of Liver**: It is measured from maximum convexity of right lateral surface of right lobe to the lateral most part of left lobe (greatest transverse measurement). Measured the by soft tissue measurement board by keeping the liver in normal anatomical position.
4. **Thickness of the Liver**: Will take it at greatest antero-posterior diameter, it is on the level with upper end of right kidney.

The data was collected with the help of standard, pre-validated case record proforma. The data was entered and descriptive statistics was calculated with the help of Microsoft excel software.

RESULTS

The present study was conducted among 160 cadaveric livers stored in 10% formalin under the department of anatomy, KIMS, Karad over the period of 12 months.

We analyzed 160 livers, with its morphological characteristics and structural variations. Mean weight of the liver was reported to be 1.05 Kg (Minimum 0.461 and Maximum 2.137 Kg) with SD of 0.34 Kg. Mean breadth of liver was reported to be 18.44 cm (Maximum 25.5 cm and Minimum 2.4 cm) with SD of 2.45 cm. Mean thickness of liver was reported to be 10.52cm (Maximum 18.3 and Minimum 3.4) with SD of 1.82 cm. (Table 1)

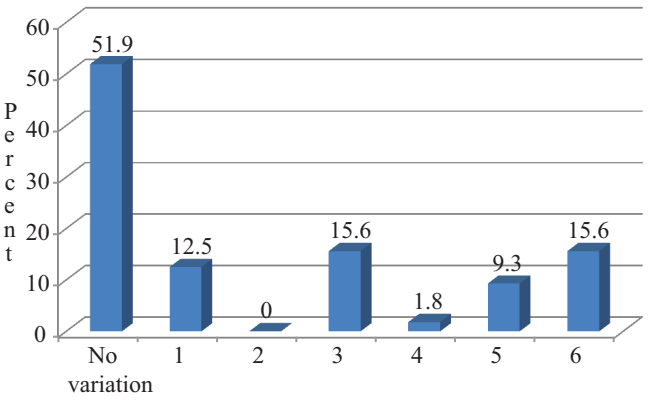

Figure-1: Distribution of variations in liver morphology

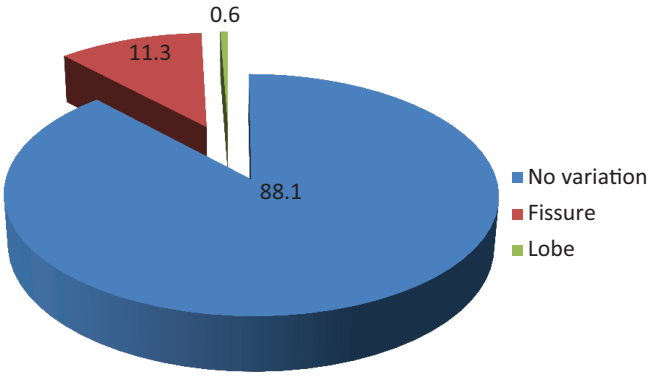

Table-2: Variation on Liver Surfaces

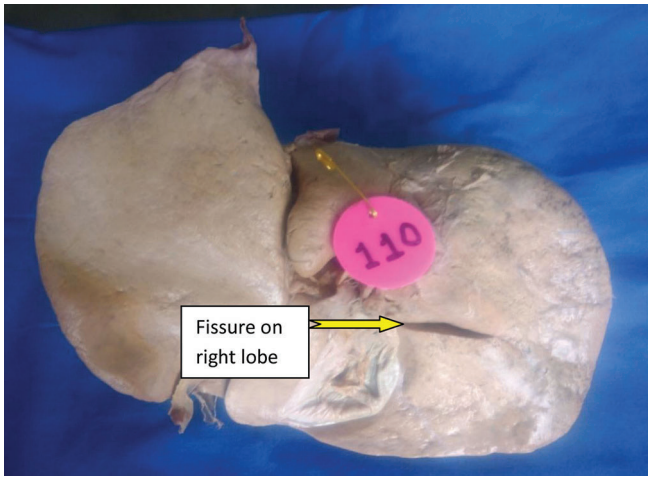

Image-1: Fissure on right lobe

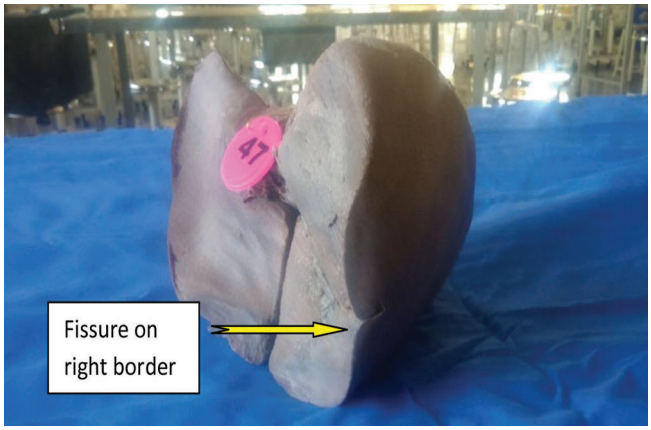

Image-2: Fissure on right border

Netter's Types of Variation	Frequency	Percentage(%)
No variation	83	51.9
1	20	12.5
2	Nil	0
3	25	15.6
4	3	1.8
5	15	9.3
6	25	15.6

Table-1: Distribution of variations in liver morphology

Variation on Liver Surfaces	Frequency	Percentage
No variation	141	88.1
Fissure	18	11.3
Lobe	1	0.6
Total	160	100.0

Table-2: Variation on Liver Surfaces

In the present study, we analysed morphological variations in liver (According to Netter's classification). No variation was seen in 83 liver specimens (51.9%), while 16 liver specimens (10%) showed each of Type 3 and type 6. 13 liver specimens reported (8.1%) type 5 (Netter's) variation. 12 specimens (7.7%) showed Type 1 variations, while 7 cases (4.4%) showed type 1 and 6 variations.(Table 2)

Fissure was the commonest variation observed on the liver surface among 11 (6.8%) liver specimens, followed by Diaphragmatic groove on 3 (1.9%) liver surfaces and Fissure on right post surface on 2 (1.2%) liver surfaces.

Variations like Fissure on left post surface, Fissure on right border (Image 2), Fissure on right lobe (Image 1), Fissure on superior surface, Lobe on left border, Notch on right border were reported on 1 liver specimen for each respectively (Table 2).

Amongst the variations on inferior border of liver: Notch was found to be the commonest variation among 20 (12.5%) liver specimens, followed by Notch on inferior border among 4 (2.5%), Fissure 2 (1.2%) and Lobe 1 (0.6%) (Table 2).

DISCUSSION

The present study was conducted in the department of anatomy, in 160 liver specimens, with the aim of analyzing various structural and morphological variations in liver according to Netter's classification system.

Mean weight of the liver was reported to be 1.05 Kg ± 0.34 Kg. Mean breadth of liver was reported to be 18.44 cm ± 2.45 cm. Mean thickness of liver was reported to be 10.52cm ± 1.82 cm. A similar kind of study was conducted by Nagato, AC et al, they reported that the mean weight ± standard deviation (SD) was 854.7 ± 256.7 g.[6] The70liver specimensstudied by SANGEETA.M et al presented a mean weight of 1.14 + 0.38, meanheight of 129.33+21.73, mean breadth of 174.48+47.90,mean thickness of 80.25 +/- 25.[7]

In the present study, we analysed morphological variations in liver (According to Netter's classification). No variation was seen in 83 liver specimens (51.9%), while 16 liver specimens (10%) showed each of Type 3 and type 6. 13 liver specimens reported (8.1%) type 5 (Netter's) variation. 12 specimens (7.7%) showed Type 1 variations, while 7 cases (4.4%) showed type 1 and 6 variations.

In the study conducted by SANGEETA.M et al among 70 livers, 5 livers showed small leftlobe with deep costal impressions (Netters Type 1 classification),3 livers showed atrophy of left lobe(NettersType 2 classification) 5 livers were transverse saddlelike with relatively large left lobe (Netters Type 3),6 liversshowed tongue like projection of left lobe (NettersType 4). 4 livers showed deep renal impression and corsetconstriction (Netter Type classification)5 livers showed deepdiaphragmatic grooves (Netters Type 6). 25 liversshowed accessory fissures and lobes. 1liver showed biliaryvesicle extending on to diaphragmatic surface. Absentquadrate lobe was observed in 1 case.3 livers showed thepresense of pons hepatis.Appendix of liver was seen in 2cases.No apparent morphological variation was observed in 10 livers.[7]

Fissure was the commonest variation observed in our study on the liver surface among 11 (6.8%) liver specimens, followed by Diaphrgmatic groove on 3 (1.9%) liver surfaces and Fissure on right post surface on 2 (1.2%) liver surfaces.

Variations like Fissure on left post surface, Fissure on right border, Fissure on right lobe, Fissure on superior surface, Lobe on left border, Notch on right border were reported on 1 liver specimen for each respectively. Amongst the variations on inferior border of liver: Notch was found to be the commonest variation among 20 (12.5%) liver specimens, followed by Notch on inferior border among 4 (2.5%), Fissure 2 (1.2%) and Lobe 1 (0.6%)

SHARMILA ARISTOTLE et al, in their study observed that the variations present wereadditional lobes in 3 cases (5%); accessory fissures in 8cases (13.3%); absence of fissure in 1 case (1.6%) andincomplete fissure in 3 cases (5%); short gall bladder in3 cases (5%); elongated left lobe in 2 cases (3.3%); verysmall left lobe in I case (1.6%); prominent caudateprocess in 1 case (1.6%); absence quadrate lobe in 3cases (5%).Additional lobes were observed in 3 cases.[8]

Michael T. Gardner et al, in their study among 69 cadaveric specimens, Six (75%) specimens had 3 or more grooves on the diaphragmaticsurface and most were well-defined deep grooves with a mean length of 4.6 cm and amean depth of 1.8 cmFour cadaveric livers (50%) also had distinctive grooves on the visceral surface.Interestingly, the visceral grooves were all on the right, fewer in number and relativelyconsistent in their location. The distinctive grooves were located on the visceralsurface of segment VI.[9]

Total 80 embalmed human livers were evacuated in this study among which 14 livers (17.5%) were normal in their external appearance. However, 66(82.5%) specimens showed anomalies in fissures, lobes, shape and size of lobe, six types of variations according to Netter's classification. Ten (12.5%) specimens had accessory fissures on the different lobes, which resulted in the formation of accessory lobes. A complete transverse fissure dividing quadrate lobe into a superior and an inferior lobe were seen in 6(7.5%) specimens. A complete transverse fissure dividing caudate lobe into a superior and an inferior lobe were seen in 3(3.7%)

specimens. Variable size and shape of pons hepatis joining the left lobe with quadrate lobe was seen in 1(1.25%) specimen

CONCLUSIONS

The present study focuses upon the frequent occurrence of morphological variations on the surface of the liver. Knowledge of these types of morphological variations in (surgical anatomy) are very important while operating various cases using laparoscopic techniques or thermal ablation of liver mass, for surgeons and gastroenterologists in planning and performing the surgical procedures, for the radiologists to prevent a possible misdiagnosis and for the anatomists to find out new variants and further research.

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