A Study on The Morphological Variations of The Human Liver And Its Clinical Implications

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Abstract: Background & objective: Liver being the largest abdominal organ, the knowledge of its normal and variant morphology is essential for the clinicians. The present study comprises the observations and analysis of the gross morphological variations and anomalies on the surface of the liver with respect to its shape, lobes, fissures and location of the gallbladder. Herein, we review, discuss and compare the literature on this study with our results. Methods: A total of 96 formalin-fixed adult human livers, irrespective of the sex, were studied over a period of four years. These livers were specifically observed for any variant or anomalous surface morphology. Results: The most common type of surface variation was accessory fissures (44.8%), followed by gall bladder fossa/ cystic notch (39.6%), fissure for ligamentum teres (28.1%), and shapes of caudate and quadrate lobes (24.1%). Interpretation & conclusion: Awareness of the anatomical knowledge of the presence of variant or anomalous surface features on the liver can contribute to the understanding of the underlying pathology and thus, helpful to the radiologists and surgeons for a favourable outcome. [Mitesh D NJIRM 2017; 8(5):75-78]

Key Words: Accessory fissures, Anomalous, Liver, Lobes, Morphology, Variant.

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Introduction: The liver is a soft, friable and largest gland in the body, occupying the upper part of the abdominal cavity just beneath the right hemidiaphragm. The greater part of it is situated under cover of the ribs, extending to the left to reach the left hemidiaphragm. It is divided into anatomical right large and left small lobes by the attachment of the peritoneum of the falciform ligament. The right lobe is further divided into quadrate and caudate lobes by the presence of the gallbladder, the fissure for the ligamentum teres, the inferior vena cava, and the fissure for the ligamentum venosum. The fundus of the gallbladder usually projects beyond the inferior border of the liver [1].

The hepatic (liver) bud appears in the middle of the 3rd week of development as an outgrowth of the endodermal epithelium at the caudal end of the foregut. This hepatic diverticulum consists of rapidly proliferating cells that penetrate the septum transversum [2].

A thorough knowledge of both the normal and anomalous or variant surface features of the liver is essential while dealing with a case of an unknown abdominal mass. Hepatic anomalies can be due either to defective development or excessive development of the liver. The latter leads to formation of accessory lobes and fissures on the hepatic surface [3].

For treating patients with primary or metastatic liver diseases, a knowledge of segmental anatomy of liver and its major fissures, is important for both the radiologists and operating surgeons, for correct interpretation of liver images, and planning of appropriate surgeries, for their eventual positive outcome [4].

The aim of the present study was to observe and analyse the type and frequency of the variations in the surface morphology of the human cadaveric livers obtained during routine dissections, and thus, to compare the literature on this study with our results.

Methods: 96 formalin-fixed human cadaveric livers, irrespective of the sex and obtained from routine dissections, were utilised for this observational study, for a period of four years. The livers were apparently normal and those with any pathology or damage were excluded from this study.These livers were specifically observed for the anomalous size and shape of the lobes, presence of accessory fissures/sulci, accessory or atrophied lobes. Any other variations on the surface of the livers were noted, and the specimens photographed. Approval of the institute ethics committee was obtained before the commencement of this study.

Results: Among the 96 livers that were utilised in this study, 53 (55.2%) were normal with respect to surfaces, lobes, fissures, grooves and borders.

However, 43 livers (44.8%) showed variations and anomalies in lobes, fissures, grooves, notch and fossa for the gall bladder. A very interesting observation was that many livers had more than one surface variation or anomaly.

The observations and results of the various morphological features are tabulated as below:

Table: 1 Frequency of the surface variations of livers in the present study

Morphological features	Number of specimens	
	N	%
Accessory fissures	43	44.8
Accessory lobes/ process	7	7.3
Atrophic/ hypoplastic lobes	6	6.3
Anomalous shapes of caudate and quadrate lobes	23	24.1
Absence of lobes	3	3.1
Variant fissure for ligamentum teres	27	28.1
Variant fossa for the gall bladder/ cystic notch	38	39.6
Impressions/ grooves on surfaces	9	9.4

Fig.1 Liver showing RL-Right lobe, LL-Left lobe, PH-Pons Hepatis, AF-Accessory fissure, AL-Accessory lobe

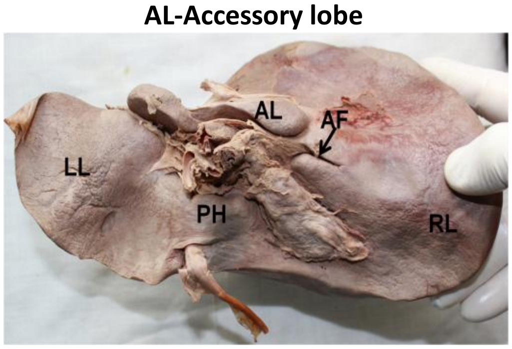


Fig.2 Liver showing CL-Caudate Lobe, QL-Quadrate Lobe, FLT-Fissure for Ligamentum Teres, AF-Accessory fissure, VI-Variant Impression

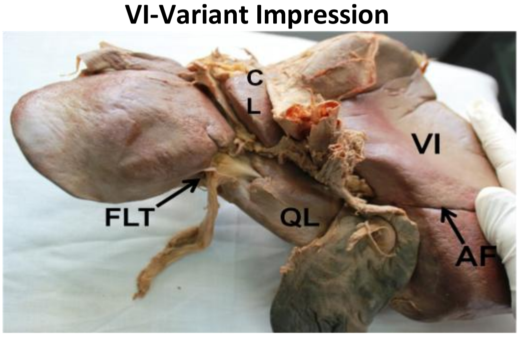


Fig.3 Liver showing LL-Left Lobe, QL-Quadrate Lobe, PH-Pons Hepatis

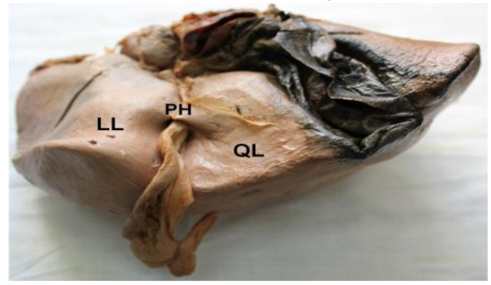


Fig.4 Liver showing QL-Quadrate Lobe, PH-Pons Hepatis, AF-Accessory Fissure

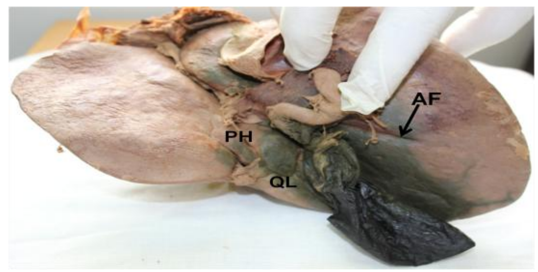


Fig.5 Liver showing CN-Cystic Notch, FLT-Fissure for Ligamentum Teres extending onto anterior surface

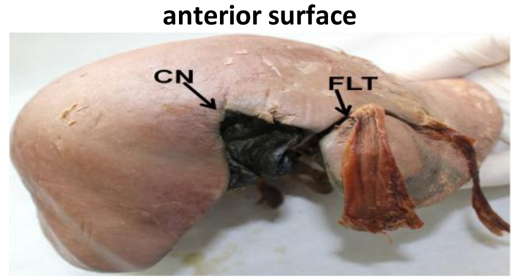


Fig.6 Liver showing AF-Accessory Fissure

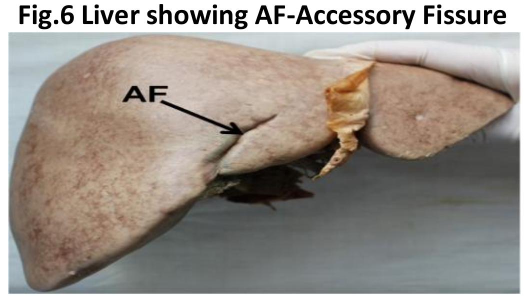


Fig.7 Liver showing LL-Left Lobe, AF-Accessory Fissure, QL-Quadrate Lobe (crescent)

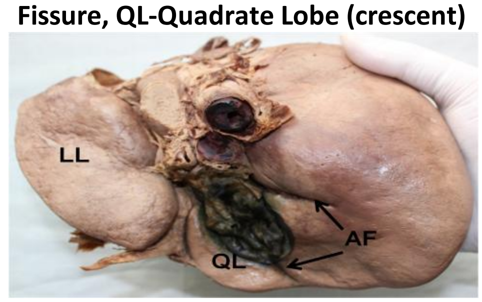


Fig.8 Liver showing CL-Caudate Lobe, QL-Quadrate Lobe, AF-Accessory Fissure, FGB-Fossa for Gall Bladder

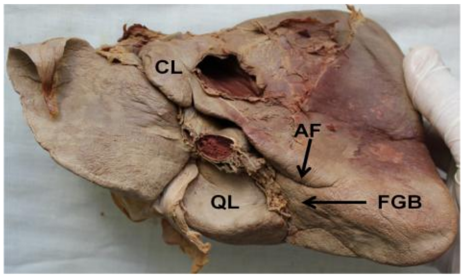
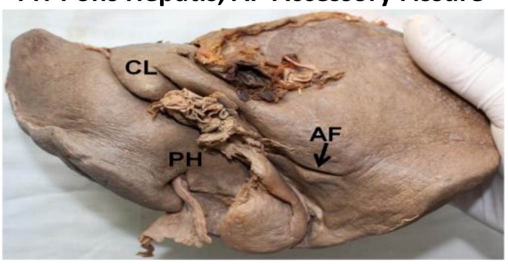


Fig.9 Liver showing CL-Caudate Lobe (bifid), PH-Pons Hepatis, AF-Accessory Fissure



Discussion: The morphological variations in the surface anatomy of the human liver can be classified as congenital or acquired. The congenital anomalies of liver can be divided into anomalies due to defective development and anomalies due to excessive development[5]. Defective development of left lobe of liver can lead to gastric volvulus, whereas defective development of right lobe may remain latent or progress to portal hypertension. The excessive development of liver results in the formation of accessory lobes of liver which may carry the risk of torsion [6].

In the present study, the most common surface variation was accessory fissures (44.8%). This is in contrast to 1.81% in the study observed by Nayak BS [7]. Variations in the fissures are relatively rare. The accessory fissures are the potential source of errors in diagnosis in imaging techniques [8].

According to Patil S et al [9], accessory fissures and lobes accounted for 10%, pons hepatis connecting left and quadrate lobes were 10%, and a complete transverse fissure dividing quadrate lobe into superior and inferior lobes was seen in 4% of specimens studied. Such transverse fissure was not observed in our study. We reported three specimens having fissure for ligamentum teres extending onto anterior surface and one was converted into a tunnel by porta hepatis. Choy KW et al [10] observed that in 10% specimens, the ligamentum teres was embedded in the groove and it was covered by parenchymatous tissue of the liver from the side of the quadrate lobe. Variable shapes of caudate and quadrate lobes were also reported by them and other authors; Joshi SD et al [11] observed notching along the inferior border of caudate lobe in 18% specimens. Deepa G et al [12] observed absence of quadrate lobe in 5%, and in 2.5% the latter not reaching the inferior border; also presence of Reidel's lobe in 2.5%. In our study, various shapes of caudate and quadrate lobes were also observed (24.1%) being wide, elongated, wedge-shaped, crescent-shaped, pear-shaped quadrate lobes. In one specimen, the caudate lobe was bifid, the smaller tissue of the bifid lobe was connected to caudate process; in another specimen the caudate lobe was absent.

Fossae for gall bladder were either deep or shallow with fundus not reaching inferior border; others had wide cystic notch; 7 specimens had gall bladder adherent in its fossa in the present study. Nayak BS reported short gall bladder failing to cross the inferior border of liver in 18.18% cases. The gall bladder may be short or atrophic when there are abnormal peritoneal folds like cystohepatocolic folds present [13]. Short gall bladders which hide in their fossa, may lead to confusions in imaging techniques and also in laparoscopic surgeries in the region.

The incidence of lobe anomalies go unnoticed very often due mainly to asymptomatic nature of these cases. Knowledge of this is helpful for the surgeon in planning biliary surgery or a portosystemic anastomosis [14].

According to Vinnakota S et al [15], hypoplastic left lobe were observed in 3.44% and lingular process of left lobe in 1.72% liver specimens. In the present study, hypoplastic left lobe was seen in 6.3% and deep impressions on surfaces in 9.4% of specimens.

Conclusion: Morphological variations of the liver could be developmental in origin or acquired later in life due to some underlying pathology. A thorough knowledge of both the normal and anomalous or variant surface features of the liver is essential while dealing with a case of an unknown abdominal mass, that would eventually be helpful to radiologists and surgeons for diagnosis and management. This study highlights and compares the frequency of occurrence of such variations and anomalies with the existing anatomical literature.

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