Original Article

MORPHOLOGICAL STUDY OF HUMAN LIVER AND ITS SURGICAL IMPORTANCE

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ABSTRACT

Background: The liver is largest abdominal viscera located in right hypochondrium ,epigastrium and left hypochondrium in upper abdominal cavity. Although the segmental anatomy of the liver has been extensively researched, very few studies have dealt with surface variations of the liver. The major fissures are important landmarks for interpreting the lobar anatomy and locating the liver lesions.

Purpose: The purpose of our study was to determine gross anatomical variations of liver and their clinical and surgical implications.

Methods and Results: Present morphological study was conducted on 50 embalmed human livers in the Department of Anatomy, Maulana Azad Medical College, New Delhi,India. Different variations in lobes, fissures and accessory lobes or fissures were observed. The liver specimens were also classified according to netter's six types of liver variations.

Conclusion: The findings of our study may be helpful for surgeons and radiologist to avoid possible errors in interpretations and subsequent misdiagnosis, and to assist in planning appropriate surgical approaches.

KEYWORDS: Liver, Quadrate, Caudate, Segment, Hepatectomy.

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INTRODUCTION

The liver is wedge shape ,largest 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 lateral line. The liver weighs approximately 5% of the body weight in infancy and it decreases to approximately 2% in adulthood. The size of the liver also varies according to sex, age and body size. The liver is anatomically divided into right, left, caudate and quadrate lobes by the surface peritoneal and ligamentous attachments [1].

Current understanding of the functional anatomy of the liver is based on Couinaud's division of the liver into eight (subsequently nine) functional segments, based upon the distribution of portal venous branches and the location of the hepatic veins in the parenchyma.[1] The major fissures are important landmarks for interpreting the lobar anatomy and locating the liver lesions. With advancement of imaging and minimally-invasive surgeries, it is essential for both the radiologists and operating surgeons to have a thorough knowledge of the anatomy and the commonly-occurring variations of liver. Although the segmental anatomy of the liver has been extensively researched, very few studies have dealt with surface variations of the liver [2].

Defective development of the left lobe of liver can lead to conditions like gastric volvulus while defective development of the right lobe can remain clinically latent or progress to portal hypertension. The anomalies related to excessive development of the liver lead to the formation of accessory lobes of liver which may carry the risk of torsion [3].

The aim of the study was to determine gross anatomical variations of liver and their clinical and surgical implications.

MATERIALS AND METHODS

The study was conducted on 50 embalmed human livers from in the Department of Anatomy, Maulana Azad Medical College, New Delhi, India. 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 was studied in detail for the size, shape, accessory fissures, and accessory lobes and the specimens were photographed. All intact cadaveric liver with no obvious deformity studied. Liver with features of cirrhosis or any damage was excluded.

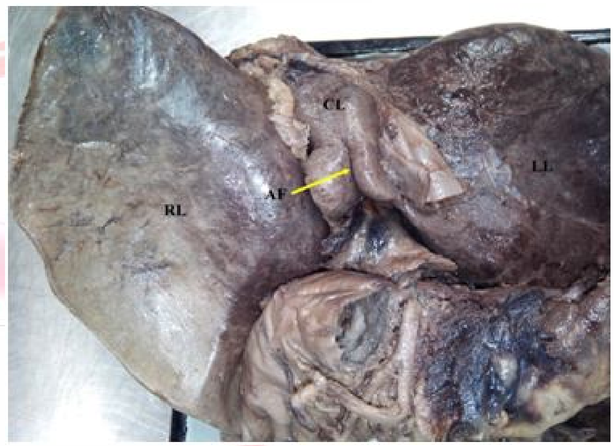
OBSERVATIONS AND RESULTS

Out of the 50 specimens, in present study the normal surfaces, fissures, and borders were observed in 28 livers (56 %) without any accessory fissures or lobes .Out of the remaining 22 specimens, 5 (10%) specimens, even though they appear normal, they had accessory fissures on the different lobes, which resulted in the formation of accessory lobes. (Figure 1 & 2). Pons hepatis of variable size and shape joining the left lobe with quadrate lobe was seen in 5 (10 %) specimens (Figure 3). A complete transverse fissure dividing quadrate lobe into a superior and an inferior lobe (Figure 4) was seen in 2(4%) specimens while a mini accessory lobe above quadrate lobe was seen in 1(2%) specimen (Figure 5). Absence of fissure for ligamentum teres was seen in 2(4%) specimen (Figure 6) (Table 1). The liver specimens were also classified according to six types of liver variations (Figure 7-11) as described by Netter [11]. (Table 2)

Fig. 1: Liver Showing Accessory Fissure On Right Lobe.

AF-accessory fissure

Fig. 2: Liver Showing Accessory Fissure On Caudate Lobe.

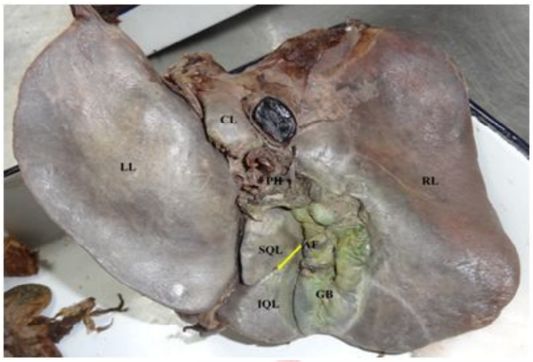


RL-right lobe,LL-left lobe,CL-caudate lobe, AF-accessory fissure

Fig. 3: Liver Showing Pons Hepatis Connecting Left Lobe With Quadrate Lobe.

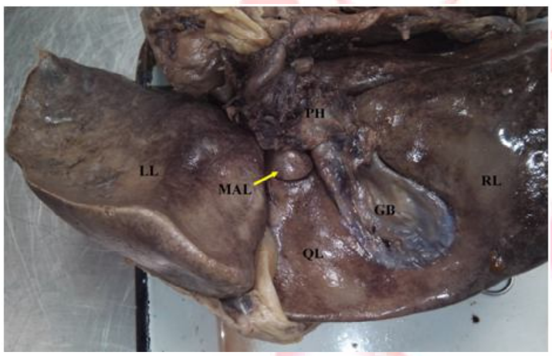
RL-right lobe,LL-left lobe,CL-caudate lobe, QL-quadrate lobe, GB-gall bladder, PoH-pons hepatis

Fig. 4: Liver Showing Acessory fissure with Superior And Inferior Quadrate Lobe.



RL-right lobe,LL-left lobe,CL-caudate lobe, SQL-superior quadrate lobe, IQL- inferior quadrate lobe ,GB-gall bladder, PH-porta hepatis, AF-accessory fissure.

Fig. 5: Liver showing Mini Acessory Lobe.

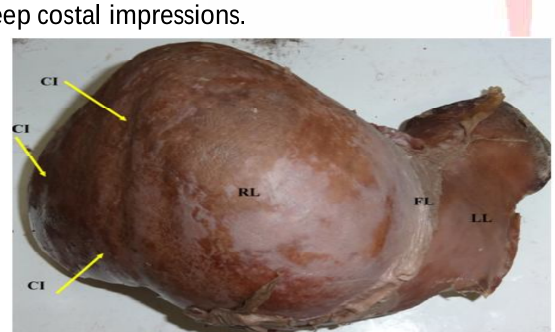


RL-right lobe, LL-left lobe, QL-quadate lobe, MAL-mini accessory lobe, GB-gall bladder,PH- porta hepatis.

Fig. 6: Liver showing absence of fissure for ligamentum teres.

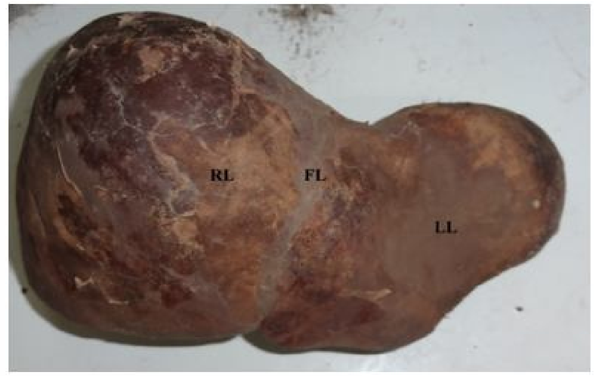
Arrow Pointing To Absence Of Fissure For Ligamentum Teres

Fig. 7: Netter's Type 1 showing very small left lobe with deep costal impressions.



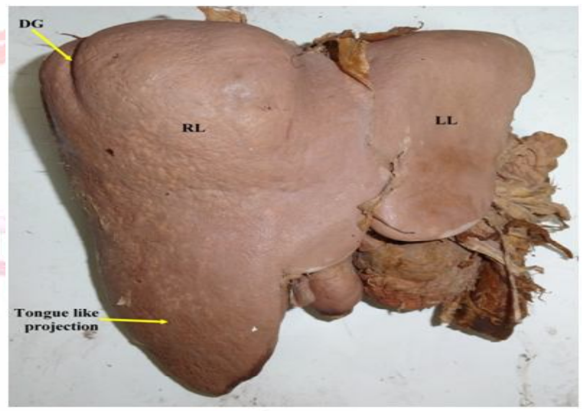
RL-right lobe,FL-falciform ligament,LL-left lobe,CI-costal impression.

Fig. 8: Netter's Type 3 liver -Transverse saddle like liver with relatively large left lobe.



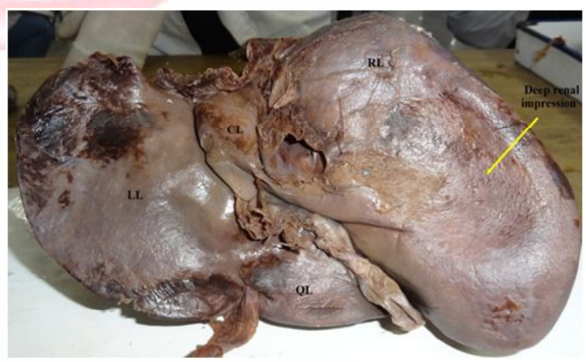
RL-right lobe,FL-falciform ligament,LL-left lobe

Fig. 9: Netter's Type 4 liver showing tongue like process of right lobe.



DG-diaphragmatic groove-, RL-right lobe,LL-left lobe

Fig. 10: Netter's Type 5 liver showing very deep renal impression and corset constriction.



RL-right lobe,LL-left lobe,CL-caudate lobe, QL-quadrate lobe

Fig. 11: Netter's Type 6 liver showing diaphragmatic grooves.

Arrow Pointing to diaphragmatic grooves

Table 1: Different morphological variations of liver.

Morphological features	Number of specimens
Normal	28 (56 %)
Accessory Fissures And Lobes	5 (10%)
Pons Hepatis Connecting Left Lobe With Quadrate Lobe	5 (10 %)
Superior And Inferior Quadrate Lobe	2(4%)

Table 2: Classification of liver according to Netter's [11].

Netter type	Number of specimens
Type 1 (Very small left lobe , deep costal impressions)	1(2%)
Type 2 (Complete atrophy of left lobe)	-
Type 3 (Transverse saddle like liver, relatively large left lobe)	5(10%)
Type 4 (Tongue like process of right lobe)	1(2%)
Type 5 (Very deep renal impression and corset constriction)	1(2%)
Type 6 (Diaphragmatic grooves)	1(2%)

DISCUSSION

The congenital malformations of the liver include agenesis of the lobes, absence of segments, deformed lobes, smaller lobes, atrophy of the lobes and hypoplastic lobes. The anomalies of liver can be either due to anomalies due to defective development or those due to excessive development. These anomalies are sometimes associated with malformations of other organs like diaphragm and suspensory apparatus of the liver [3].

The lobar and segmental anomalies are rarest of all malformations. The embryological basis of the anomalies of liver morphology occurring in the course of organogenesis remains to be elucidated [4]. It has recently been reported that some apparent morphological changes detected during advanced imaging examinations may actually be pseudolesions resulting from perfusion defects, focal fatty infiltrations and other causes, and may not represent true parenchymatous lesions [5].

The diaphragmatic sulci result from uneven growth of the hepatic parenchyma caused by variable resistance offered by different bundles of the diaphragm muscle. But more recently, radiological and corrosion cast studies have attributed the formation of sulci to the existence of weak zones of hepatic parenchyma, represented by the portal fissures between the adjacent sagittal portal territories. These weak zones offer a lower resistance to external pressure of the diaphragm. Macchi et al suggested that the diaphragmatic sulci could represent a useful landmark for surface projection of the portal fissures and of the hepatic veins and their tributaries running through them [6].

The mini accessory lobe which is being reported here is surgically and radiologically very important due to its small size. Due to the small size, it might be mistaken for a lymph node. It might be accidentally removed during the surgeries in and around the porta hepatis. A damage to the lobe or its vascular pedicle might result in bleeding into the abdominal cavity. Accessory lobes need attention when there is torsion of the vascular pedicle or metastasis occurring in them. Torsion of the accessory lobes is a surgical emergency and it has to be attended to early [7,8]. An accessory lobe could be formed by the displacement of the primitive rudiment of the organ, or by persistence of the mesodermal septa during its proliferation [9]. Its presence occurs due to an error in the formation of the endodermal caudal foregut and segmentation of the hepatic bud in the third month of the intrauterine life [7].

In the present study, accessory fissures were seen on right lobe, quadrate lobe and caudate lobe According to Auh et al. the accessory hepatic fissures are potential sources of diagnostic errors during imaging. Any collection of fluid in these fissures may be mistaken for a liver cyst, intrahepatic haematoma or liver abscess. Implantation of peritoneally-disseminated tumour cells into these spaces may mimic intrahepatic focal lesions. Mazziotti et al advocated the use of intraoperative ultrasonography in liver surgery to determine the anatomical location and the extent of the lesion, thereby minimising unnecessary tissue dissections and traumatic surgical manoeuvres. Knowledge of such possible variations is important during radiological investigation and surgery [10].

The different morphology of all lobes was noted in our study, and the presence of the pons hepatis bridging the fissure for ligamentum teres are very important findings which was reported in previous study by Joshi et al. In cases of the pons hepatis bridging the fissure for ligamentum teres, normal visualisation of the fissure would not be possible and dimensions of the right and the left lobes may be mistaken [2]. It has been observed that on computed tomography, a normal-sized or small papillary process may be mistaken for enlarged porta hepatis nodes [10].

CONCLUSION

With advances in liver surgery like laparoscopic hepatectomy and laparoscopic thermal ablation for patients with hepatic tumour ,these variations assume more importance . In conclusion, this study highlights the frequent occurrence of morphological variations on the liver surface. The findings of our study may be helpful for surgeons and radiologist to avoid possible errors in interpretations and subsequent misdiagnosis, and to assist in planning appropriate surgical approaches.

Conflicts of Interests: None

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