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A Study of The Morphometry of The Liver

KEYWORDS: liver, lobes, fissures, impressions

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ABSTRACT *Anomalies of the hepatic morphology are often overlooked. Nevertheless knowledge of these anomalies is important since all may not remain clinically latent. Excessive development of liver may lead to the formation of accessory lobes. These may mimic tumors' also. Atrophy of left lobe can lead to gastric volvolus and right lobe atrophy can lead to portal hypertension. This study was carried out in 70 formalin fixed livers to note the dimensions shape, presense of accessory lobes and fissures, impressions etc. .This study may be useful for surgeons and radiologists in interpreting the images better to prevent subsequent misdiagnosis.*

INTRODUCTION

Liver is the largest of the abdominal viscera occupying a substantial portion of the abdominal cavity. The size of the liver varies according to sex , age and body size.On an average it weighs 2% of the body weight. It has an overall wedge shape which is in part determined by the form of the abdominal cavity into which it grows. The superior and lateral aspects are shaped by the anterolateral abdominal and chest wall as well as diaphragm , inferior aspect being shaped by adjacent viscera. The organ typically measures 21-22.5 cm across its widest point, 1012.5 cm from front to back, and 15-17.5 cm at its maximum vertical height (1).

Detailed studies of the macroscopic anatomy of cadaveric livers can still contribute to the identification of important anatomical variations. In many cases, such variations have enabled researchers to understand specific responses to therapies that have been applied in the treatment of liver disease.Historically the liver has been considered to be divided into right , left, caudate and quadrate lobes by the surface peritoneal and ligamentous attachments.

Variations in the liver morphology can be congenital or acquired.Congenital changes in the organ are characterized by the following aspects: a) lobes separated by glands (considered to be a congenital variation by some anatomists); b) atrophy at some locations in the parenchyma; c) presence of only one lobe; d) presence of multiple lobes, typically involving numerous divisions (up to 16) of the right lobe; e) small lobes; f) peduncular lobes; g) lobes without division; and h) accessory lobes. Acquired changes in liver morphology are represented by the following characteristic features: i) linguiform lobes, ii) costal organ with very small left lobe, iii) deep renal impressions and "corset" type constriction, and iv) local inflammation of the organ or gallbladder (1).

AIM:

The aim of the study was to study the morhometry of the livers and their frequency of occurrence .

MATERIAL AND METHODS:

70 formalin fixed livers were used as the study material. The shape ,dimensions (Height, Breadth, Thickness) and weight of all the livers wererecorded with sliding calipers and digital weighing scale respectively.Height (measured from the bottom of the right hepatic lobe), transverse diameter (extending from the right side edge of the right hepatic lobe to the tip of the left lateral lobe) and thickness (from the front of the right hepatic lobe to the rear of the same lobe) were taken. All these measurements were taken by two observers independently to minimize interobserverbias.The shape of the liver was noted. All the livers were held in the anatomical position and noted for presence of accessory fissures, lobes, accessory processes, atrophy of lobes ,impressions grooves, presence of biliary vesicle extending on to diaphragmatic surface etc.

RESULTS:

Of the 70 livers studied, 5 livers showed small left lobe with deep costal impressions (Netters Type 1 classification),3 livers showed atrophy of left lobe(Netters Type 2 classification) 5 livers were transverse saddle like with relatively large left lobe (Netters Type 3),6 livers showed tongue like projection of left lobe (Netters Type 4).4 livers showed deep renal impression and corset constriction(Netter Type classification)5 livers showed deep diaphragmatic grooves (Netters Type 6).(Table 2). 25 livers showed accessory fissures and lobes. 1liver showed biliary vesicle extending on to diaphragmatic surface. Absent quadrate lobe was observed in 1 case.3 livers showed the presense of pons hepatis .Appendix of liver was seen in 2 cases.No apparent morphological variation was observed in 10 livers.(Table1) and(Fig A-H). The70liver specimens studied presented a mean weight of 1.14 + .38, mean height of 129.33+21.73, mean breadth of 174.48+47.90, mean thickness of 80.25 +/- 25.

TABLE1:MORPHOLOGICAL VARIATIONS OF THE LIVER OTHER THAN INCLUDED IN NETTERS CLASSIFICATION

MORPHOLOGICAL FEATURES	NO OF SPECEIMENS
Normal Liver	10 (14.2%)
Accssory lobes and fissures	25(3.5%)
Presense of Biliary vesicle	1(1%)
Presense of pons hepatis	3(4%)
Absent quadrate lobe	1(1%)
Appendix of liver	2(2%)

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TABLE 2:MORPHOLOGY OF LIVER ACCORDING TO NETTERS CLASSIFICATION

NETTERS TYPE	NUMBER
Type 1	5(7%)
Type 2	3(4%)
Type 3	5(1%)
Type 4	6 (9%)
Type 5	4 (6%)
Type 6	5(7%)

DISCUSSION:

The knowledge of the commonly occuring lobar variations is of more significance in the diagnostic imaging and minimally invasive surgical approaches. 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(2). Lobar variations are most often found in the females mostly involving the right lobe(3) .Our study also showed similar findings. Most of the accessory lobes and fissures were observed in the right anatomical lobe. Accessory lobes are composed of normal hepatic tissue, containing their own hepatic blood vessels and bile ducts which are connected to the rest of the liver (4). 25 livers in our study showed accessory fissures and lobes in various locations on the liver. Accessory lobes need attention when there is torsion of the vascular pedicle or metastasis occurring in them (8,9). 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 [10]. 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 our study accessory fissures were seen on right lobe, caudate lobe, quadrate lobe. The accessory hepatic fissures are potential sources of diagnostic errors during imaging. Any collectionof fluid in these fissures may be mistaken for a liver cyst, intrahepatic hematoma or liver abscess. Implantation of peritoneally disseminated tumor cells into these spaces may mimic intrahepatic focal lesions (11). 5 livers in our study showed relatively large left lobe. Left lobe anomaly may occur postoperatively after splenectomy wherein the left lobe may migrate into the splenic bed depending on many factors including liver pliability, obesity, age of the patient or the previous existence of splenomegaly and its duration.(5). Elongated left lobe may be misdiagnosed as distension of the hepatic flexure of the colon, gastrooptosis, hydatid cyst or sarcoma of liver (3). These morphological anomalies are sometimes associated with malformations of other organs like diaphragm and suspensory apparatus of the liver. 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 parenchymatouslesions . We also encountered 2 such livers in our study. 5 livers showed deep diaphragmatic impressions. 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) Pons hepatic bridging the groove for Inferior vena cava was noted in one of the 70 livers studied. This finding was noted with increased frequency by Joshi et al in which he reported the pons hepatis bridging the fissure for ligamentumteres. Absent quadrate lobe was visualized in one liver which in all probabilities could be congenital.

TABLE 3: COMPARISON OF DIFFERENT STUDIES ON MORPHOLOGICAL VARIATIONS OF LIVER

AUTHORS	NAGATO ET AL	SACHIN ET AL	OUR STUDY
SAMPLE SIZE	61	50	70
NETTERS TYPE 1	8.19%	2%	7%
NETTERS TYPE 2	1.64%	NOT OBSERVED	3%
NETTERS TYPE 3	6.56%	10%	7.1%
NETTERS TYPE 4	21.31%	2%	9%
NETTERS TYPE 5	9.84%	2%	6%
NETTERS TYPE 6	6.56%	2%	9%

The findings in our study correlate to some extent with the study by Nagato et al but in their study the frequency of tongue like projection of left lobe was high. (Table 3).

CONCLUSION:

This study has been done 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 of liver and for the students to create awareness of the various morphological variations and the interpretations of the same.

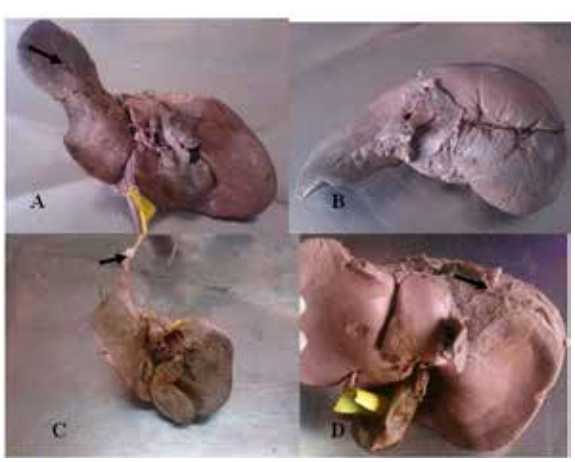

FIGURE A : ARROW SHOWING LINGULAR PROCESS.
FIGURE B :MULTIPLE FISSSURES AND LOBES ON THE ANTERO SUPERIOR SURFACE OF LIVER.
FIGURE C: ARROWS SHOWING APPENDIX OF LIVER AND QUADRATE LOBE DIVIDED INTO TWO BY A COMPLETE FISSURE .
FIGURE D :ARROW SHOWING PONS HEPATIS

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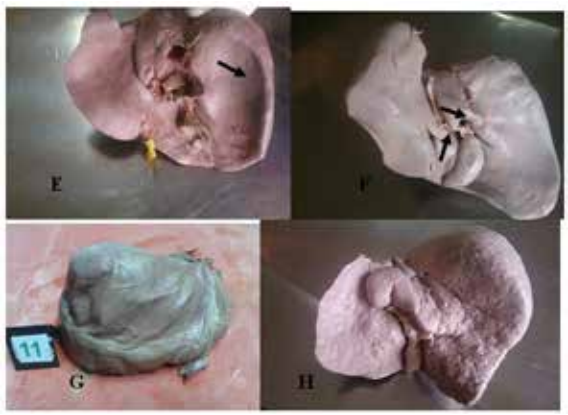

FIGURE E: ARROW SHOWING DEEP RENAL IMPRESSION.
FIGURE F: ARROWS SHOWING ACCESSORY LOBES.
FIGURE G: : LIVER SHOWING DEEP COSTAL IMPRESSION.
FIGURE H: : LIVER SHOWING THE ABSENCE OF QUADRATE LOBE.

FIGURE I: DEEP DIAPHRAGMATIC IMPRESSION SHOWING GROWTH ON THE SURFACE OF LIVER.
FIGURE J: PROMINENT OVAL IMPRESSION ON THE SUPERIOR SURFACE OF LIVER,NOTE THE SHAPE OF LIVER (TRANSVERSLY OVAL).
FIGURE K: ARROW SHOWING SMALL LEFT LOBE.
FIGURE L: GALL BLADDER PROJECTING ON THE DIAPHRAGMATIC SURFACE OF LIVER

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