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Original Research Article

Morphological Variations of Liver

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ABSTRACT

Introduction
Morphological variations of liver are relatively rare. Although the segmental anatomy of the liver has been extensively researched, very few studies have dealt with surface variations of the liver. Current study deals with some morphological variations of liver and their probable cause.
Materials and Methods
All livers were taken from embalmed cadavers used for routine dissection. Among 80 cadavers dissected during six years (from 2008 - 2014 batches) were observed for any morphological variations in liver and their Photographs were taken.
Results
Out of 80 livers studied; Sulci on the anterior surface were present in 20 (25%); Abnormalities of Caudate lobe were present in 24 (30%); abnormalities of Quadrate lobe were present in 10 (12.5%); Extra lobes (Riedel's lobe) were present in 2 (2.5%); left lobe abnormalities were present in 10 (12.5%).
Conclusion
Morphological variations of liver could be developmental in origin or due to some pathology developed during lifetime of a person.

Key words: **-** Sulci, Caudate lobe, Quadrate lobe, Riedels lobe, Left lobe.

INTRODUCTION

The liver is the largest abdominal viscera, occupying right hypochondriac, epigastric and small part of left hypochondriac region of the upper abdominal cavity. The liver has four lobes; gross anatomical appearance of the liver has been divided into the right, left, caudate and quadrate lobes by the surface peritoneal and ligamentous attachments. Right and left lobes anteriorly separated by the attachment of the falciform ligament, posteriorly by the fissure for ligamentum venosum, and inferiorly, by the fissure for ligamentum teres. On left side, the caudate and quadrate lobes are bounded by the groove for the inferior vena cava and the gall bladder fossa. [1]

The classification of the liver, depending on the internal architecture is different from the above classification. The most widely-accepted classification is that described by Couinaud (1957) and Healy and Schroy (1953). According to these classifications, an imaginary plane passing through the gall bladder fossa, divides the liver into functional right and left lobes. Segments I(Caudate lobe), II, III and IV make up the functional left lobe, and segments V, VI, VII and VIII make up the functional right lobe. This classification is also accepted by the Federative Committee on Anatomical Terminology. [1,2]

The modern era of liver surgery started after the intrahepatic segmentary anatomy was classified. With the advent of ultrasonography and the perfection of radiological diagnosis in the early 1980s, liver surgery progressed from pioneer to routine. [3] The success of liver transplantation points towards an increase in liver operations in the future. [4] In operative procedures involving the liver, a surgeon's knowledge of liver morphology is vital in determining the patient's outcome.

Liver imaging is usually performed to search for primary or metastatic liver diseases. [5] The major sulci and fissures are important landmarks for interpretation of lobar anatomy and locating the liver lesions, also for doing minimally-invasive Procedures. So both the radiologists and operating surgeons to must have a thorough knowledge of the Morphology and the commonly-occurring variations of liver. [6] The variations in the surface morphology of this organ were observed very frequently during the routine dissections. Although the segmental anatomy of the liver has been extensively researched, very few studies have dealt with surface variations of the liver. Hence, this study was conducted to observe the variations on the surface of the liver.

MATERIALS AND METHODS

For the present study 80 livers were taken from embalmed cadavers used for routine dissection during six years (from 2008 - 2014 batches). The apparently normal livers were taken for this study. They were observed for any morphological variations such as presence of accessory sulci and fissures, abnormalities in caudate and Quadrate lobe, presence of extra lobes. Photographs of all morphological variations were taken.

RESULTS

Following results were obtained

Sulci on the anterior surface:

The sulci were localized in the anterior and superior surface of the right lobe and also on the left lobe. They were narrow with variable depths ranging from 1 to 2 cm; variable in number (1–6 sulci) (Figure No. 1, 2 & 10). Deep sulci were mentioned as fissures (Figure No. 1). Out of 80 in 20 (25%) livers the sulci were observed. The sulci and fissures were not only localized to anterior surface but also present on posterior and inferior surface and were seen in caudate (Figure No. 4 & 6) and quadrate lobe (Figure No. 3).

Morphological variations of Caudate lobe:

Morphological variations in caudate lobe were present in 24 (30%) specimens. Enlargement of caudate process and paracaval portion was seen in 8 (10%) specimens (Figure No. 3). Enlargement of papillary process (*Spiegel's lobe* or *Couinaud's segment*) was seen in 4 (5%) specimens (Figure No. 5). Notch or fissure separating papillary process from rest of the caudate lobe was seen in 2 (2.5%) specimens (Figure No. 6). Morphological variations in shape of caudate lobe were observed in 10 (12.5%) specimens including streak shaped hypoplastic caudate lobe in one specimen (Figure No. 7).

Morphological variations of Quadrate lobe:

Morphological variations in Quadrate lobe were present in 10 (12.5%) specimens. These include presence of Pons Hepatis segment of hepatic tissue connecting quadrate lobe to left lobe over the fissure for ligamentum teres hepatis (Figure No. 8). Others include presence of horizontal fissures (Figure No. 3) and shape of quadrate lobe (Figure No. 7).

Extra lobes (Riedel's lobe):

Extra lobes separated completely except a small portion in relation to inferior border of liver were present in 2 (2.5%) specimens (Figure No. 10).

Morphological variations of Left Lobe:

Morphological variations in left lobe were present in 10 (12.5%) specimens. These include hypertrophy of left lobe (appendix of liver) (Figure No. 5 & 9), hypoplasia of left lobe (Figure No. 2 & 7) and presence of fissures.

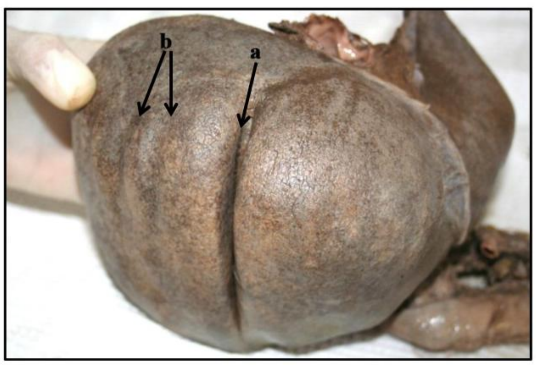

Figure No. 1: Showing Fissure (a) and Sulci (b) on antero-superior surface of right lobe Liver.

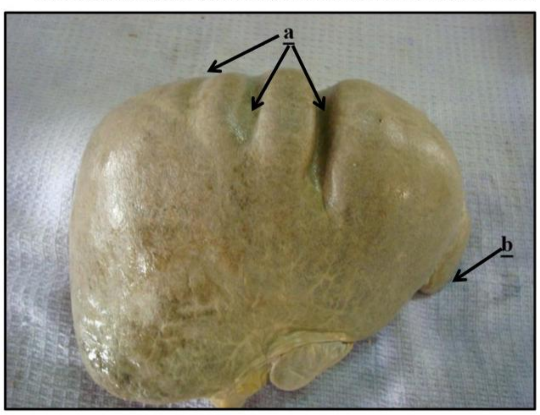

Figure No. 2: Showing multiple Sulci (a) on antero-superior surface of right lobe and hypoplastic left lobe (b) of Liver.

Figure No. 3: Showing enlarged caudate process (paracaval portion)(a) and horizontal fissure on quadrate lobe (b) of Liver.

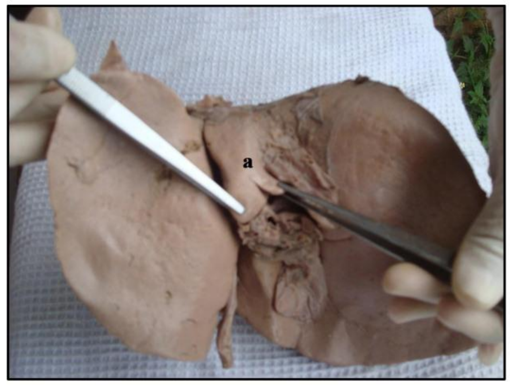

Figure No. 4: Showing notch separating papillary process and caudate process (paracaval portion)(a) of caudate lobe of Liver.

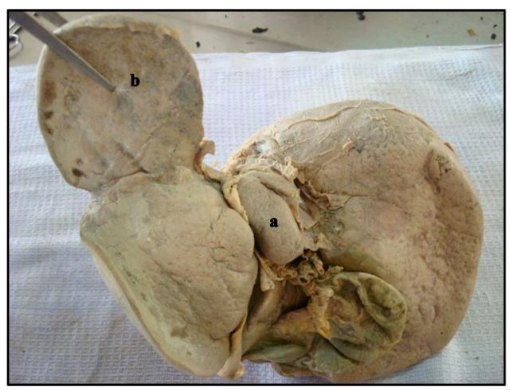

Figure No. 5: Showing enlarged papillary process (a) of caudate lobe and hypertrophied Appendix of left lobe (b) of Liver.

Figure No. 6: Showing separated papillary process (a) from rest of caudate lobe by an oblique fissure and accessory fissure on right lobe (b).

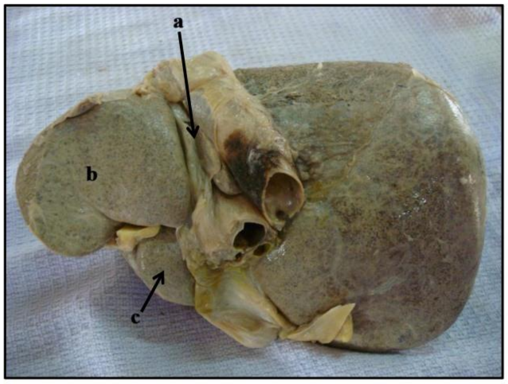

Figure No. 7: Showing streak shaped hypoplastic caudate lobe (a), hypoplastic left lobe (b) and abnormal position shape of quadrate lobe of Liver (c).

Figure No. 8: Showing Pons Hepatis (segment of hepatic tisuue) bridging over fissure for ligamentum teres (a), joining left lobe with quadrate lobe of Liver

Figure No. 9: Showing hypertrophied left lobe (a) and hypertrophied Appendix of left lobe (b) of Liver.

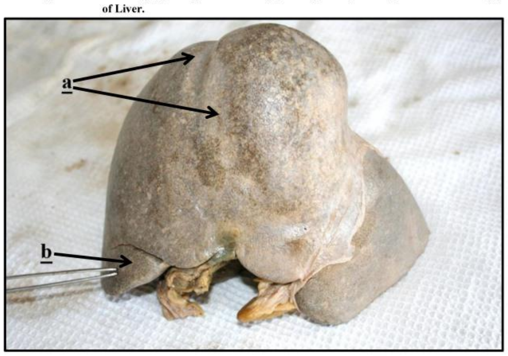

Figure No. 10: Showing multiple Sulci on antero-superior surface of right lobe (a) and riedels lobe in relation with inferior border (b) of Liver.

DISCUSSION

Sulci and Fissures on the antero-superior surface were found in 25% of the livers. A higher incidence of such grooves was observed by Macchi et al [7,8] and Auh et al. [9] According to Schafer and Symington (1896) and De Burlet (1910), [7,8] diaphragmatic sulci result from uneven growth of the hepatic parenchyma caused by variable resistance offered by different bundles of the diaphragm muscle. [7] 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. [7,8] 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. [78]

Accessory fissures were also seen other than the diaphragmatic fissures in this study on inferior and posterior surfaces, caudate and quadrate lobes. 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. [10]

Morphological variations in shape of caudate lobe were observed in 10 (12.5%) specimens including streak shaped hypoplastic caudate lobe in one specimen. Sahni et al also reported a variety of shapes of the caudate lobe. [11] The caudate lobe has been described to comprise two portions, joined by a narrow parenchymal bridge the caudate isthmus. One is situated to the left of the inferior vena cava, corresponding to the Spiegel's lobe or Couinaud's segment.

The second part extends in front of and to the right of the inferior vena cava. It also extends caudally as a caudate process. This is termed as the paracaval portion.[3] Enlargement of caudate process and paracaval portion was seen in 8 (10%) specimens. Notch or fissure separating papillary process from rest of the caudate lobe was seen in 2 (2.5%) specimens. Kogure et al also noticed the presence of the notch along the inferior border in approximately half of the patients undergoing hepatectomy. [12] Based on the cast study, they confirmed the existence of a portal fissure between the Spiegel's lobe and the paracaval portions, and further proposed that the external notch can be used as an index to separate the Spiegel's lobe from the paracaval portion. Sahni et al observed that the frequency of occurrence of the notch decreased with advancing age. [11] Kogure et al were of the view that this external notch may be a vestige of the portal segmentation of the caudate lobe, as demonstrated in animal livers. [12] Couinaud reported that in 34 of 96 cases, the hepatic vein lay in the fissural plane. [13]

Enlargement of papillary process (*Spiegel's lobe* or *Couinaud's segment*) was seen in 4 (5%) specimens in our study. Auh et al observed that on computed tomography, a normal-sized or small papillary process may be mistaken for enlarged porta hepatis nodes. An enlarged papillary process may mimic a pancreatic body mass, if it extends so far to the left that it displaces the body of the stomach anteriorly. [14] Aktan et al observed an absence of the caudate lobe in 7.41% of the 54 livers studied. [15] We found streak shaped hypoplastic caudate lobe in one specimen

In this study we found presence of Pons Hepatis that is segment of hepatic tissue connecting quadrate lobe to left lobe over the fissure for ligamentum teres hepatis. Others include presence of horizontal fissures and shape of quadrate lobe. A very narrow, buried or absent quadrate lobe may create confusion in the mind of the radiologist, as the fissure for ligamentum teres in such cases would be very near to the left margin of the gall bladder fossa. 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. [16]

Presence of Riedels lobe might be mistaken as an unidentified abdominal mass on various no- invasive imaging techniques. It is also useful for resection and transeplant. [13] 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 possible variations is important during such evaluations. [3]

CONCLUSION

In conclusion, Morphological variations of liver could be developmental in origin or due to the pressure given by diaphragm, peritoneal ligaments and other organs in relation with liver so developed during lifetime of a person. The knowledge about the same will be helpful for radiologists in diagnosis of liver diseases and surgeons for planning biliary or Porto-systemic anastomotic surgeries & also during segmental resection of liver.

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