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ORIGINAL ARTICLE

Variations in Hepatic Segmentation on the Surface of Liver - A Cadaveric Study

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Abstract

Background: Congenital anomalies of liver are rare as opposed to anatomical variations. In the past these anomalies were found accidently on autopsy and during laparotomy. Today CT and US are important in evaluation of hepatic morphology. The liver has four lobes and eight segments, whether it is defined by its gross appearance or its internal architecture. Although the segmental anatomy of liver has been researched extensively but very less literature is available on variations of surface anatomy of liver. ***Purpose:*** This study was conducted with the aim to observe and note various surface variations of liver for better results in radiological diagnosis and surgical outcomes. ***Material and Methods:*** This observational study was conducted on 50 formalin fixed human livers. ***Results:*** In the current study various shapes of the caudate lobe were encounter owing to the presence of various fissures. In 2% cases pear shape caudate lobe was seen with fissure along its superior border. Small caudate lobe was observed in 8% cases. Bicornuate caudate lobe with vertical fissure along its inferior border was observed in 24% of livers. Presence of pons hepatis was an important finding in 4% cases and in 8% cases, prominent papillary process was observed. Fusion of quadrate lobe with left lobe was noticed in 4 cases. Ligamentum teres was attached to left margin of gall bladder fossa in few cases. Transverse fissure in quadrate lobe was a common finding in our study. ***Conclusion:*** Thorough knowledge of hepatic anatomy and such commonly occurring segmental variations acquires significance for radiologists in imaging interpretation and for surgeons for better outcomes in hepatic surgeries.

Key Words

Hepatic segments, Fissures, Quadrate lobe, Caudate lobe, Papillary process

Introduction

Historically, the gross anatomical appearance of the liver has been divided into right, left, caudate and quadrate lobes by the surface peritoneal and ligamentous attachments. Falciform ligament divides the anterior surface of liver into right and left anatomical lobes. On the visceral surface, liver is divided into large right, left caudate and quadrate lobe by fissure for ligamentum venosum and fissure for ligamentum teres hepatis (1). Internal architecture of liver differs from above description. Couinaud has divided liver into 8 segments, I-IV form functional left lobe and V-VIII for right lobe (1). Although the segmental anatomy of liver has been researched extensively but very less literature is available on variations of surface anatomy of liver.

Anomalies of hepatic morphology are quite diverse. Hepatic anomalies should not be considered mere curiosities of interest to anatomists only but those anomalies should be known to physicians and surgeons

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because of their significant clinical impact. Hepatic variations are common as opposed to hepatic anomalies of liver. Variations of hepatic morphology are part of normal anatomy. Variations may be seen in the form of accessory sulci, fissures or accessory lobe (2). Accessory sulci are more commonly seen an anteriosuperior surface of liver. Presence of these sulci may be attributed by diaphragmatic musculature and to some extent by pressure exerted by the surrounding ribs (3).

Pons hepatis is a bridge between quadrate lobe and left lobe. Various dimensions of pons can be seen in relation to fissure for Ligamentum teres. Complete bridging of the fissure by pons may lead to fusion of quadrate lobe with left lobe (4). Papillary process is a part of caudate lobe of liver. When large it can simulate mass lesion in pancreatic head region or it may mimic periportal lymph node on radio imaging. Echogenicity of papillary process is similar to liver parenchyma and knowledge of this variant may help to avoid errors in radiodiagnosis (5).

The extraction of liver tissue is very important for hepatic disease diagnosis, function assessment, and computer-assisted surgery (6). Among the various medical imaging techniques, computed tomography (CT) is often used for these purposes due to better spatial resolution. However, it is tedious and time-consuming to get liver regions by manual delineation from several thousand slices. Based on this problem, many researchers have proposed some semi-automatic or automatic methods for liver segmentation (7). The aim of the present study was to observe and note various surface variations of liver for better results in radiological diagnosis and surgical outcomes.

Material and Methods

The liver specimens for the study were obtained from the Department of Anatomy, MMIMSR, Mullana, Ambala, Haryana. 50 formalin fixed liver were used for the study. All specimens were of adults, of unknown age and sex. Gross appearances of livers were apparently normal. All surfaces of liver were examined to study size and shape of caudate and quadrate lobe. Fusion of these lobes with right or left lobe of liver was noticed. The presence of fissures, accessory lobes, caudate process and papillary process was noticed and results were analyzed and formulated in form of tables.

Results

The results of the study are tabulated in the form of following tables:

Table 1: Showing Results of Caudate Lobe in Cadaveric Livers (n = 50)

Observations	Number of Livers	Percentage
Small caudate lobe	4	8
Diaphragmatic sulci	2	4
Pear shape caudate lobe with fissure along its superior border	1	2
Bicornuate caudate lobe with notch or fissure along the inferior border	12	24
Bicornuate caudate lobe with prominent caudate and papillary process	4	8
Presence of papillary process	4	8

Table 2: Shows the Results of Quadrate Lobe in Cadaveric Livers (n = 50)

Observations	Number of Livers	Percentage
Small quadrate lobe	4	8
Absence of quadrate lobe	1	2
Fusion of quadrate lobe with left lobe	4	8
Presence of pons hepatis	2	4
Transverse fissure in quadrate lobe	8	16
Fissure in both QL + CL	4	8

Discussion

There have been significant recent developments in liver transplantation and introduction of advanced imaging methods. These developments have mandated the need to better understand anatomical hepatic variations as well as vascular and biliary territories which can be isolated as units for partial hepatectomy and other local surgical interventions. Hepatic imaging is usually performed to search for any primary or metastatic liver disease. The

major fissures are important landmark for interpretation of lobar anatomy and location of hepatic lesions. Diaphragmatic sulci become clinically relevant when fluid collection in sulci gives appearance of liver cyst or intrahepatic hematoma. In present study we observed 02 cases of diaphragmatic sulci out of the 50 specimens.

Recently caudate lobe has acquired considerable importance because of its own vascularisation and biliary drainage. Caudate lobe is a central structure seen readily on abdominal imaging. Caudate anatomy is complex, may cause difficulties in the interpretation of cross-sectional images (8). In our study various shapes of the caudate lobe were encountered due to the presence of various fissures. In 2% cases pear shape caudate lobe was seen with fissure along its superior border. Small caudate lobe was observed in 8% cases, where lobe did not reach the superior surface of liver. Majority of CL have a rectangular shape followed by pear shape. Chavan *et al*. (9) have given an incidence of various shapes of caudate lobe as follows: rectangular 48%, pear shaped 25%, oval 14%, square 6%, triangular 4% and inverted flask shaped in 2%. Sahni *et al*. (10) have found rectangular shape in 94.5% of the livers studied. Sarala *et al*. (11) in their study found rectangular shape in 58%, pear shape in 10%, irregular in 20%, and triangular in 8% of the observed specimens. Joshi *et al*. (4) found a rectangular shape in 58% and a bicornuate shape in 20%. cases.

Three major fissures run through liver parenchyma named as main, right and left portal fissure. Knowledge of hepatic fissures is imperative for segmental resection for hepatic carcinoma & cyst. Bicornuate caudate lobe with vertical fissure along its inferior border was observed in 24% of livers while Joshi *et al*. (4) reported 30% cases of bicornuate caudate lobe.

On CT scan a small sized papillary process may be misinterpreted as enlarged porta hepatis nodes and enlarged papillary process may mimic a pancreatic body mass (12). In present study 8% cases of prominent papillary process was observed whereas Joshi *et al*. (4) noticed 30% such cases. In current study presence of pons hepatis was an important finding in 4% cases, same as that Saritha *et al*. (13) reported in their study. Patil *et al*. (14) found it in 10% of specimens examined while Joshi *et al*. (4) found a higher incidence (30%) of Pons hepatis which is remarkably higher as compared to our study.

Absence of quadrate lobe was seen in 2% cases in our study. Ebby *et al.* (15) noticed absence of quadrate lobe in one case and Aktan *et al.* (16) in 3.7% cases. Fusion of quadrate lobe with left lobe was noticed in 4 cases out of total 50 specimens observed by us. Ligamentum teres was attached to left margin of gall bladder fossa in few cases. Such cases may create confusion for the radiologists in demarcating right and left lobes.

Transverse fissure in quadrate lobe was a common finding in our study. Saritha *et al.* (13) found transverse fissure on the quadrate lobe in 2% cases. Patil *et al*. (14) described the presence of transverse fissure dividing the quadrate lobe into upper and lower parts without mentioning its incidence. In 20% cases, Joshi *et al*. (4) found the fissures on the quadrate lobe. Vinnakota *et al.* (17) reported a very high incidence of transverse fissure in quadrate lobe (35.48%), and Reddy *et al.* (18) reported still higher incidence (56%). In the present study, the incidence of these fissures was 16% which is comparable to the findings of other authors.

Presence of accessory sulcus and change in hepatic segments can be an incidental finding during laparoscopic surgeries (19). Hence it is very much promising to know about segmental variations of liver for hepatobiliary surgeons, anatomists and radiologists.

Conclusion

In the era of imaging, and minimum invasive surgeries, a thorough knowledge of hepatic anatomy and commonly occurring variations is very important for radiologist and surgeons. We want to highlight the importance of surface variations of liver to avoid misinterpretation of images by radiologist and better outcome of surgeries. The prominent papillary process, the bicornuate caudate lobe, presence of pons hepaticus, and transverse fissure in quadrate lobe have been discussed in detail in the present study and it is expected that it would be of help to the surgeons doing hepatobiliary surgeries, liver transplant, and the radiologists in proper interpretation of USG and CT.

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Conflicts of Interest

There are no conflicts of interest.

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