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Morphological Study of Human Cadaveric Liver

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Abstract: The liver is the largest abdominal viscera which occupies a significant portion of the upper abdominal cavity. Aim of the study is to study morphology of liver and morphological variations in human cadaveric liver. The organ proportion of total body size is larger in foetus as compared to adult. The present study was conducted on 160 cadaveric livers after obtaining the ethical clearance from Institutional Ethical Committee KIMS, DTBU, Karad. Present medical era is of modern imaging techniques, advanced diagnostic techniques, minimally invasive approaches and transplant surgery. Therefore, it becomes utmost important to radiologist, surgeons and diagnosing clinician to have thorough knowledge of the morphology and its commonly occurring morphological variations of liver.

INTRODUCTION

The liver is the largest abdominal organ. It occupies the right hypochondrium, epigastrium and a small part of the left hypochondrium. In males liver weighs between 1.4-1.8 kg while females weighs between 1.2-1.4 kg. The organ proportion of total body size is larger in foetus as compared to adult. Liver is solid and soft in consistency. It is friable. It does not move much from its anatomical position. And that is why more susceptible to trauma, lacerations (Standring, 2016). Liver has posterior, inferior (visceral), anterior, superior (diaphragmatic), right lateral surface and sharp inferior border. The inferior border separates anterior and right lateral surface from inferior surface. Superior surface of liver covers right and left lobes. It fits under the vault of diaphragm which is covered with peritoneum except over the small triangular area. The right and left lobe are convex but its central area shoes depression called as cardiac impression (Standring, 2016). The inferior surface of right lobe is marked by three impression, colic impression related to right colic flexure, duodenal impression and renal impression which is usually well marked, situated behind the colic impression. The relations of liver show considerable variation for which movements and postures of respiration are only partly responsible. Importance to liver anatomy and its morphological variations ultimately lies in its clinical implications. A lot of morphological variations can hinder the imaging utility in diagnostics, like an accessory lobe, accessory fissure can create wrong impression of pathology. This may leads to lots of diagnostic dilemmas. This further aggravates unnecessary interventions. All these things can be easily avoided if we are thorough with the anatomy and variations. Not only radiologists but hepatobiliary surgeons, thoracic surgeons, pathologists can be benefited immensely due to this study. Diseases have their own geographical distribution, their own susceptible population. Diseases affect different races, ethnicity differently. Same is the case with hepatic morphology and variations. Variations are of two the forms, acquired and congenital. Congenital variations like atrophy of liver lobe, absence of one lobe, multiple lobes,

very small lobes, pedunculated lobe, accessory lobe. Acquired changes like corset type constriction and deep renal impression, lingular lobes and local inflammation of tissue (Nagato *et al*., 2011).

Aim and objectives

Aim: To study morphology of liver and morphological variations in human cadaveric liver.

Objectives: To study morphology of liver. To see the morphological variations of liver. To study different morphological Netter (2000)'s types of liver. To compare present study with other studies.

Literature review: Netter (2000) classified liver in to six types, according to variations in morphology of liver. Type 1 liver is that liver with very small left lobe, type 2 liver is complete atrophy of left lobe, type 3 liver is which has Transverse saddle like liver with relatively large left lobe, type 4 liver is which that has tongue like extended process of right lobe, type 4 liver has very deep renal impression and corset constriction. Sangeeta and Varalakshmi (2014) studied 70 formalin fixed liver. Their study reported; 7% of type 1 livers, 3% type 2 livers, 7.1% type 3 livers, 9% type 4 and 6 livers, 6% of type 5 livers.

Phad *et al*. (2014) studied morphology of liver for 4 years, at Vadodara Medical College on 80 cadaveric livers. She used liver specimen removed by undergraduate students during routine dissection. She has classified livers according to Netter's classification. The result of study were type 2 liver (17.4%), type 4 liver (1.25%), type 5 (1.25%), type 6 (7.5%). In her study, she did not found type 2 and type 3 livers.

Liver has superior surface, posterior surface, anterior, inferior (visceral) and right lateral surface. Rao *et al*. (2011) studied morphology on 45 years old male during medico legal autopsy. They reported, furrows on right lobe on anterior surface, measured 7 cm and 4cm each.

Jambhekar *et al*. (2010) reported, accessory lobe of liver with separate blood supply. The 24 years old female patient came to their hospital with upper quadrant abdominal pain, vomiting, nausea. She had tenderness at epigastric and upper right quadrant. CT scan showed separate liver tissue attached to left lobe with thin stalk which contains hepatic blood vessels. That accessory lobe underwent torsion. Diagnosis was confirmed by MRI.

Auh *et al*. (1984), suggested that increased frequency of grooves in cadaveric studies, are post-mortem changes due to external compression from rib.

Srikant, conducted study on 100 liver specimens which were collected from the department of Anatomy at a tertiary care teaching hospital. They were preserved in 10% of formalin. Caudate lobe studied in detail for their shape, fissure and accessory lobes and also morphometric data was collected by the help of thread, scale and vernier calliper. Reported the mean length of caudate lobe was 5.33±1.01 cm, breadth 2.75±0.65 cm and depth 1.93±0.55 cm. Accessory fissure on inferior margin of caudate lobe 20(20%) absent caudate lobe in 1% liver (Emue *et al*., 2013).

Khedekar and Hattangdi (2014) studied 45 cadaveric livers (40 males and 5 females) for morphological variation of quadrate lobe but he didn't found any variation on quadrate lobe. Dev *et al*. (2014) after studying 90 formalin fixed livers, reported in 20% specimens accessory fissure on quadrate lobe and 30% showed connection between left lobe and quadrate lobe.

Vinnakota and Jayasree (2013), mentioned that the pons hepatis terminology was first described by von Haller in 1743, the (hepatic bridge or pons hepatique) is a segment of hepatic tissue connecting the quadrate lobe to left lobe over the ligamentumteres fissure. But in his study, the pons hepatis refers to hepatic tissue that surrounds the inferior vena cava.

MATERIALS AND METHODS

The study was conducted on 160 cadaveric livers after obtaining the ethical clearance from Institutional Ethical Committee. All these specimens were acquired from different colleges. Prior permission of higher authorities of our college and other colleges was taken. Names of these colleges are mentioned below:

- Krishna Institute of Medical Science, Deemed to be University Karad
- Government Medical College, Miraj
- Bharati Vidyapeeth Deemed University and Hospital, Sangli
- D.Y. Patil Medical College, Kolhapur
- Rajarshi Chhatrapati Shahu Maharaj Government College, Kolhapur
- Shrimati Kashibai Navale Medical College and Hospital, Narhe, Pune
- Bharati Vidyapeeth Deemed University and Hospital, Pune

All the specimens were seemingly normal in appearance. Liver was observed carefully. The variations in morphology of liver shape, size, fissures, accessory lobes, abnormal lobes, additional sulci on surface, fissures, extra lobes in Caudate and Quadrate lobe, presence of Pons hepatis were noted. Photographs were taken for documentation of the variations. Did analysis of collected data and tabulated. All measurements (Height, breadth and thickness) were taken with the help of Soft tissue measurement board; Weight with electronic weighing machine and vernier caliper (30 cm) was used

for measurement of length, breadth of quadrate and caudate lobe. All morphometric analysis was done over all 160 livers by same instruments and with two same observers to avoid inter-observer error.

RESULTS AND DISCUSSION

After careful observation of 160 cadaveric livers, we came across many variations. Variations were like, presence of accessory sulci, accessory lobes on various surfaces of liver. Also did morphometric observations on liver, caudate lobe, quadrate lobe.

Some variants in the form of diaphragmatic grooves, very short left lobe, transverse saddle like liver, very deep renal impression, tongue like process of right lobe, complete atrophy of left lobe. These variations were classified alike Netter's classification of liver. Observations of present study reported in Table 1.

All surfaces (superior, inferior, anterior, posterior, right lateral) were observed carefully for presence accessory fissures and accessory lobes. Result of these observation tabulated in Table 2.

Inferior border is sharp border which separate visceral surface with anterior and right lateral surface. Sometimes accessory lobe, fissure, deep notch are seen on inferior border. Observations of these finding are tabulated in Table 3.

Height, breadth and thickness were measured by tissue measurement board. After keeping the liver in anatomical position, all these measurements were taken by two observers. Observations were analyzed and tabulated in Table 4.

Knowledge of morphology of liver and its morphological variations is important since they do not always remain clinically latent. Variations might be congenital or acquired (Phad *et al*., 2014). Congenital anomalies are mostly due to defective or excessive development. Accessory lobes are example of excessive development while agenesis is of defective or non-development of liver (Daver *et al*., 2005). Tumor necrosis causes acquired variations like pathological grooves which causes involution, desmoplasia and retraction of hepatic capsule (Yang *et al*., 2008). Accessory grooves and sulci present on different surfaces of liver might lead to false positive pathological conditions during imaging because it resembles pathological liver disease. These fissures may get invaginated by tumor cells. These tumor cells occupy the fissure spaces and mimics intrahepatic focal lesion (Auh *et al*., 1984). Accessory sulci may mimic laceration of liver in trauma patients (Alonso-Torres *et al*., 2005). Sulci also increase complications during liver transplant (Alonso-Torres *et al*., 2005). In surgeons and radiologist intervention of liver is increasing. Surgeons were haunted for many years for ischemic complications following liver resection mainly in living donors (Jin *et al*., 2008). The knowledge of normal and abnormal anatomy of liver is critical for the safe and efficacious surgical and percutaneous hepatobiliary interventions.

Table 1: Basis of types of Netter's classification

Netter's types of variation	Frequency	Percentage
No variations	72	45.0
1	15	9.4
2	Nil	0.0
3	25	15.6
4	3	1.9
5	15	9.3
6	30	18.8

Table 2: Variations on liver surfaces

Variation on liver surfaces	Frequency	Percentage
No variations	141	88.1
Accessory fissure	18	11.3
Accessory lobe	1	0.6
Total	160	100.0

Table 3: Variation on inferior border

Variation on contour of inferior border	Frequency	Percentage
No variations	137	85.7
Fissure	2	1.2
Accessory lobe	1	0.6
Notch	20	12.5
Total	160	100.0

Table 4: Descriptive statistics of liver parameters

Liver parameters	N	Range	Minimum	Maximum	Mean	SD
Weight (kg)	160	1.676	0.461	2.137	1.05	0.34
Height (cm)	160	19	1	20	13.63	2.36
Breadth (cm)	160	23.1	2.4	25.5	18.44	2.45
Thickness (cm)	160	14.9	3.4	18.3	10.52	1.82

CONCLUSION

In this study, various morphological variations of liver were observed. The awareness about this will aid the radiologists to make more accurate analysis of the radiological images and thereby assisting in the lessening of the deceitful reports. A prior knowledge of such variations will help the interventional radiologist to reduce or avoid misinterpretations and subsequent misdiagnosis and help/guide the hepatobiliary surgeon in minimizing iatrogenic complications. It would also allow the surgeons to carry out a structured surgical procedure and bring about an improved and successful post-operative result.

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