Section: Anatomy

Original Research Article

A MORPHOLOGICAL STUDY OF HUMAN CADAVERIC LIVER VARIATIONS ALONG WITH ITS SURGICAL AND RADIOLOGICAL IMPORTANCE

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Abstract

Background: Variations in the human liver may have a congenital or acquired origin. The papillary process, caudate process and accessory processes on primary lobes of liver can mislead to diagnostic errors while reporting liver pathology. Accessory lobes are due to overgrowth of liver tissue and can be mistaken as lymph nodes. Laparoscopic hepatectomy and laparoscopic ablation of hepatic tumors are the choice of advanced procedures now. The knowledge of accessory fissures and accessory lobes is essential for the radiologist and surgeons for the best outcomes. **Objective:** To observe external morphological variations and to add this knowledge for better clinical outcome. **Materials and Methods:** The morphological observations were noted in detail in 30 human cadaveric liver specimens obtained from adult embalmed human cadavers. Lobes, surfaces and borders of each liver was observed for the presence of any anatomical variations. **Results:** 22 livers had one or more gross variations like accessory fissures and accessory lobe in right left quadrate and caudate lobe. Other variations were renal impressions, appendix, pons hepatis, partially divided quadrate lobe, diaphragmatic groove, transverse saddle like relatively large left lobe, tongue like projection on right lobe etc. Only one liver was having hypertrophied caudate lobe of which width was much larger than length. A liver with partially divided quadrate lobe was observed. In one liver a bridging vessel was observed on fissure for ligamentum venosum connecting quadrate lobe and left lobe. Liver specimens were also classified according to the netter's classification (Type-1 to Type-6). **Conclusion:** Knowledge of details of anatomical variation of liver lobes will not only add precision in the radiodiagnosis but also will result in a better outcome of surgery with least mistakes. Present study showed the prevalence of different hepatic lobe variations including netters classification. Living study by the help of ultrasonography or other imaging techniques can be compared with cadaveric studies. This cadaveric study will augment the current knowledge of morphological variations of lobes of liver and will help the radiologists and surgeons for accurate diagnosis and treatment.

INTRODUCTION

The largest abdominal viscera are the liver which is wedge-shaped and occupies right hypochondrium, epigastrium and extend up to variable portion of left hypochondrium. Anatomically liver is divided into larger right lobe and smaller left lobe by a line connecting attachment of falciform ligament anteriorly and fissure for ligamentum teres and ligamentum venosum lying inferiorly. Two additional lobes are present - quadrate lobe anteriorly and caudate lobe posteriorly. Many times, at the inferior margin of caudate lobe, there are two processes present called papillary process and caudate process.

Variations in the human livers may have a congenital or acquired origin.[1,2] Functionally quadrate lobe is the part of left lobe and receives its blood supply from the left branches of hepatic artery and portal vein. Caudate lobe is subdivided into Spiegel's lobe (the caudate lobe proper and the papillary process], caudate process and paracaval portion. Caudate lobe is supplied by both right and left hepatic arteries and portal veins.[3] The papillary process, caudate process and accessory processes on other lobes can mislead to diagnostic errors while reporting liver pathology.

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Accessory lobes are due to overgrowth of liver tissue and can be mistaken as lymph node.[4]
Other than primary fissures, fewer occurring fissures are also present on different lobes and surfaces of liver. These are called accessory fissures. These accessory hepatic fissures are potential sources of diagnostic errors during imaging.[5] Though the major fissures are important landmarks to locate different lobes of liver in imaging, yet the knowledge of accessory fissures and accessory lobes is essential for the radiologist and surgeons for the best outcomes.[6] Laparoscopic hepatectomy and laparoscopic ablation of hepatic tumors are the choice of advanced procedures now. Thus, anatomical study should be conducted to add the knowledge of variations as it will of benefit for the advance surgeries and radio-diagnostic procedures.[7]

MATERIALS AND METHODS

This study was conducted on 30 human cadaveric livers in department of anatomy, Sawai Man Singh Medical College, Jaipur, Rajasthan. Liver specimens were obtained from adult embalmed human cadavers after the routine dissection done by undergraduate and post graduate students in the department. The morphological and morphometric observations were noted in detail. Lobes, surfaces and borders of each liver was observed for the presence of any accessory fissures, accessory lobe, accessory processes, deep impressions, pons hepatis, appendix, elongation or atrophy or any other variations.

RESULTS

30 Human cadaveric livers were studied. Out of them only 8 livers were without any variations, 22 livers were having one or more gross variations like accessory fissures and accessory lobe in right left quadrate and caudate lobe. Other variations were renal impressions, appendix, pons hepatis, partially divided quadrate lobe, diaphragmatic groove, transverse saddle like relatively large left lobe, tongue like projection on right lobe etc. 10 Livers with accessory fissures on right lobe and two livers with accessory lobe on the right lobe were encountered. 2 livers with accessory fissures on all right, left, quadrate and caudate lobe were observed. 4 Livers with elongated left lobe observed. In one liver a bridging vessel was observed on fissure for ligamentum venosum connecting quadrate lobe and left lobe (FIG 1). Caudate lobes of 4 livers were having accessory fissures while in 3 caudate lobes of liver were having accessory lobes. Only one liver was having hypertrophied caudate lobe of which width was much larger than length (FIG 6). One liver with partially divided quadrate lobe was observed (FIG 6). 3 Livers with pons hepatis were encountered.
Liver specimens were also classified according to the netter's classification (Type-1 to Type-6) which is described in table 1 (FIG 3,4,5,6).

Table 1: Netter's classification

Netter's type	Number of specimens in present study
Type 1 (Very small left lobe, deep costal impressions)	2
Type 2 (Complete atrophy of left lobe)	Not observed
Type 3 (Transverse saddle like liver relatively large left lobe)	5
Type 4 (Tongue like process of right lobe)	2
Type 5 (Very deep renal impression and corset constriction)	2
Type 6 (Diaphragmatic grooves)	1

Table 2: Comparison of different study according to netter's classification.

Authors	Nagato et al	Sachin et al	Sangeetha M et al	Our Study
Sample Size	61	50	70	30
Netters Type1	8.19%	2%	7%	7%
Netters Type 2	1.64%	Not Observed	3%	Not Observed
Netters Type 3	6.56%	10%	7.1%	16.7%
Netters Type 4	21.31%	2%	9%	7%
Netters Type 5	9.84%	2%	6%	7%
Netters Type 6	6.56%	2%	9%	3.3%

Table 3: Data compilation of variations in morphological feature of liver of different studies.

Morphological features	Sunitha V et al. %(number)	Sachin Patil et al. %(number)	HR Singh et al. %(number)	Anbumani L et al. %(number)	Present study %(number)
Sample size	58	50	70	30	30
Accessory Fissures in Right lobe	17(10)		51.43	40(12)	33(10)
Accessory Fissures in Left lobe	10(6)		11.43	3.3	13.3(4)
Accessory Fissures in caudate lobe	14(8)		27.14(19)	10	13.3(4)
Accessory Fissures in quadrate lobe	15(9)		32.86(23)	6.3	3.3(1)
Accessory lobe in caudate lobe	14(8)				10(3)
Hypoplastic left lobe	3(2)				3.3(1)
Hypertrophied caudate process			2.86		3.3(1)
Hypo trophied caudate process					3.3(1)
Bilobed quadrate lobe		4(2)	7.14(5)		3.3(1)

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Beavers' lobe (elongated left lobe)			12.86(9)	6.6	6.6(2)
Riedles lobe				3.3	
Pons hepatis		10(5)	22.86(16)	13.3(4)	10(3)
Variation in antero-superior surface			11.43		3.3(1)

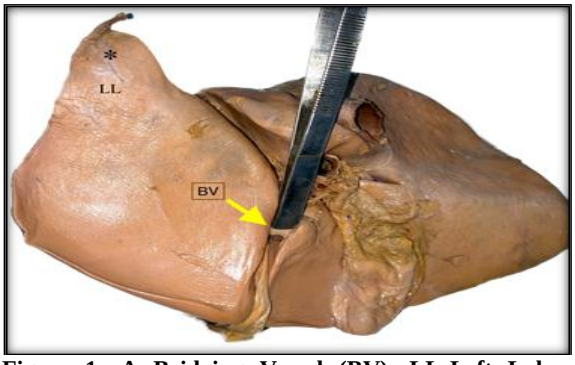

Figure 1: A Bridging Vessel (BV), LL-Left Lobe, *Appendix of Liver

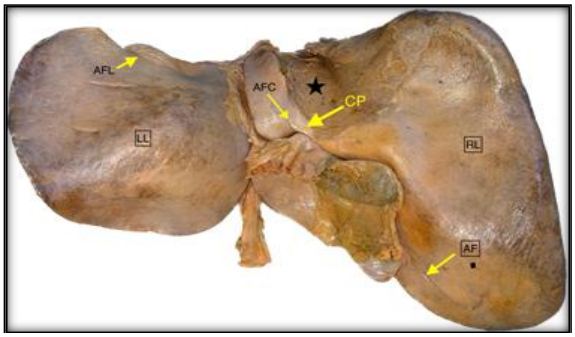

Figure 2: Netters Type 3. LL-Left Lobe, RL-Right Lobe, CP- Caudate Process, AF-Accessory Fissure on RL, AFC-Accessory Fissure on Caudate Lobe, AFL-Accessory Fissure on LL, *Paracaval Part of Caudate Lobe

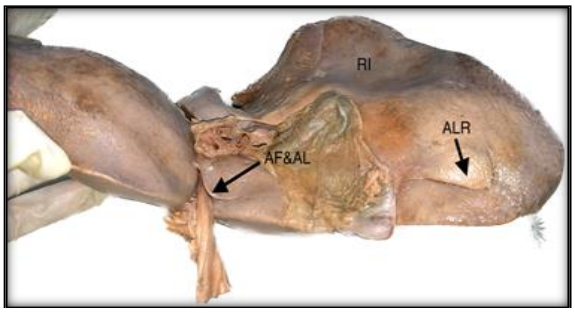

Figure 3: Netter's Type 5. AF&AL-Accessory Fissure and Lobe on Quadrate Lobe, ALR-Accessory Lobe on Right Lobe, RI-Deep Renal Impression

Figure 4: Netters Type 1, PH-Pons Hepatis, @Hypotrophied Caudate Lobe

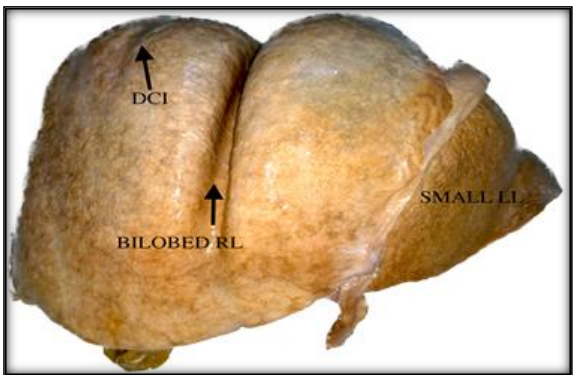

Figure 5: Netter's Type 1, DCI-Deep Costal Impression, Small Left Lobe (LL), Bilobed Right Lobe (RL)

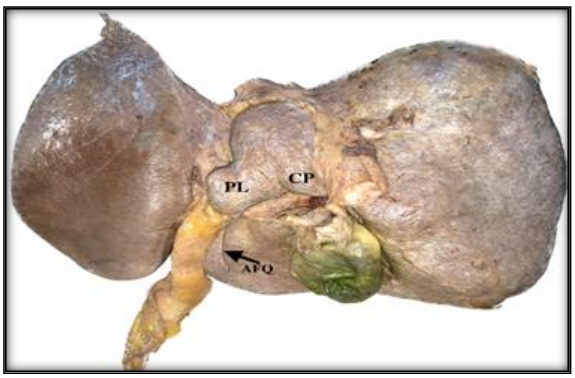

Figure 6: Netter's Type 3, Hypertrophied Caudate Lobe, PL-Papillary Process, CP-Caudate Process, AFQ-Accessory Process on Quadrate Lobe

DISCUSSION

The knowledge of variations in liver is having its significance during diagnostic imaging and surgical procedures. Liver starts its organogenesis early in the 3rd week of intrauterine life and develops very rapidly.[9] The variations may be congenital or acquired during life. Defective development of left lobe of liver can lead to gastric volvulus, whereas defective development of right lobe may remain latent or progress to cause portal hypertension.[10]

Some findings in our study are in accordance with other studies while some are not. based on the major fissures, the lobes of liver are divided into right, left, caudate and quadrate lobes. Any fissures other than these major fissures are called as accessory fissure. These accessory fissures are potential sites for fluid collection and maybe mistaken as a hepatic cyst, hepatic abscess or hematoma.[11] Sometimes a fissure seen on the right of the porta hepatics is called rouvieres sulcus which serves as an important landmark during laparoscopic cholecystectomy.

In present study, accessary fissure on right lobe of liver were observed in 33%. A liver was observed with bilobed right lobe and deep costal impression which is unveiling the developmental aspect of liver

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lobes (FIG 5). Accessory fissures are the strong cause of diagnostic error during ultrasonography and CT imaging. Fissures only or fissures producing lobes can be misdiagnosed as the abscess or cyst of liver. Disseminated peritoneal tumor cells may implant into these fissures producing a pseudo image of intrahepatic lesion during imaging. In the present study, 50% livers were having accessory fissures. Accessory fissures were observed in Anbumani L et al (20%,7), Singh HR et al (51.43%, 36) and Sunitha V et al (10%, 6). Hypoplastic left lobe were observed in the study of Sunitha v et al (3%) and in present study only (3.3%, FIG 5). Bilobed quadrate lobe was observed in this study (3.3%) as well as in the studies of Sachin Patil et al (4%) and HR Singh et al (7.14%). Hypertrophied as well as hypo-trophied caudate lobes were observed (FIG 4,6).

According to the criteria given by Netter, livers were tried to put into the different category of Netter's type 1 to type 6 (Table 1,2). In present study most of the livers are classified as Netter's type 5 (16.7%). This finding is in accordance with the Sachin et al (10%), but in the study of Nagato et al, maximum livers observed were of Netter's type 4 (21.31%) (Table 2). Netter's type 2 liver was not observed in this study as well as in the study of Sachin et al. It is observed that all the livers can not be classified according to the Netter's classification. Thus, revised or new criteria should be developed to turn up into a better classification.

CONCLUSION

Cadaveric study of liver lobes for the details of anatomical variation is very fruitful and must be paid attention by radiologist and surgeon. Knowledge of variation will not only add the precision in the radiodiagnosis but also will result in a better outcome of a surgery with least mistakes. Present study showed the prevalence of different hepatic lobe variations including netters classification. Living study by the help of ultrasonography or other imaging techniques can be compared with cadaveric studies. This cadaveric study will augment the current knowledge of morphological variations of lobes of liver and will help the radiologists and surgeons for accurate diagnosis and treatment.

REFERENCES

1. Sunitha V, Neelee J. A New Insight into the morphology of the human liver: a cadaveric study. ISRN Anatomy. 2013; Article ID 689564:6 pages. http://dx.doi.org/10.5402/2013/689564
2. Sachin Patil, Madhu Sethi, Smita Kakar. Morphological study of human liver and its surgical importance. Int J Anat Res. 2014; 2(2):310-14.
3. Kumon M, Kumon T, Tsutsui E, et al. (2020). Definition of the caudate lobe of the liver based on portal segmentation. Global Health & Medicine. 2(5) :328-336
4. Auh YH, Lim JH, Kim KW et al. Loculated fluid collections in hepatic fissures and recesses: CT appearance and potential pitfalls. Radiographics. 1994; 14:529-40.
5. Sangeeta M, Varalakshmi KL, Shilpa Naik. A study of the morphometry of the liver. Indian journal of applied research. August 2014; 4[8]:441-443
6. Anbumani L, Pavazhakkurinji TN, Thamaraiselvi A. Morphological study on variation of external surface of liver. Int J Anat Res. 2020; 8(2.2):7481-85.
7. Singh HR, Rabi S. Study of morphological variations of liver in human. Translational Research in Anatomy. 2019; 14:1–5.
8. Nagato AC, Silva AS, Trajano ETL et al. Quantitative and morphological analyses of different types of human liver. J Morphol Sci. 2011; vol. 28[4]:275-279.
9. Champetier J, Yver R, Letoublon J, Vigneau B. A general review of anomalies of hepatic morphology and their clinical implications. Anatomia Clinica. 1985; vol. 7(4):285–299.
10. R Seltzer as quoted in Skandalakis J E, Skandalakis L J, Skandalakis P N, Mirilas P. Surgical Clinics of North America. 2004; 84:413.
11. Heena J Chaudhari, Minal K. Ravat, Vasant H. Vaniya, and Amul N. Morphological study of liver and its surgical importance. J Clin Diagn Res. 2017 Jun; 11(6):AC09–AC12.doi: 10.7860/JCDR/2017/24467.10020
12. Netter F. Atlas of Human Anatomy. 2nd ed. New York: Guilford Pres; 2000.

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