International Journal of Anatomy and Research,
Int J Anat Res 2016, Vol 4(4):3273-78. ISSN 2321-4287
DOI: http://dx.doi.org/10.16965/ijar.2016.458

Original Research Article

DIAPHRAGMATIC FISSURES AND ACCESSORY SULCI OF LIVER IN THE POPULATION OF TELANGANA

Tallapaneni Sreekanth

MD, Associate Professor, Department of Anatomy, Shadan Institute of Medical Sciences, Teaching Hospital & Research Center, Peerancheeruvu, Near Arramaisamma Temple, Hyderabad, Telangana, India.

ABSTRACT

Background and Aims: The sources of information of the Diaphragmatic Fissures and Accessory Sulci of Liver are only the research reports. Routine anatomy Textbooks do not even mention them. Extensively research has been done on the segmental anatomy of liver but work done on diaphragmatic fissures and accessory sulci of liver is scanty. The present study can make a significant contribution to the existing literature. Hepatology is complete only with the knowledge of these fissures and sulci.

Materials and Methods: The present study was carried on 45 cadaveric [40 Male and 5 Female] livers. The mean age of the cadavers ranges between 25 – 65 years. All the surfaces of the harvested livers were meticulously observed and photographed.

Result: In the present study the diaphragmatic fissures and accessory fissures were seen in 14(31.11%)] livers. 12 (26.66%) livers showed diaphragmatic and accessory fissures on the right lobe and two (4.44%) showed on left lobe. The deep diaphragmatic fissures seen on the antero superior surface, postero superior surface caused notched appearance of the liver. The fissures were ranging from shallow to deep, narrow to broad, single to multiple. Two liver specimens showed the furrowing of the diaphragmatic muscle fibers making indentations on the entire right lateral surface. 3 livers on their inferior surfaces showed the presence of accessory fissures. About 3 (6.66%) caudate lobes showed accessory fissures. In the present study none of the quadrate lobes showed any accessory fissures.

Conclusion: The present study throws light on the frequency of occurrence of diaphragmatic fissures and accessory sulci on different surfaces of liver. The results of the present study may be gainfully utilized by Forensic specialist during postmortem study, Radiologists reporting the abdominal sonograms, C.T. and M.R.I scans and Hepato-biliary Surgeons operating on Livers.

KEY WORDS: Accessory sulci, Diaphragmatic Fissures, Inferior Surface, Caudate lobe.

Address for Correspondence: Dr. Tallapaneni Sreekanth, Associate Professor, Department of Anatomy, Shadan Institute of Medical Sciences, Teaching Hospital & Research Center, Peerancheeruvu, Near Arramaisamma Temple, Hyderabad, Telangana, India.
Mobile No: 70934 49309, 91006 83056. **E-Mail:** anatomysreekanth18@yahoo.com

Access this Article online

Quick Response code

DOI: 10.16965/ijar.2016.458

Web site: International Journal of Anatomy and Research
ISSN 2321-4287
www.ijmhr.org/ijar.htm

Received: 03 Nov 2016
Peer Review: 03 Nov 2016
Revised: None

Accepted: 01 Dec 2016
Published (O): 31 Dec 2016
Published (P): 31 Dec 2016

INTRODUCTION

The liver (hepato)is the magnificent organ of regeneration besides being one of the first organs to develop in the embryo. The human liver is the largest gland with both exocrine and endocrine activity, measuring about 1.5 – 1.8 kg. i.e., is approximately 2% to 3% of total body weight of an individual [1]. The liver is situated in the right upper quadrant of the abdomen under the right dome of diaphragm. It is divided

into a large right lobe and small left lobe by falciform ligament anteriorly, fissure for ligamentum venosum posteriorly and fissure for ligamentum teres inferiorly [2]. The musculotendinous diaphragm is related to superior surface of the liver. The exertion of diaphragmatic costal pressure results in the formation of the diaphragmatic fissures which may be shallow or deep [3]. Their presence is incidentally reported during the radiological procedures or autopsy study [4]. Some authors believe their occurrence to be congenital [5]. While others consider, due to genetic predisposition [6].

The span of activity and shift of hepatic growth zones are dependent on beta-catenin/Wnt activity. Lack of genetic guidance in the younger age groups can lead to the formation of the accessory sulci [7]. The diaphragmatic fissures and the accessory sulci are of different shapes being linear, horizontal or curved. They can be of various lengths and depths ranging from single to multiple in numbers [8]. Furrowing in the surface of the liver caused by the invaginations of the muscular diaphragm and peritoneum is termed as accessory fissures [9]. The diaphragmatic fissures are not genuine fissures but accessory fissures seen on the inferior surface of the liver are called true fissures as they are caused by the infolding peritoneum. The accessory inferior sulci refers to the presence of extra fissures on the visceral surface of liver [10]. Hepatology is complete only with the knowledge of the diaphragmatic fissures and the accessory sulci.

MATERIALS AND METHODS

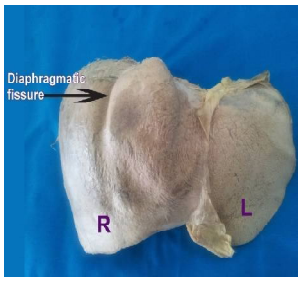
The present study was carried on 45 cadaveric [40 Male and 5 Female] livers. The mean age of the cadavers ranges between 25 – 65 years. These livers were used for prosection during the dissection classes of 1st MBBS premedical students of Shadan Institute of Medical Sciences, Teaching Hospital and Research Centre, Hyderabad, Telangana. The medical history of the cadavers stating the cause of death was not available. All the surfaces of the harvested livers were meticulously observed for the presence of any fissures and sulci, and accordingly photographed.

RESULTS

In the present study the Diaphragmatic and Accessory fissures were seen in 14 (31.11%) livers out of 45 that were studied. 12 (26.66%) livers showed the fissures on the different regions of the right lobe and 2 (4.44%) livers showed them on the left lobe. The fissures were ranging from shallow to deep, single to multiple, narrow to broad. A single broad deep diaphragmatic fissure causing a wide prominent notch was seen on the antero superior surface of the right lobe of the liver. The portion of the liver medial to it was seen bulging upwards. Fig (1). 2 deep fissures were seen on superior surface of the liver causing notched appearance. The first diaphragmatic fissure was shallower in depth and shorter in length than the second fissure. The inferior surface of both the right and left lobes of the same liver showed 2 accessory fissures. There were no veins observed in the depth of any of these fissures Fig(2). The accessory fissure seen on the inferior surface of the left lobe coursed obliquely forwards and downwards towards the ligamentum teres. The second fissure, was shorter and deeper seen on the inferior surface of the right lobe of the liver was by the side porta hepatis. Multiple shallow and wide Diaphragmatic fissures were seen on the postero superior surface of the liver. As the diaphragm was stripped (during dissection) more and more upto 9 fissures shallow and broad were seen. The anterior surface and the right lateral surface did not reveal any fissures. Fig (3). Accessory fissure was seen on the under surface of the right lobe of the liver close to the inferior border in another liver specimen. Fig (4). 3 liver specimens showed the presence of accessory fissures on the caudate lobes . One of them had a fissure resembling a vertical groove making the caudate lobe appear to be bifid (5). Other specimen showed 2 accessory fissures on the caudate lobe Fig (6). One large liver showed the furrowing of the diaphragmatic muscle fibers on the superior surface of the right and left lobes imparting a wrinkled appearance with the loss of normal smooth contour Fig (7). Two liver specimen showed the shallow but extensive areas of indentations of the diaphragmatic muscle fibers on the right lateral surface giving it a

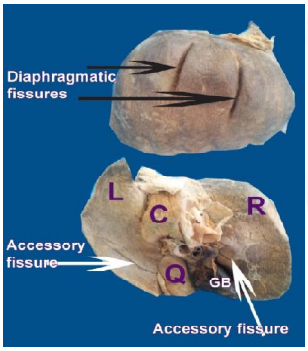
wrinkled appearance Fig (8). In the present study none of the quadrate lobes showed any accessory fissures.

Fig. 1: A single broad and deep diaphragmatic fissure causing a wide prominent notch on the antero superio surface of the liver. The portion of the liver medial to it is seen bulging upwards.



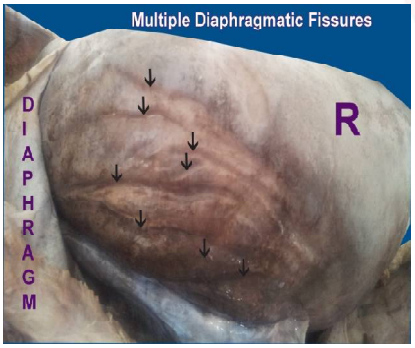
R - RIGHT LOBE
L – LEFT LOBE

Fig. 2: Two deep diaphragmatic fissures seen on the superior surface of the liver causing notched appearance. Two accesory sulci / fissures are seen on its inferior surface of both right (shorter) and left (longer) lobes.



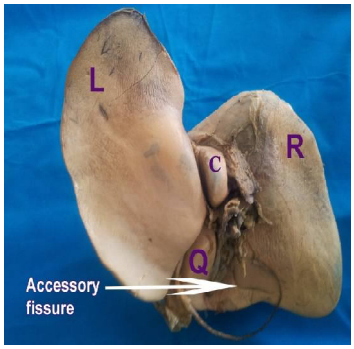
L- LEFT LOBE
C- CAUDATE LOBE
Q- QUADRATE LOBE
GB- GALL BLADDER
R- RIGHT LOBE

Fig. 3: Shallow and wide multiple (9) diaphragmatic fissures[pointed out by small black arrows] seen on the postero superior surface on the right lobe of the liver.



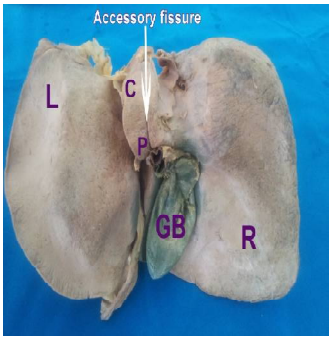
R-RIGHT LATERAL SURFACE OF THE LIVER

Fig. 4: Inferior surface of the right lobe of liver showing accessory fissure close to the inferior border.



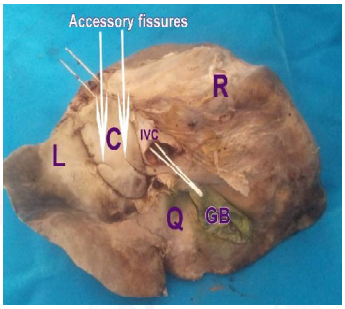
L-LEFT LOBE
C- CAUDATE LOBE
Q- QUADRATE LOBE
R- RIGHT LOBE

Fig. 5: Accessory fissure seen on the caudate lobe giving it a bifid appearance.



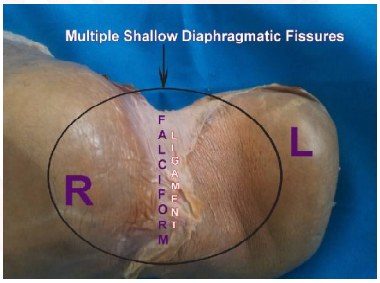
L-LEFT LOBE
C-CAUDATE LOBE
P-PAPILLARY PROCESS
GB- GALL BLADDER
R- RIGHT LOBE

Fig. 6: Two accessory fissures / sulci seen on the caudate lobe of the liver.



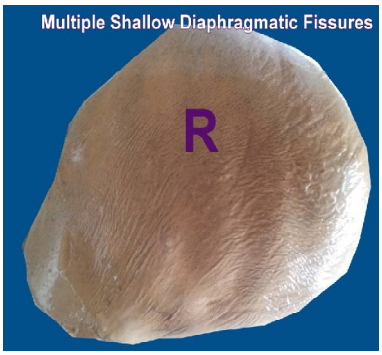
L-LEFT LOBE
C-CAUDATE LOBE
P-PAPILLARY PROCESS
GB- GALL BLADDER
R- RIGHT LOBE
IVC-INFERIOR VENA CAVA

Fig. 7: The wrinkled appearance of the superior surface of both the right and left lobes of the liver due to multiple diaphragmatic furrows. The smooth contour of the surface is lost.



R-RIGHT LOBE
L-LEFT LOBE

Fig. 8: The wrinkled appearance of the entire right latteral surface of the liver due to shallow but extensive occurrence of diaphragmatic furrows.



R-RIGHT LATERAL SURFACE

Table 1: Showing the incidence of Diaphragmatic and Accessory fissures in the different lobes of liver in the present study.

S.No.	Lobes of the Liver	No. of Livers	% of fissures
1	Right Lobe	12	26.66%
2	Left Lobe	2	4.44%
3	Caudate Lobe	3	6.66%
4	Quadrate Lobe	0	0

Table 2: Showing the incidence of the diaphragmatic and accessory fissures reported by various authors.

Name of the Authors with years	% of Accessory Fissures
Ono ML (2000)	11.90%
Veronica Macchi (2003)	40%
Faizah B Othman (2008)	5%
B Senthil Kumar (2012)	18%
Hussein Muktyaz (2013)	12.10%
Sunitha Vinnakota (2013)	53.44%
Satheesha Nayak B (2013)	1.81%
Satish Jain (2015)	36.10%
S. Saritha (2015)	30%
Shamir O Cawich (2016)	12%
Present study	31.10%

Table 3: Showing the comparative study of incidence of diaphragmatic and accessory fissures with the earlier authors.

Sl.No	Lobes of the Liver	S Saritha	Satheesha N B	Present Study
1	Right Lobe	16%	0	26.66%
2	Left Lobe	2%	1.81%	4.44%
3	Caudate Lobe	6%	0	6.66%
4	Quadrate Lobe	10%	0	0

DISCUSSION

In the present study, the maximum percentage of diaphragmatic and accessory fissures were seen in the right lobe of the livers. The number of diaphragmatic fissures varied from one, two to many. They were single deep, dual deep and multiple shallow and broad occurring in the antero superior surface, anterior and posterior superior surface respectively. Satheesha N B [11] reported the incidence of diaphragmatic fissures in the antero superior surface of a large liver where left lobe was larger than the right lobe. The two diaphragmatic fissures appeared as two deep notches. In the present study similarly two notches were present on the right lobe but the left lobes was smaller and normal. Joshi et.al. [12] reported the incidence of diaphragmatic fissures in the antero superior surface to be 2 to 6 in number. In the present study up to 9 multiple fissures were seen but on the postero superior surface of the right lobe of the liver.

Veronica Macchi [13] reported their incidence to be 40% at autopsy and all fissures were present in the right lobe of the liver. 47% of this fissures were multiple. In the present study the incidence of the fissures was 26.66% , mostly seen in the right lobe. One liver showed the furrowing of diaphragmatic muscle fibers on the superior surface of both right and left lobes. Studies using the corrosion casts showed that rather than the action of hypertrophied muscle bundles, the pressure exerted by the diaphragm as a whole could be responsible for the production of the fissures at level of weak zones represented by the portal fissures where the hepatic parenchyma exhibits a lower resistance to the external pressure. Zahn [3] reported the incidence of the diaphragmatic fissures to be more frequent on the superior surface of the right lobes and rarely on the left lobe. In the present study a liver showed diaphragmatic fissures on the superior surface of both the right and left lobes giving rise to a wrinkled appearance. A liver showed the indentation of the diaphragmatic muscle fibers that caused wrinkling of the entire right lateral surface.

S. Saritha [14] reported the incidence of the accessory fissures to be 16% in the right lobe and 2% in the left lobe. In the present study their incidence was 26.66% in the right lobe and 4.44% on the left lobe. She reported their incidence on the caudate lobe to be 6% and on quadrate lobe tobe 10%. In the present study the incidence is 6.66% and 0% respectively. Joshi et.al.,[12] reported a higher incidence of accessory fissures in both caudate lobe and quadrate lobe to be 18% and 20% respectively which is much higher when compared to the present study. Sunitha Vinnakota [15] reported the highest incidence of accessory fissures on the inferior surface of the livers to be 53.44%. and quadrate lobe be 35.48%. these results are not coinciding with those of the present study. However, in the present study no accessory fissures were seen on the quadrate lobe instead the caudate lobes of 3 livers showed accessory fissures. One of them showed two small accessory fissures on the caudate lobe.

Faizah B Othman [16], Satheesha Nayak B [18] reported their incidence to be 5% in the right lobes and 1.81% in the left lobes respectively. Shamir [17] reported the incidence of accessory sulci in afro-caribbean population to be 12%. Satheesha Nayak B [18]reported the incidence of accessory fissure which divided the left lobe into two parts. Auh et .al.,[4] reported that

onlyone accessory fissure out of four was correctly identified on C.T. Scans often misdiagnosed as pathological lesions .satish jain [19] reported their occurrence to be 36.1% and the present study reports it to be 31.1%. According to Satish Jain [19] 11 accessory fissures occurred in the region of porta hepatis and 2 on the rest of the inferior surface. In the present study only 2 livers showed the accessory fissures close to the porta hepatis. The accessory fissures are potential sources of diagnostic errors during imaging. Any fluid collection in them may be mistaken for a liver abscess or cyst or intrahepatic haematoma

CONCLUSION

The routine anatomy text books don't even mention about the diaphragmatic fissures and accessory sulci / fissures. The only source of their information are the research reports. The present study highlights their occurrence on all the surfaces of the right lobe of the liver. In one of the larger liver specimen multiple and shallow diaphragmatic fissures were seen on the superior surface of the left lobe also. The knowledge of the diaphragmatic fissures and accessory sulci may be gainfully utilized by forensic specialists while performing postmortem study as they mimic injuries of abdominal trauma, Radiologists while interpreting Sonograms, C.T. and M.R.I scans. Also, Confusion during hepatic resection and transplantation can be avoided by hepatobiliary surgeons.

ACKNOWLEDGEMENTS

This publication is dedicated to Senior Advocate Sri Vedula Venkataramana Garu, a towering personality, tall and handsome, doyen in Law, roaring lion, brilliant in arguments, with great stunning memory. He is an inspiration for so many hardworking people. I thank H.O.D and the staff of Department of Anatomy for supporting me. I also thank Mr. J. George William. Librarian, Shadan Institute of Medical Sciences, for all his help and Mr. Verma for labeling the pictures.

Conflicts of Interests: None

REFERENCES

[1]. John E. Skandalakis,MD, PhD, Lee J. Skandalakis, MD, Panajiotis n. Skandalakis, MD, Petros Mirilas, MD, Msurg, Hepatic surgical anatomy, Surgical clinics of North America, 2004;84:413-435.

[2]. Standring S, Ellis H, Healy JC, et al. Liver in: Standring S, ed Gray's Anatomy: The Anatomical Basis of Clinical Practice. 39th ed. London: Elsevier Churchill Livingstone, 2005; 1213-25.

[3]. Zahn FW. Note sur les plis respiratories du diaphragm et les sillons diaphragmatiques du foie. Rev. Med Suisse Romande. 1882;2:531-535.

[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]. Thompson A: the morphological significance of certain fissures in the human liver. J Anat Physiol 1899;33:22.

[6]. Macchi V, Porzionato A, Parenti A, et al. Main accessory sulcus of the liver. Clin Anat.2005;18:39-45.

[7]. Suksaweang S, Lin CM, Jiang TX, Hughes MW, Widelitz RB, Choung CM. Morphogenesis of chicken liver: identification of localized growth zones and the role of beta-catenin/Wnt in size regulation. Dev Biol 2001;266:109-122.

[8]. Newell RLM M-JR: Grooves in the superior surface of the liver. Clin Anat 1933;18:39-45.

[9]. Auh YH, Rubenstein WA. Ziirinsky K, Kneeland JB, Pardes JC, Engel IA, Whalen JP, Kazam E. Accessory fissures of the liver: C.T. and sonographic appearance. AJR. Am J Roentgenol 1984: 3: 565-572.

[10]. Johnson PB, Cawich SO, Roberts P, Shah S, et al., Variants of hepatic arterial supply in a Caribbean population: A computed tomography based study. Clin. Radiol. 2013;68(8):823-827.

[11]. Satheesha Nayak B, Prasad A M, Narendra Padmidi, Bincy M George. Notched liver associated with subhepatic caecum and appendix – a case report. International Journal of Anatomical Variations . 2012;5:48-50.

[12]. Joshi SD, Hoshi S S, Agthavale S A, some interesting observations on the surface features of the liver and their clinical implications, Singapore Med J. 2006;50(7):715-719.

[13]. Veronica Macchi, Glampietro Feltrin, Anna Parenti, and Raffaele De Caro. Diaphragmatic sulci and portal fissures. Journal of Anatomy.2003;202(3):303-308.

[14]. S. Saritha, Ramani, Nagajyothi, yesender. Cadaveric study of morphological variations in the human liver and its clinical importance. Valley International Journals. International journal of Medical Sciences and Clinical Inventions. 2015;2(6):1020-1031.

[15]. Sunitha Vinnakota, Neelee Jayasree. A New Insight into the Morphology of the Human Liver: A cadaveric Study. 2013;http://dx.doi.org/10.5402/2012/689564.

[16]. Faizah B. Othman, MD, PhD. Azian A. Latiff, MD, PhD, Farihab H. Subaiml. MBBS. PhD, Srijit Das, MBBS, MS. Accessory sulci of the liver, Saudi Med J 2008; 29(9):1247-1249.

[17]. Sharmir O. Cawich, Michael T. Gardner, Ramnanand Shetty, Neil W. Pearce, Vijay Naraynsingh. Accessory Inferior Sulci of the Liver in an Afro-Caribbean Population. Int. j. Biomed Sci. 2016 Jun; 12(2): 58-64.

[18]. Satheesha Nayak B. A study on the Anomalies of Liver in the south Indian Cadavers.int. J. Morphol., 2013;31(2):658-661.

[19]. Satish Jain, Indersain Gupta, Monica Jain, RP Singal. Accessory Sulci of Liver in the Population of Haryana. Int.J. Anat. Res. 2015;3(2):977-79.

How to cite this article:

Tallapaneni Sreekanth DIAPHRAGMATIC FISSURES AND ACCESSORY SULCI OF LIVER IN THE POPULATION OF TELANGANA. Int J Anat Res 2016;4(4):3273-3278. **DOI:** 10.16965/ijar.2016.458