Syeda Shabeeh Rubab,¹ Warisha Iftikhar,² Iram Atta,³ Tehreem Fatima,⁴ Saira Aslam,⁵ Areebah Akram⁶

ABSTRACT

Background and Objective: Rouvier's Sulcus is present as an indentation on the inferior aspect of right lobe of liver. It is used as an anatomical landmark by surgeons to begin dissection during laparoscopic cholecystectomy. It may be oriented horizontally, obliquely or vertically. The aim of our study was to determine the morphological appearance, size, frequency, types and orientation of Rouvier's Sulcus.

Methods: A cross-sectional study was conducted on 38 formalin fixed cadaveric livers from March 2024 to August 2024. The livers which were healthy on gross examination were taken and measurement of rouvier's sulcus was done along with its type and orientation.

Results: Rouvier's sulcus was present in 68% of the sample (mean length: 2.91cm). Three types were observed: Type 1A (46%), Type 1B (23%), and Type 2 (26.9%). Type 3 was rare (3.8%). Sulcus orientation was mainly oblique (80.7%) or horizontal (19.2%).

Conclusion: The rouvier's sulcus is a consistent, easily identifiable landmark unaffected by biliary inflammation or cirrhosis. Its most common morphology noted is Type I, facilitates clear visualization of biliary and vascular structures.

Key Words: Laparoscopic cholecystectomy, anatomical landmark, liver, rouvier's sulcus.

How to cite: *Rubab SS, Iftikhar W, Atta I, Fatima T, Aslam S, Akram A. Frequency and morphological pattern of Rouvier's sulcus in human liver. JAIMC. 2024;22(4); 123-126*

holecystectomy is the latest procedure used for removal of gall bladder. Laparoscopic approach is gold standard in this regard.¹ It is usually a safe procedure but can lead to serious complications due to lack of understanding of anatomy. Its most feared complication is injury of common bile duct or hepatic arteries.² It can be easily avoided by keeping in mind the presence of Rouvier's Sulcus. A safe cholecystectomy is the one without injury to bile flow and vascular injury. For this purpose, an anatomical landmark, that is Rouvier's Sulcus, is used.³

Rouvier's Sulcus is located on the right lobe of liver at its inferior aspect. It is mostly visible as a

1-4. Department of Anatomy SIMS, Lahore

6. Undergraduate Student, SIMS, Lahore

Correspondence:

Syeda Shabeeh Rubab, Department of Anatomy SIMS, Lahore. Email: syeda.ssr_786@hotmail.com

Submission Date:	05-11-2024
1st Revision Date:	30-11-2024
Acceptance Date:	13-12-2024

deep groove. Its morphological appearance shows marked differences in different people. It may not be present in some individuals. Roughly, it has been found that it is present in around 90% of total cases studied,⁴ and absent in rest of the cases. It is 2-5 cm long cleft commonly visible as a deep fissure.⁵ It accurately indicates place of common bile duct. Its anatomical importance is reflected in surgical procedures.⁶

The importance of this in the surgical world has led to its increased use in laparoscopic surgeries and consequently more studies on this subject. The R4U line is a hypothetical line along Rouvier's sulcus, extending from the porta hepatis to liver segment IV.⁷ It defines a plane for safe cholecystectomy. The cystic duct and artery lie above this plane and common bile duct lies below this plane. The area above the plane is thought to be a safe zone for laparoscopic cholecystectomy while the area below it is dangerous zone.⁸ Common bile duct is subjected to ligation if clamped in dangerous

^{5.} Department of Anatomy Fatima Memorial Hospital, Lahore

zone. The anatomy of this sulcus is not affected by any pathology.⁹ This sulcus is vaguely observed in open procedures but clearly in laparoscopic cholecystectomy because of presence of CO2 insufflation opening it widely and due to greater illumination and image quality of digital endoscopic cameras.

This sulcus has been named after the scientist who discovered it. Different terminologies have also been cited. Like it is also called Incisura Dextra of Ganz. It is also known by the name of sulcus of caudate process.¹⁰

Although its presence has led to safe surgical procedures, its morphology and frequency of occurrence are not well known. Though many attempts have been made in the past regarding this but still disparity remains there. The prevalence of these also varies from cadaver to cadaver. Though immensely important but still there is insufficient data about it. Whatever information exists about this comes from its initial discovery mainly. To fill this gap this study aimed to determine the morphological appearance, size, frequency, types and orientation of Rouvier's Sulcus.

METHODS

The study was done on 38 formalin fixed cadaveric liver from Anatomy Department of Services Institute Medical Sciences. It was carried out after ethical approval from IRB from March 2024 to August 2024. The sample included gross healthy livers without any mass growth or showing any gross inflammation. The frequency of presence of rouvier's sulcus was noted by examining visceral surface of right lobe of liver. The measurement of sulcus was done by metric scale. The orientation of sulcus (horizontal, oblique and vertical) was noted by using inferior border of liver as reference point¹¹. The type of sulcus (Type 1 deep, Type 2 slit and Type 3 scar) was also observed. The frequency and morphological types of rouvier's sulcus were analyzed using descriptive statistics in SPSS software (version 23.0) to provide a quantitative summary of the data.

RESULTS

The study revealed that rouvier's sulcus was present in (68%) n=26 of the sample, with a mean length of 2.91cm as mentioned in Table 1. The sulcus exhibited three distinct types: Type 1A (open deep sulcus) in (46%) n=12 as shown in Fig 1, Type 1B (closed deep sulcus) in (23%) n=6, and Type 2 (slitlike sulcus) in (26.9%) n=7 as shown in Fig 2. A fourth type, Type 3 (scar-like sulcus) as shown in Fig 3, was observed in (3.8%) n=1 of the livers. The sulcus orientation was predominantly oblique (80.7%) n=21 and horizontal (19.2%) n=5.

Table 1:	Morphology	and mor	phometry	of
Rouvier's	s sulcus.			

Parameters		Ν	%
Frequency of rouvier's sulcus		26	68%
	1A	12	46%
Type of rouvier's sulcus	1B	6	23%
	2	7	26.90%
	3	1	3.80%
Orientation of	Oblique	21	80.70%
rouvier's sulcus	Horizontal	5	19.20%
	Vertical	Nil	Nil



Figure 1: *Type 1A with oblique orientation. RS= rouvier's sulcus, LL=left lobe, CL=caudate lobe, QL=quadrate lobe, GB=gallbladder.*



Figure 2: Type 2 with horizontal orientation.



Figure 3: Type 3 with horizontal orientation. (RS= rouvier's sulcus, LL=left lobe, CL=caudate lobe, QL=quadrate lobe, GB=gallbladder)

Discussion

Rouvier's sulcus is an important surgical landmark for hepatobiliary surgery especially laparoscopic cholecystectomy. Our findings indicate that rouvier's sulcus was observed in a significant proportion 68% of the sample, although this frequency is lower than that reported by Sreevidya J et al. 90% in a similar study conducted in India⁴. There are different classifications for the types of Rouvier's sulcus in literature. But the most commonly used classification for types of rouvier's sulcus is deep, slit and scar type.¹² The frequency of rouvier's sulcus types in the present study shows a notable similarity to the findings reported by Bajpayee et al.¹³ There is no association in morphology of rouvier's sulcus with the anatomical variations of intra hepatic and extrahepatic biliary system.¹⁴ It is a fixed anatomical landmark and is not affected in any adhesion, inflammation or hemorrhage of gall bladder.

It is noted in literature that using rouvier's sulcus as an anatomical landmark during laparoscopic cholecystectomy decreases the risk of iatrogenic bile duct injury that is a common complication in patients with inflammation and adherence of gallbladder. The position of cystic duct and cystic artery in Calot's triangle is confirmed by surgeons for 'critical view of safety' before cutting any structure. Lockhart et al. have used the word "RANGERS" which means (Rouviere at Neck of Gallbladder Eases Recognition of Structures.¹⁵ The present study found that 80.7% of rouvier's sulcus exhibited an oblique orientation, which is significantly lower than the 29% reported by Voruganti et al. who instead observed a higher prevalence of horizontal orientation (69.8%).¹⁶ This anatomical landmark can help in identification of right hepatic duct and common bile duct. This sulcus is not visible by radiological techniques.¹⁷

The rouvier's sulcus lies anterior to segment VI and contains the right portal pedicle or its branches most commonly right anterior portal pedicle for segment VI and VII. Therefore, the rouvier's sulcus can be used as an important surgical landmark for segmental resection of segment VI and VII in case of trauma of liver and for colorectal liver metastasis. In the international nomenclature of anatomy, the term 'sulcus of caudate process' is used instead of Rouvier's Sulcus.¹⁸ A limitation of the present study is the lack of exploration of the sulcus contents. Future research should focus on exploring the contents of the sulcus to gain a more comprehensive understanding. There is also other accessory sulcus present in liver due to diaphragmatic muscle pull on liver's parenchyma. A surgeon's lack of familiarity with key anatomical landmarks can lead to misinterpretation and increased risk of iatrogenic bile duct injuries (IBDI). Enhancing knowledge of rouvier's sulcus can contribute to improved surgical safety protocols.

CONCLUSION

In the present study the most common type of rouvier's sulcus noted was Type 1 A with oblique orientation. This detailed knowledge of rouvier's sulcus will help surgeons in identification of common bile duct during laparoscopic cholecystectomy. It will also help in identification of the right portal pedicle during segmental resection of liver.

Ethical Approval:

The ethical approval was obtained vide letter no. IRB/2024/1490/SIMS.

Conflict of Interest:	None
Funding Source:	None

Author's Contribution

All authors read and approved the final draft.

Conceptualization study design	SSR, WI, IA
Data Acquisition	SSR, WI, IA, AK
Data Analysis/ interpretation	SSR, WI, TF
Manuscript drafting	SSR, WI, TF, SA
Manuscript review	SSR, WI, TF, SA, AK

REFERENCES

- 1. Mannam R, Narayanan RS, Bansal A, Yanamaladoddi VR, Sarvepalli SS, Vemula SL, et al. Laparoscopic cholecystectomy versus open cholecystectomy in acute cholecystitis. Cureus. 2023;15(9).
- 2. Fu JN, Liu SC, Chen Y, Zhao J, Ma T. Analysis of risk factors for complications after laparoscopic cholecystectomy. Heliyon. 2023;9(8).
- Yassein T, Ibrahim TM, Dawoud AS, Fayed YA. Importance of Rouviere's Sulcus in Laparoscopic Cholecystectomy. Egypt J Hosp Med. 2024;94:1104-8.
- Sreevidya J, Dharani V, Arumugam K, Savithri K. A cadaveric study on Rouviere's sulcus–morphology & morphometric study. Int J Acad Med Pharm. 2023;5(3):1277-9.

- 5. Jha AK, Dewan R, Bhaduria K. Importance of Rouviere's sulcus in laparoscopic cholecystectomy. Ann Afr Med. 2020;19(4):274-7.
- 6. Ragavan S, Muraleedharan A, Bage NN, Devi R. A comprehensive study and extensive review of morphological variations of liver with new insights. Surg Radiol Anat. 2022;44(3):455-66.
- 7. Gupta V, Jain G. The R4U planes for the zonal demarcation for safe laparoscopic cholecystectomy. World J Surg. 2021;45(4):1096-101.
- 8. Sebastian M, Sebastian A, Rudnicki J. Recommendation for photographic documentation of safe laparoscopic cholecystectomy. World J Surg. 2021;45:81-7.
- Deshatty DD, Shruthi BN, Kavitha S, Madhumitha LM. Morphometry and Morphology of Rouviere's Sulcus of Liver for Laparoscopic Cholecystectomy--A Cadaveric Study. J Evol Med Dent Sci. 2021;10(19):1403-8.
- 10. Manatakis DK, Tasis N, Antonopoulou MI, Agalianos C, Piagkou M. Morphology of the sulcus of the caudate process (Rouviere's sulcus) in a Greek population and a systematic review with metaanalysis. Anat Sci Int. 2022:1-0.
- 11. Ragavan S, Muraleedharan A, Bage NN, Devi R. A comprehensive study and extensive review of morphological variations of liver with new insights. Surg Radiol Anat. 2022;44(3):455-66.
- Kumar A, Shah R, Pandit N, Sah SP, Gupta RK. Anatomy of Rouviere's sulcus and its association with complication of laparoscopic cholecystectomy. Minimally invasive surgery. 2020;2020(1):-3956070.
- 13. Bajpayee P, NeeleshKanaskar PV, Manivikar PR. Significance of Rouviere's Sulcus in Hepatobiliary Surgery: A Cadaveric study. Int J Anat Res. 2021;9(3.2):8074-78.
- El-Saman BE, Abdulhalim Lasheen AM, Abdelaty WR. Role of Rouviere's sulcus in identification and dissection of Calot's triangle during Laparoscopic Cholecystectomy. Al-Azhar International Medical Journal. 2022;3(12):186-94.
- 15. Péré G, Benvegnu V, Mercé C, Maulat C, Carrère N, Lopez R. The sulcus of the caudate process (Rouviere's sulcus): anatomy and clinical applications—a review of current literature. Surg Radiol Anat. 2020;42(12):1441-6.
- Voruganti MR, Mohammed N, Gurrala RC, Chowdary GH, Devarakonda L. Rouviere's Sulcus: Anatomy and its Clinical Significance in Laparoscopic Cholecystectomy. World J Lap Surg. 2023;16(1):4-7.
- 17. Ugo L, Brocco S, Merola A, Mescoli C, Quaia E. Liver Anatomy. Imaging of the Liver and Intra-Hepatic Biliary Tract. Imaging Techniques and Nontumoral Pathologies. 2021:15-47.
- 18. Sanudo JR, Talarico EF, Duparc F, Vázquez T, Valderrama F, Mompeó Corredera BR. Practical pregraduate teaching in human anatomy: a review. Eur J Anat. 2021.