

ORIGINAL ARTICLE

Frequency of Rouviere's Sulcus and its Relation to the Dissection Time of Calot's Triangle

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ABSTRACT

Objective: To determine the frequency of Rouviere's Sulcus in patients undergoing laparoscopic cholecystectomy and assess its relationship with the dissection time of Calot's Triangle.

Methods: A descriptive cross-sectional study was carried out at the Department of General Surgery, Combined Military Hospital, Quetta, Pakistan, from November 2024 to January 2025. All patients undergoing elective laparoscopic cholecystectomy for uncomplicated cholelithiasis were included using non-probability consecutive sampling. Intraoperative identification of Rouviere's Sulcus was performed and classified into open, closed, and slit types. The operative dissection time of Calot's Triangle was recorded from the insertion of the last port to clipping of the cystic duct and artery.

Results: Among 52 patients, the median age was 34.5 (IQR 27-40) years. Rouviere's Sulcus was identified in 48 (92.3%) patients. Among visible Rouviere's Sulcus, the open type was most common 26 (54.2%), followed by closed 16 (33.3%) and slit types 6 (12.5%). Visibility was higher in patients ≤ 35 years 30 (100%) compared to >35 years 18 (81.8%). The median operative dissection time of Calot's Triangle was shorter in patients with visible Rouviere's Sulcus compared to those without 9.5 (8-13) vs. 14 (11-15) minutes.

Conclusion: Rouviere's Sulcus was visible in the majority of elective laparoscopic cholecystectomy cases, with open type being most common. Its presence was related with reduced dissection time, underscoring its role as a critical anatomical landmark for safe cholecystectomy.

Keywords: Biliary Tract Surgical Procedures, Biliary Tract Anatomy, Cholecystectomy, Laparoscopic, Intraoperative Period.

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INTRODUCTION

Laparoscopic cholecystectomy has become one of the most common surgical procedures in general surgery worldwide due to its minimally invasive nature, reduced postoperative pain, shorter hospital stay, and quicker recovery.¹ Moreover, surgeons are now advised to identify and follow specific anatomical landmarks during laparoscopic cholecystectomy to improve orientation and ensure safer dissection.² The common anatomical landmark or reference is Rouviere's Sulcus.²⁻⁴ Its identification during laparoscopic cholecystectomy is crucial, as it serves as a reliable anatomical landmark; the cystic duct and cystic artery consistently lie anterosuperior to the sulcus, thereby aiding in the correct identification of Calot's triangle and reducing the risk of bile duct injury.⁵

Calot's triangle is bordered superiorly by the inferior surface of the liver, laterally by the cystic duct, and

medially by the common hepatic duct.⁶ Rouviere's Sulcus serves as a valuable extra-biliary anatomical landmark for initiating dissection and confirming the location of Calot's triangle. Its identification can help prevent bile duct injuries and thereby improve surgical outcomes.^{3,7} This landmark thus plays a critical role in enhancing the safety of laparoscopic cholecystectomy.^{8,9}

Despite its importance, the frequency of Rouviere's Sulcus and its impact on operative efficiency remain underreported in the Pakistani population. This study aims to document the prevalence of Rouviere's Sulcus and evaluate whether its visibility influences dissection time. By comparing operative time between cases with a clearly visible versus non-visible Rouviere's Sulcus, this study will provide objective evidence on its role in improving surgical efficiency and patient outcomes. The findings will help surgeons incorporate Rouviere's Sulcus identification as a reliable intraoperative

landmark, potentially reducing operative time, minimizing complications, and enhancing patient safety in laparoscopic cholecystectomy.

METHODS

This cross-sectional study was conducted at the department of General Surgery, Combined Military Hospital (CMH) Quetta, Pakistan from November 2024 to January 2025. Ethical approval was obtained from the ethical committee of CMH Quetta (Ref #: CMH QTA-IERB/59/2024). Patient confidentiality and autonomy were strictly maintained, and participants retained the right to withdraw from the study at any stage with no impact on the treatment.

The inclusion criteria were patients aged 20-65 years, of either gender, with ultrasound-confirmed uncomplicated cholelithiasis undergoing elective laparoscopic cholecystectomy. While patients with acute cholecystitis (clinical or radiological), severe adhesions, gallbladder wall >4mm, pericholecystic fluid, prior upper abdominal surgery, or conversion to open cholecystectomy were excluded.

Rouviere's Sulcus was defined as a transverse cleft on the inferior surface of the liver, situated lateral to the hepatic hilum and anterior to the caudate process, commonly housing the right posterior branch of the portal vein. Its classification applies only to cases where Rouvière's Sulcus was identified intraoperatively. In cases where Rouviere's Sulcus was identifiable during surgery, it was intraoperatively categorized into four distinct types: open, with the medial end opening toward the porta hepatis allowing visualization of portal structures; closed, where the medial end terminated before reaching the porta hepatis; slit-like, appearing as a shallow groove with only its length appreciable; and scar-type, presenting as a thin, white linear mark. Calot's Triangle was an anatomical region bounded superiorly by the inferior surface of the liver, laterally by the cystic duct, and medially by the common hepatic duct. The operative dissection time of Calot's Triangle was defined as the time from insertion of the final port to the application of clips on the cystic duct and artery.

All laparoscopic cholecystectomies were carried out by two surgeons with a minimum of five years of post-fellowship experience to ensure procedural consistency and reduce inter-operator variability. A standard four-port technique was utilized, involving two 10 mm ports at the umbilicus and epigastric region, and two 5 mm ports placed in the right hypochondrium at the mid-clavicular and anterior axillary lines. The

initial port was introduced using the Hasson open technique to establish pneumoperitoneum. Subsequent ports were placed under direct vision, and the start time of the procedure was documented. Rouviere's Sulcus was identified intraoperatively, and dissection of Calot's Triangle was initiated superior to its level. The cystic artery and cystic duct were individually dissected, clearly identified, and clipped. Completion time was recorded following secure ligation of these structures. The gallbladder was then retrieved through the 10 mm epigastric port, and all port sites were closed using non-absorbable sutures.

Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. Categorical variables such as gender, presence or absence of Rouviere's Sulcus, types of Rouvière's Sulcus, and comorbidities were reported as frequencies and percentages. Continuous variables such as age and dissection time were presented as median with interquartile range (IQR). Fisher-Exact test was applied to see the relationship of Rouvière's Sulcus types with general characteristics of the patients. Furthermore, Kruskal-Wallis test were applied to compare the median dissection times across the different types of Rouviere's Sulcus, with statistical significance set at p -value ≤ 0.05 .

RESULTS

Of total 52 patients undergoing laparoscopic cholecystectomy, the median age was 34.5 (27-40) years, with 30 (57.7%) of the patients aged ≤ 35 years and 22 (42.3%) aged > 35 years. The study cohort comprised 23 (44.2%) male and 29 (55.8%) female patients. The presence of comorbidities was also analyzed, with 7 (13.5%) patients diagnosed with diabetes mellitus and 16 (30.8%) patients having hypertension.

Rouviere's Sulcus was intraoperatively visualized in 48 (92.3%) patients, while it was not identified in 4 (7.7%) patients. Among those in whom the sulcus was visible, the open type was the most frequently observed configuration, seen in 26 (54.2%) patients, followed by the closed type in 16 (33.3%) patients and the slit type in 6 (12.5%) patients (Figure 1).

Rouvière's Sulcus was more frequently visible in patients aged ≤ 35 years 18 (81.8%) and in those with diabetes mellitus 4 (57.1%). However, no statistically significant differences were observed between the type of Rouvière's Sulcus and patient characteristics such as age (p -value 0.134), gender (p -value 0.473), diabetes mellitus (p -value 0.611), and hypertension (p -value 0.492). (Table 1).

The median dissection time of Calot's Triangle was 9.5 (8-13) minutes in patients with a visible Rouviere's Sulcus and 14 (11-15) minutes in those where it was not visible (Figure 2). Patients aged >35 years had a shorter median dissection time 8 (7-9) minutes in the visible group compared to those aged ≤35 years 12 (8-14) minutes.

Among different types of Rouviere's Sulcus, the median dissection time was 8.5 (7-13) minutes for the open type, 9 (8-13) minutes for the closed type, and 11 (10-13) minutes for the slit type. No significant differences were observed in dissection time across age groups, gender, or comorbidities (p-value >0.05) (Table 2).

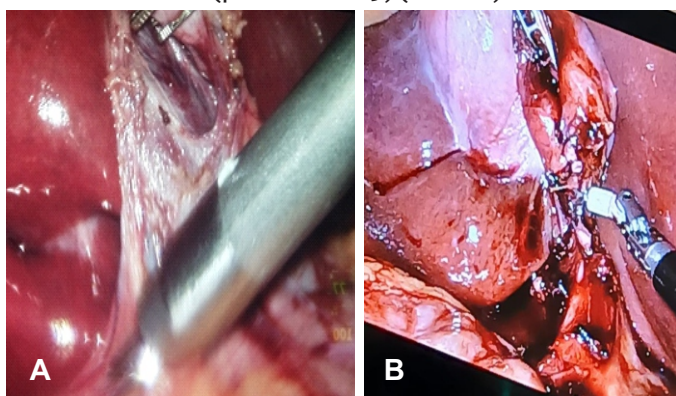


Figure 1: Closed and Slit type of Rouviere's Sulcus.

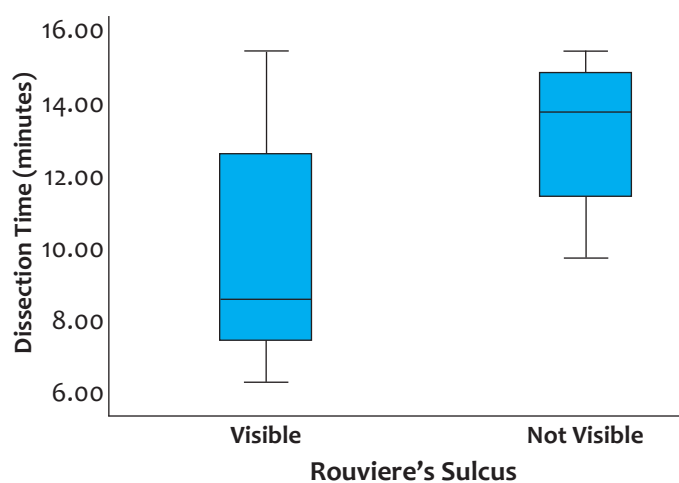


Figure 2: Median dissection time (minutes) by presence of Rouviere's Sulcus

DISCUSSION

The present study demonstrated a high intraoperative visibility of Rouviere's Sulcus, with identification achieved in over 90% of cases. This frequency is in agreement with previous anatomical and surgical studies by Nyaanga et al, Basukala et al, and Dahmane et al, which have demonstrated Rouviere's Sulcus presence in 80-90% of laparoscopic cholecystectomy cases.¹⁰⁻¹² Moreover, the predominance of the open

type, followed by the closed type and slit type, is consistent with findings by Basukala et al. and Manatakis et al, who reported a similar distribution of Rouviere's Sulcus types among patients.^{11,13} The predominance of the open-type sulcus in our cohort and previous studies reinforces its utility as a readily identifiable anatomical landmark during laparoscopic cholecystectomy.

The study revealed that dissection time was prolonged in patients over 35 years of age, suggesting that age-related changes in liver morphology may influence its anatomical presentation. Additionally, a novel finding of this study was the higher non-visibility rate of Rouviere's Sulcus in hypertensive patients, which could be attributed to chronic inflammation and fibrosis associated with hypertension, potentially leading to anatomical distortions. These findings are biologically plausible, as both advancing age and hypertensive vascular changes may contribute to denser connective tissue, adhesions, or altered vascular anatomy, complicating the dissection process. These findings reinforce the widely accepted importance of identifying Rouviere's Sulcus as a critical landmark for initiating the dissection of Calot's Triangle, thereby enhancing the safety of laparoscopic cholecystectomy, as supported by previous studies as well.¹⁴⁻¹⁸

The dissection time of Calot's Triangle was shorter in patients with a visible Rouviere's Sulcus compared to those without. In a study, Kumar A et al. reported that the mean operative time in Rouviere's sulcus visible group is 29.16 ± 8.736 minutes which is less than the Rouviere's sulcus not visible group i.e. 42.9 ± 23.646 minutes.⁴ Notably, the type of Rouviere's Sulcus did not significantly influence dissection time, suggesting that its mere presence, regardless of classification, is a useful anatomical guide. Furthermore, this may suggest that while the presence of Rouviere's Sulcus offers general orientation benefits during surgery, its morphological subtype may not independently influence operative efficiency in a measurable way, particularly in experienced hands using standardized techniques.^{19,20}

The findings of this study reinforce the clinical importance of Rouviere's Sulcus as a dependable anatomical landmark in laparoscopic cholecystectomy. While the morphological subtype did not show a statistically significant impact on dissection time, its intraoperative recognition still provides a crucial reference point that may aid in orienting the dissection plane and avoiding biliary injury. This is particularly useful in cases with distorted anatomy due to inflammation, adhesions, or previous interventions,

Table 1: Relationship between types of Rouviere's Sulcus with general characteristics of the patients (n= 48)

Variables	Type of Rouviere's Sulcus			p-value
	Open (n=26)	Closed (n=16)	Slit (n=6)	
Age (years)				
≤35	18 (60.0)	7 (23.3)	5 (16.7)	0.134
>35	8 (44.4)	9 (50.0)	1 (5.6)	
Gender				
Male	12 (54.5)	6 (27.3)	4 (18.2)	0.473
Female	14 (53.8)	10 (38.5)	2 (7.7)	
Comorbidities				
Diabetes Mellitus	3 (75.0)	1 (25.0)	0 (0)	0.611
Hypertension	6 (46.2)	6 (46.1)	1 (7.7)	0.492

Fisher-Exact test applied

Table 2: Median dissection time across different types of Rouviere's Sulcus, stratified by patient characteristics (n = 48)

Dissection Time (minutes)	Type of Rouviere's Sulcus			p-value
	Open	Closed	Slit	
	Median (IQR)	Median (IQR)	Median (IQR)	
Total	8.5 (7-13)	9 (8-13)	11 (10-13)	0.420
Age (years)				
≤35	10 (7-14)	13 (12-14)	11 (10-14)	0.290
>35	14 (11-15)	8 (7-9)	8 (8-8)	0.896
Gender				
Male	10 (10-10)	9 (7-14)	11 (9-14)	0.584
Female	8 (7-10)	8 (7-9)	14 (13-14)	0.423
Comorbidities				
Diabetes Mellitus	9 (8-9)	8 (8-8)	-	0.317
Hypertension	8 (8-9)	8 (7-9)	8 (8-8)	0.928

Kruskal-Wallis test applied

where conventional landmarks may be obscured. A major strength of this study is its prospective design and the inclusion of surgeons with standardized surgical experience, reducing variability in Rouviere's Sulcus identification and dissection time measurement. Additionally, the study provides new insights into the relationship between Rouviere's Sulcus visibility and diabetes, which has not been extensively reported before. However, this study has some limitations. The small sample size limits the generalizability of the findings. The use of non-probability sampling may introduce selection bias. Furthermore, intraoperative visibility of Rouviere's Sulcus may be influenced by surgeon experience, though this was controlled by including only experienced surgeons. The study did not account for liver morphology variations or prior abdominal surgeries, which could have affected Rouviere's Sulcus visibility. Future studies should include larger, multi-center cohorts to validate these

findings. Further research is needed to explore the impact of hepatic fibrosis and metabolic diseases on Rouviere's Sulcus visibility. Additionally, longitudinal studies could assess whether Rouviere's Sulcus visibility correlates with long-term postoperative outcomes, such as bile duct injuries. Advances in preoperative imaging techniques, such as high-resolution ultrasound, could also be evaluated to determine their role in preoperatively predicting Rouviere's Sulcus presence.

CONCLUSION

Rouviere's Sulcus was identified in the majority of patients undergoing laparoscopic cholecystectomy, with the open type being the most prevalent. Although its morphological subtype did not significantly affect the dissection time of Calot's Triangle, the sulcus remains a valuable extra-biliary landmark for ensuring safe dissection, particularly when operating above its

level. Routine identification of Rouviere's Sulcus may enhance intraoperative orientation and contribute to reducing the risk of bile duct injury, especially in complex cases.

ETHICAL APPROVAL: This study was approved by the Institutional Ethical Review Board, CMH Quetta, (Registration number CMH QTA-IERB/59/2024, dated: 13.12.2024)

AUTHOR'S CONTRIBUTIONS: FS, TMF: Substantial contributions to the conception or design of the work. FS, MWAB: Acquisition, analysis, and interpretation of data; methodology. FS, MWAB, TMF: Drafting the manuscript or revising it critically for important intellectual content. FS, TMF, MAT, FF: Provided supervision and/or project administration, including oversight of the research activity planning and execution. All authors approved the final version of the manuscript to be published.

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