ORIGINAL ARTICLE

# Revealing Rouviere's Sulcus: An Observational Study on Anatomy Presence and Clinical Significance in Laparoscopic Cholecystectomy at a Tertiary Care Center in Tamil Nadu

Anson Renil[1], Ram Prasath[2], Sujith Kumar[3], Catherine Rexy[4]

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## Abstract

**Purpose:** In the realm of laparoscopic cholecystectomy, the significance of Rouviere's Sulcus as a pivotal physiological landmark cannot be overstated. Its identification plays a crucial role in facilitating the meticulous dissection of Calot's triangle, ensuring the secure ligation of the cystic artery and duct, and ultimately preventing common bile duct injuries. Understanding the anatomical variations of Rouviere's Sulcus is paramount for surgeons aiming to enhance the precision and safety of this common surgical procedure.

**Materials and methods:** This observational study was designed to meticulously examine 49 patients presenting with confirmed gallstones, identified through ultrasound of the abdomen, in the general surgery outpatient department. The individuals included in the study were aged 19 years and above, representing both genders. The study methodology involved a comprehensive observation during laparoscopic cholecystectomy procedures.

**Results:** Among the 49 patients subjected to laparoscopic cholecystectomy, the visualization of Rouviere's Sulcus was achieved in 46 cases (93.9%). The observed variations in Rouviere's Sulcus were diverse, revealing distinct anatomical configurations: Open type: 23 cases (46.9%), closed type: 7 cases (14.3%), slit type: 9 cases (18.4%), scar type (oblique): 4 cases (8.2%), scar type (transverse): 3 cases (6.1%) and absent: 3 cases (6.1%).

**Conclusion:** These findings underscore not only the high prevalence of Rouviere's Sulcus but also the diverse nature of its anatomical presentations. The recognition of such variations emphasizes the need for a nuanced and individualized surgical approach, ensuring the utmost safety and efficacy in laparoscopic cholecystectomy.

**Keywords:** Bile duct injuries, Laparoscopic cholecystectomy, Rouviere's sulcus.

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## Introduction

To ensure effective and safe dissection in surgical procedures, a profound understanding of surgical anatomy is paramount. The advent of laparoscopy, while revolutionizing surgical approaches, has brought about challenges, particularly an increased risk of bile duct damage during laparoscopic cholecystectomy now considered the "Gold Standard" treatment for symptomatic gall stones.[1] The limitations of laparoscopy, with its inherent 2-D perspective on anatomical structures existing in a 3-D axis, pose difficulties for surgeons in identifying these structures accurately. Various factors contribute to the heightened risk of bile duct damage during laparoscopic cholecystectomy, including hemorrhage, aberrant anatomy, inflammation or infection in cases of acute cholecystitis, and the experience level of the surgeon.[2] The complex interplay of these factors necessitates innovative approaches to mitigate iatrogenic damage to the biliary system and prevent complications associated with this commonly performed procedure.

In recent years, research efforts have been dedicated to exploring diverse methods aimed at reducing the incidence of iatrogenic biliary system injuries during laparoscopic cholecystectomy. These endeavors encompass advancements in imaging technologies, refining surgical techniques, and developing guidelines to enhance the overall safety and efficacy of the procedure. By addressing the multifactorial nature of bile duct injuries in laparoscopic cholecystectomy, these research initiatives strive to elevate the standard of care, ultimately minimizing the risks associated with this widely adopted surgical intervention.

In laparoscopic cholecystectomy, bile duct injuries are rare, occurring 0.5% or less frequently. Bile duct injuries still occur and the rates of injury have not significantly decreased despite improvements in laparoscopic surgery.[3] In the past ten years, with an increased focus on patient safety, it has been advised to recognize and adhere to some significant landmarks as reference points. Doing so may help the surgeons determine where to start

[1–3]Department of General Surgery, Karpaga Vinayaga Institute of Medical Sciences & Research Center, Chengalpattu, Tamil Nadu, India

[4]Department of Community Medicine, Karpaga Vinayaga Institute of Medical Sciences & Research Center, Chengalpattu, Tamil Nadu, India

**Corresponding Author:** Anson Renil, Department of General Surgery, Karpaga Vinayaga Institute of Medical Sciences & Research Center, Chengalpattu, Tamil Nadu, India, Phone: +91 9488969099, e-mail: Ansonrenil@gmail.com

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the dissection by helping them recognize the plane of the common bile duct even before the dissection begins.

The Rouviere's sulcus is a significant landmark that has been discussed in more recent papers. The fissure that exhibits a person's name was initially labeled in 1924 by French surgeon MH Rouviere. The posterior bed dissection in the laparoscopic cholecystectomy procedure at the beginning itself will disclose Rouviere's sulcus, a 2–5 cm fissure located between the right lobe and caudate process in the liver which provides an easier way for dissection calot's triangle.[4,5] It has either its branches or the appropriate entrance toad. Accurately locating the common bile duct plane is the function of the sulcus.

Rouviere's sulcus is prominently visualized when the abdomen is inflated with $CO_2$ at the beginning of the procedure due to the widening of the fissure, and the enhanced illumination and image quality of the digital laparoscopy triple chip high-definition cameras both make it conceivable easier to see the anatomy of Rouviere's sulcus during laparoscopic cholecystectomy effectively. This is in contrast to the open surgery era when it was difficult to see and describe this anatomy purely based on the tactile perception of the gallbladder and cystic duct.

Rouviere, Gans, and Chouinard's seminal work on liver anatomy was where we learned what little we do know about the sulcus. These investigations reported that the sulcus was present in most specimens but did not go into detail about its function. Its significance in advancing hepatectomy procedures was emphasized by Reynaud.[6] Hugh et al. were the first to emphasize the significance of it during laparoscopic cholecystectomy since it correctly identified the plane of the CBD. Hence, a safer and more efficient, less traumatic laparoscopic cholecystectomy can be performed by a surgeon with the help of viewing the Rouviere's sulcus. The significance of viewing the Rouviere's sulcus during the procedure is performed for the safe dissection of Calot's triangle in all the patients requiring laparoscopic cholecystectomy, the purpose of the study was to determine the incidence of routine sulcus frequency with its types while performing laparoscopic cholecystectomy.[7]

## Materials and Methods

This observational study was conducted on 49 patients who presented with Symptomatic Cholecystitis and underwent laparoscopic cholecystectomy from November 2022 to October 2023 in the Department of General Surgery, Karpaga Vinayaga Institute of Medical Sciences & Research Center, Chengalpattu, Tamil Nadu. The types of Rouviere's sulcus and the operation time were documented. All the data were entered into a Microsoft Excel sheet and verified before analysis using SPSS version 25.0. It shows that the observed data were not normally distributed. The experimental values were tabulated using frequency and percentage. The student *t*-test was used to examine the mean difference between operation time for minutes with Rouviere's groups and without Rouviere's groups. Consider the 5% level of significance.

### Sample Size Calculation

The proportion of Rouviere's Sulcus was reported as 76% by Dr Hitesh Bhatia et al.[2] in the recent edition of the Journal of Medical Science and Clinical Research. With this reference and assuming a 95% confidence interval, a 5% absolute precision value, and with the available population size of 48. The minimum required sample size will be 41~ 45.

$$n = \frac{Z^2_{1-\frac{\alpha}{2}} p(1-p)}{d^2}$$

### Inclusion Criteria

All patients of age ≥19 years with acute cholecystitis, calculous cholecystitis, cholelithiasis, gall bladder polyp, and gall bladder wall rupture disease who are undergoing laparoscopic cholecystectomy.

### Exclusion Criteria

Patients with complicated gallstone disease, patients willing to undergo open cholecystectomy, and not fit for general anesthesia. coagulopathy, severe cardiopulmonary disease, abdominal wall infection, pregnancy generalized peritonitis and massive ascites.

## Results

Out of 49 patients on whom the study was conducted, the majority were 40–50 years of age, and among both male and female patients, female patients had a higher prevalence of cholelithiasis (Table 1).

Out of 49 persons who underwent laparoscopic cholecystectomy. About 46 (93.9%) patients Rouviere's sulcus was visualized. In that open type was observed in 23 (46.9%), closed type was observed in 7 (14.3%), slit type was observed in 9 (18.4%), scar type oblique in 4 (8.2%) and transverse in 3 (6.1%). Absent in 3 (6.1%) patients (Fig. 1). In this Rouviere's sulcus was identified first and dissection was started from there the procedure was completed without any injury to the common bile duct. One case had been converted from lap to open cholecystectomy and the operation time was more than 55 minutes in a patient with absent Rouviere's sulcus (Table 2).

None of these patients had any intraoperative complications, while only 3 of them had a port-site infection as a major postoperative complication. Of all these individuals, only one had undergone surgery in such a way that laparoscopic cholecystectomy had been converted to open cholecystectomy.

**Table 1:** Descriptive statistics for demographical variables

| | *Frequency (n = 49)* | |
|---|---|---|
| *Characteristics* | *n* | *%* |
| Age-group (years) | | |
| 20–30 | 3 | 6.1 |
| 30–40 | 12 | 24.5 |
| 40–50 | 24 | 49 |
| 50–60 | 8 | 16.3 |
| Above 60 | 2 | 4.1 |
| Sex | | |
| Male | 24 | 49 |
| Female | 25 | 51 |
| Age | | |
| Mean ± SD | 45.18 ± 10 | |

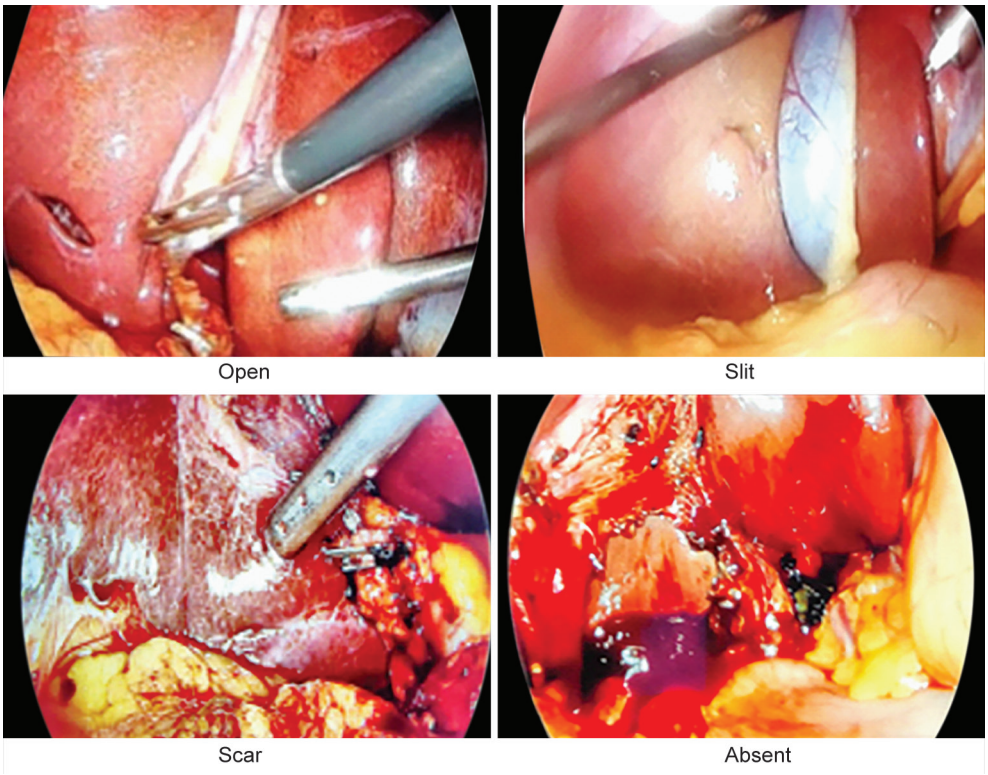


**Fig. 1:** Intraoperative images

**Table 2:** Descriptive statistics for study parameters

| | *Frequency (n = 49)* | |
|---|---|---|
| *Study parameters* | *n* | *%* |
| Diagnosis | | |
| Acute cholecystitis | 1 | 2 |
| Calculous cholecystitis | 3 | 6.1 |
| Cholelithiasis | 42 | 85.7 |
| Gall bladder polyp | 2 | 4.1 |
| Gall bladder wall rupture | 1 | 2 |
| Rouviere's sulcus | | |
| Present | 46 | 93.9 |
| Absent | 3 | 6.1 |
| Types of Rouviere's sulcus | | |
| Nil | 3 | 6.1 |
| Open | 23 | 46.9 |
| Slit | 9 | 18.4 |
| Scar | 7 | 14.3 |
| Closed | 7 | 14.3 |
| Scar | | |
| Oblique | 4 | 8.2 |
| Transverse | 3 | 6.1 |
| Intraoperation complication | | |
| Yes | 0 | 0 |
| No | 49 | 100 |
| Postoperative complication | | |
| No | 46 | 93.8 |
| Yes | 3 | 6.1 |
| Conversion to open | | |
| No | 48 | 98 |
| Yes | 1 | 2 |
| Operation time for minutes | | |
| Mean ± SD | 57.76 ± 11.27 | |

A student test shows that the probability value is less than 0.05, indicating a significant difference between the mean operation time for patients in minutes and Rouviere's sulcus ($t = 3.291$, $p = 0.002$). The result reveals that the absence of Rouviere's sulcus was influencing the operation time of surgery in minutes. The Rouviere's sulcus was prominent for 46 subjects, and the surgery time was shortened (mean = 56.52) compared to the rest of the 3 subjects, for whom the Rouviere's sulcus was absent, so the surgery time was prolonged (mean = 76.67) (Table 3).

## Discussion

Laparoscopic cholecystectomy is the most commonly followed gold standard procedure for cholelithiasis, and cholecystitis even though it is very challenging for the surgeons to do a safe laparoscopic cholecystectomy due to anatomical variations in the biliary tract

**Table 3:** The mean difference between operation time for minutes and Rouviere's sulcus

| | *N* | *Mean* | *SD* | *p-value* |
|---|---|---|---|---|
| Operation time for minutes | 46 | 56.52 | 10.481 | < 0.002* |
| | 3 | 76.67 | 2.887 | |

*p*-value considered as less than 0.05 is significant. *Highly significant

and gallbladder. The most common difficulty is dissection near the cystic artery and cystic duct. Improper dissection may lead to bile duct injury and cystic artery injury. Improper ligation of the cystic duct can cause biliary leakage and also in some patients more dreadful complications like complete transection of the common bile duct or thermal injury causing necrosis of the common bile duct.[8,9]

In this study, the identification and visualization of Rouviere's sulcus is an important landmark while performing laparoscopic cholecystectomy for safer dissection of Calot's triangle. We identified the Rouviere's sulcus in 94% of the patients, among visualized Rouviere's sulcus most common type, and least common type in this study. The operation time was increased from 30 minutes to 1 hour in patients where there is absence of Rouviere's sulcus.[10] Rouviere's sulcus can be used as a particular landmark to identify the structures within Calot's triangle and safer dissection to avoid bile duct injuries and complications.

## Conclusion

Out of 49 persons who underwent laparoscopic cholecystectomy 46 (93.9%) patients Rouviere's sulcus is visualized that open type observed in 23 (46.9%), closed type observed in 7 (14.3%), slit type observed in 9 (18.4%), scar type oblique in 4 (8.2%) and transverse in 3 (6.1%). Absent in 3 (6.1%) patients (Table 2 and Fig. 1). The Rouviere's sulcus was identified first, dissection started from there, and the procedure was completed to prevent accidental injury to the common bile duct. One case had been converted from lap to open cholecystectomy and the operation time was more than 55 minutes in a patient with absent Rouviere's sulcus.

In summary, identifying Rouviere's sulcus at the outset of surgery is a prudent step that strengthens surgical confidence, facilitates safe dissection, reduces operative time, and ultimately minimizes the risk of complications such as bile duct injury. Surgeons often rely on such anatomical landmarks to navigate complex procedures with precision and safety.

## Ethical Committee Approval

The Institutional Ethics Committee of Karpaga Vinayaga Institute of Medical Sciences & Research Center, Maduranthagam, reviewed and discussed the application for approval for the above study, and the proposal is approved. My approval number IEC Ref. No: KIMS/PG/2022/39.

## Orcid

*Anson Renil* https://orcid.org/0009-0000-7987-0428
*Ram Prasath* https://orcid.org/0000-0003-0198-9490
*Sujith Kumar* https://orcid.org/0000-0002-3992-6842
*Catherine Rexy* https://orcid.org/0000-0002-6543-7524

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