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Original Research Article

Rouviere's sulcus: a surgical GPS guiding laparoscopic cholecystectomy

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ABSTRACT

Background: Laparoscopic cholecystectomy is the gold standard for managing gallstone disease but carries a risk of bile duct injury, particularly in cases of difficult anatomy or inflammation. Rouviere's sulcus, an extrahepatic biliary landmark, has been proposed as a guide to safer dissection. This study aimed to determine the prevalence and anatomical variations of Rouviere's sulcus in patients undergoing laparoscopic cholecystectomy and evaluate its role in preventing biliary tract injuries.
Methods: A prospective descriptive study was conducted between January 2021 and August 2022 involving 100 patients undergoing laparoscopic cholecystectomy at a tertiary care teaching hospital. The presence, type, and clinical utility of Rouviere's sulcus were documented, along with intraoperative and postoperative outcomes. Demographic, clinical, and surgical data were recorded and statistically analyzed.
Results: Rouviere's sulcus was identified in 79% of patients. The most common type was the open sulcus (60.75%), followed by closed (20.25%), slit (12.65%), and scar (6.32%) types. The conversion rate to open surgery was 21%, with reasons including difficult dissection, uncontrolled bleeding, bile duct injury, and bowel injury. Bile leak occurred in 5% of cases; four managed conservatively with endoscopic retrograde cholangiopancreatography (ERCP), and one required surgical management. No mortality was observed.
Conclusions: Rouviere's sulcus is a reliable anatomical landmark present in the majority of patients, aiding in safe dissection and reducing bile duct injury risk during laparoscopic cholecystectomy. The routine identification and use of this landmark should be incorporated into surgical practice, although awareness of its absence or difficult visualization in a minority of cases is essential.

Keywords: Laparoscopic cholecystectomy, Safe laparoscopic cholecystectomy, Rouviere's sulcus, Bile duct injury

INTRODUCTION

Cholelithiasis is one of the most common conditions encountered in general surgical practice. Traditionally, cholecystectomy was performed via an open approach using a subcostal incision; however, over the past two decades, advances in minimally invasive surgery have established laparoscopic cholecystectomy as the procedure of choice.[1] Numerous randomized controlled trials and meta-analyses have demonstrated reduced postoperative pain, lower wound infection rates, faster recovery, and shorter hospital stay with the laparoscopic approach.[2,3]

Despite these advantages, laparoscopic cholecystectomy is associated with a higher incidence of iatrogenic bile duct injury compared to open surgery, primarily due to misidentification of biliary anatomy.[4] Several studies have highlighted the importance of anatomical landmarks in preventing such injuries.[5,6]

Rouviere's sulcus is an important extrahepatic biliary landmark that can guide safe dissection during

laparoscopic cholecystectomy.[7] By extrapolating an imaginary line from the sulcus through the porta hepatis to the base of segment IVb of the liver, a safe dissection plane can be identified above this line, where the cystic duct and artery lie.[8] The area below this plane should be avoided to prevent injury to the common bile duct.

Clinically reported studies suggest that Rouviere's sulcus is present in a majority of patients and can be reliably identified intraoperatively.[9,10] Its identification is particularly useful in cases where conventional landmarks are obscured due to inflammation, edema, or fibrosis.

With the widespread adoption of laparoscopic cholecystectomy, the incidence of bile duct injuries has increased, emphasizing the need for consistent anatomical landmarks.[4]

This study aims to evaluate the prevalence and anatomical variations of Rouviere's sulcus and assess its role in guiding safe dissection during laparoscopic cholecystectomy.

METHODS

Study design and setting

This was a prospective descriptive study, conducted at Department of General Surgery, Sir JJ Group of Hospitals, Mumbai, India. Carried out from January 2021 to August 2022 and sample size was 100 patients.

Inclusion criteria

Patients aged 18-70 years undergoing laparoscopic cholecystectomy for gallstone disease or related pathologies were included in the study.

Exclusion criteria

Patients with age <18 or >70 years, contraindicated for general anesthesia or laparoscopic procedures, not providing informed consent and pregnant or nursing women were excluded from the study.

Data collection

Demographic and clinical data

Age, sex, presenting complaints, comorbidities, prior surgeries, substance use, laboratory and imaging findings.

Intraoperative data

Presence and type of Rouviere's sulcus, rupture of gallbladder, blood loss, duration of surgery, need for drain, conversion to open surgery and reasons.

Postoperative data

Complications [bile leak, need for endoscopic retrograde cholangiopancreatography (ERCP), reoperation], duration of hospital stay.

Surgical technique

Standard four-port laparoscopic cholecystectomy was performed. Rouviere's sulcus was identified after establishing pneumoperitoneum and retracting the gallbladder neck upward and leftward. The types of sulcus (open, closed, slit, scar) were determined visually. Dissection commenced superior to the sulcus to avoid injury to the common bile duct.

Statistical analysis

Data were tabulated using Microsoft excel and analyzed with IBM-SPSS Statistics v25. Continuous variables were described using mean and standard deviation; categorical variables were summarized as frequencies and percentages.

RESULTS

Demographics

Sample size was 100 patients and mean age was 45.25±12.72 years (predominantly 30-60 years).

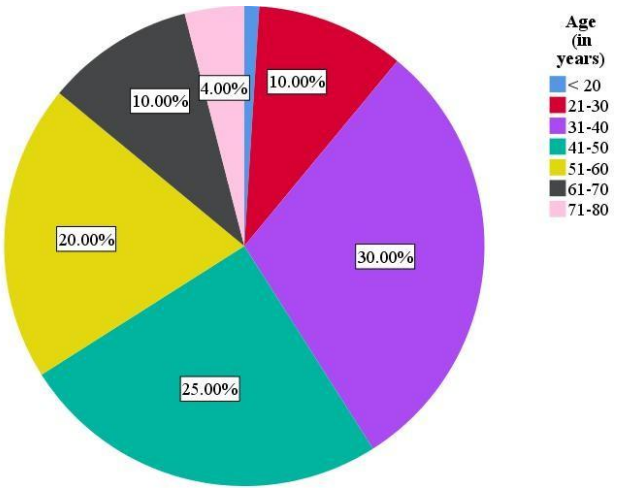

Figure 1: Age distribution.

The 71 were females and 29 were males (female:male=2.45:1). Common symptoms were pain abdomen (69%), dyspepsia (20%), nausea/bloating (11%) (Figure 1).

Comorbidities were present in 36%; most common were diabetes (18%) and hypertension (11%). Prior surgeries 43% had previous operations (Figure 2).

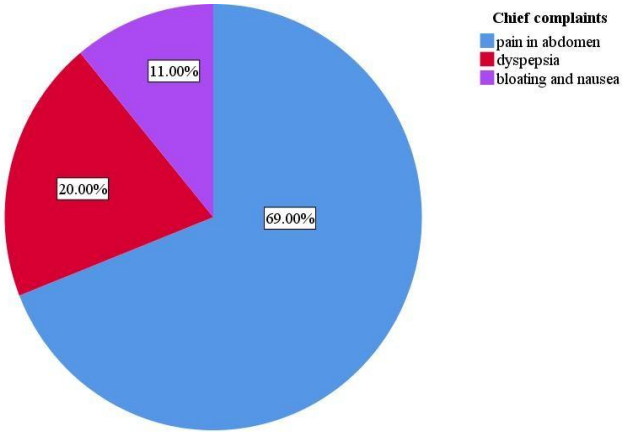

Figure 2: Chief complaints.

Intraoperative findings

Presence of Rouviere's sulcus observed in 79% of patients.[1,2]

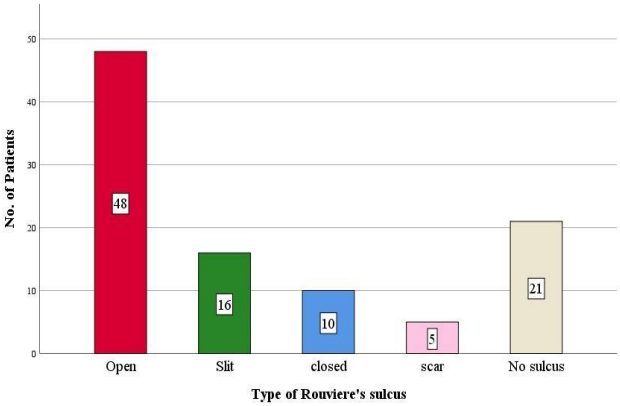

Figure 3: Distribution of types of Rouviere's sulcus.[3]

Types of sulci

Open

The 48 cases (60.75%) this type of sulcus appears as a groove on inferior surface of liver with its medial end open towards the neck of gallbladder. The content of the sulcus can be easily visualised in this type. It is the most commonly observed anatomical variant of Rouviere's sulcus.[3,4,7]

Closed

The 16 cases (20.25%) this type of Sulcus has a deep grooved pattern but with its medial end closed. Content of the sulcus can be seen in this type. It is the second most commonly observed anatomical variant of Rouviere's Sulcus.

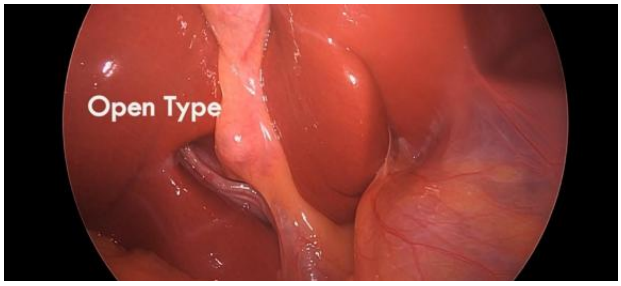

Figure 4: Open type of sulcus.

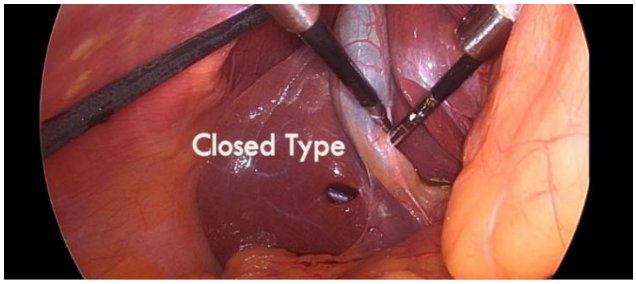

Figure 5: Closed type of sulcus.

Slit types

The 10 cases (12.65%)-this type appears as a shallow groove on inferior surface of liver. Content of the sulcus cannot be appreciated in this type.

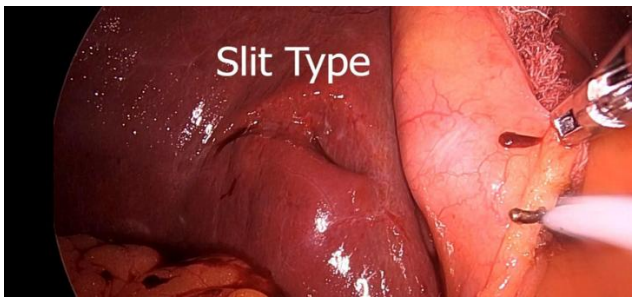

Figure 6: Slit type of sulcus.

Five cases (6.32%), in this type the sulcus appears as a superficial scar. Contents can't be seen. It is the least commonly observed type of sulcus.

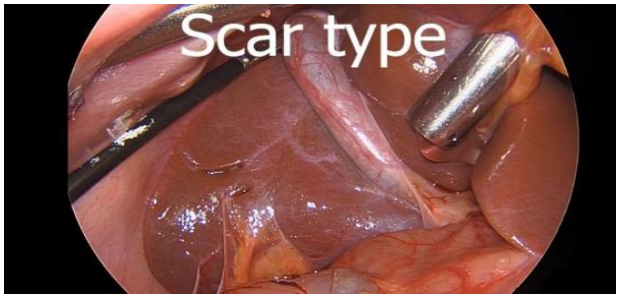

Figure 7: Scar type of sulcus.

Other findings

Gallbladder rupture in 20%, drain placement needed in 36%, conversion to open cholecystectomy in 21%. Mean duration of surgery was 110±10.58 minutes.

Complications were bile leaks, 5 cases (all Strasberg A, except 1 with complete transection). Managed conservatively with ERCP/stenting (4), surgical anastomosis (1).

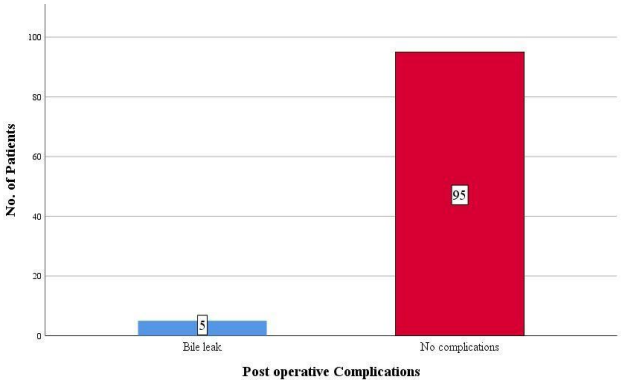

Figure 8: Post operative complications.[9]

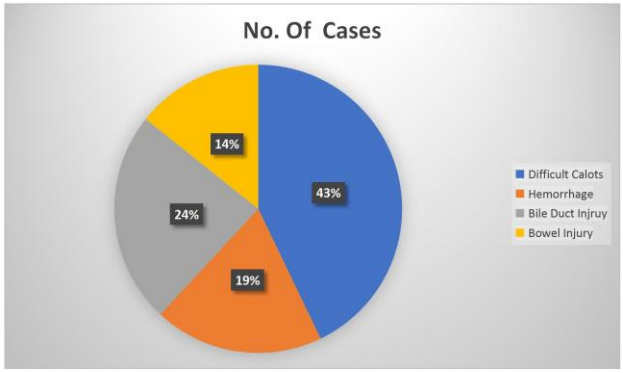

Figure 9: Causes of conversion to open surgery.[10]

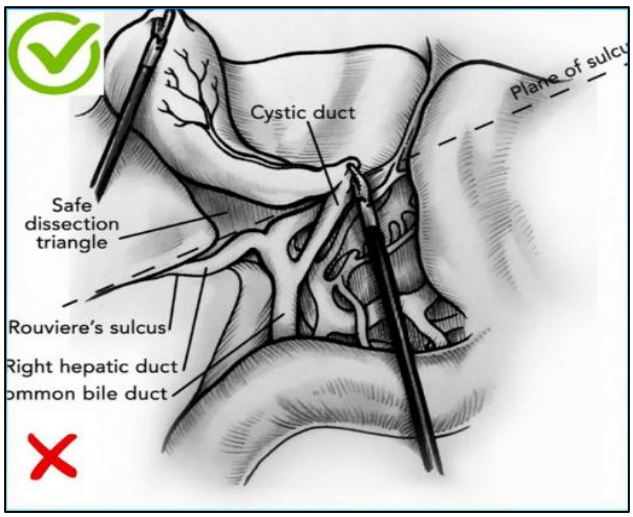

Figure 10: Depiction of safe plane of dissection.

Conversion causes were difficult dissection, uncontrolled bleeding, bile duct or bowel injury.

No mortality observed. Hospital stay was mean duration: 6.38±4.01 days.

DISCUSSION

Laparoscopic cholecystectomy remains the gold standard for the treatment of symptomatic gallstone disease; however, bile duct injury continues to be a significant concern. The use of anatomical landmarks such as Rouviere's sulcus has been increasingly advocated to improve surgical safety.[1,2]

In the present study, Rouviere's sulcus was identified in 79% of patients. This finding is consistent with previously reported prevalence rates ranging from 75% to 90% in various anatomical and clinical studies.[3,4] Cheruiyot et al reported a pooled prevalence of approximately 82%, supporting the reliability of this landmark.[5]

Regarding anatomical variations, the open type was the most common (60.75%), followed by closed, slit, and scar types. This distribution is comparable to findings by Singh et al and Kumar et al who also reported the open type as the predominant variant.[6,7] The higher visibility of the open type makes it particularly useful during laparoscopic dissection.

The mean operative time in this study was 110 minutes, which is slightly higher than some reported series. This may be attributed to the learning curve associated with a teaching institution and the inclusion of difficult cases. Similar observations have been noted in studies evaluating surgical training environments.[8]

The conversion rate to open surgery was 21%, which is higher than the 5-15% range reported in literature.[9] This may be explained by the inclusion of complex cases with dense adhesions, inflammation, and intraoperative complications. Studies have shown that difficult anatomy and unclear identification of structures are major contributors to conversion.[10]

Postoperative bile leak was observed in 5% of cases. Most were minor (Strasberg A) and managed conservatively with ERCP and stenting. This is comparable to reported bile leak rates of 1-5% in similar studies.[11] Importantly, major bile duct injury was rare, supporting the protective role of Rouviere's sulcus when used as a dissection guide.

The use of Rouviere's sulcus is particularly advantageous in cases where Calot's triangle is obscured due to inflammation or fibrosis. In such situations, achieving the critical view of safety becomes challenging, and reliance on alternative landmarks becomes essential.[12]

Overall, the findings of this study reinforce that Rouviere's sulcus is a consistent and valuable anatomical landmark. Its identification helps in maintaining a safe plane of dissection and reduces the likelihood of bile duct injury. However, surgeons must remain cautious in cases where the sulcus is absent or difficult to identify and should employ adjunctive techniques such as intraoperative cholangiography when required.

Limitations

This study has certain limitations. First, it is a single-center study with a relatively small sample size, which may limit the generalizability of the findings. Second, the study was conducted in a teaching institution, which may have influenced operative time and conversion rates due to the learning curve. Third, interobserver variability in identifying Rouviere's sulcus was not assessed. Finally, long-term follow-up data regarding biliary complications were not included. Further multicentric studies with larger sample sizes are recommended to validate these findings.

CONCLUSION

With the advent laparoscopic cholecystectomy as the gold standard for cholelithiasis, the incidence of iatrogenic bile duct injury has also increased. Using well-described anatomical landmarks and fixed extra biliary reference points, combined with other well documented strategies, such as the 'critical view of safety', the risk of injury to the biliary tract during laparoscopic cholecystectomy will be minimized. Identifiable in most healthy livers, Rouviere's sulcus provides an easy reference point for safe laparoscopic cholecystectomy, specially is cases with predominant inflammation and fibrosis obscuring the gall bladder anatomy. Rouviere's Sulcus was seen in 79% cases in present study. It remains vital however, to achieve the critical steps in the procedure safely, and identifying Rouviere's sulcus can only be a component of the surgery. It is important to remember that the sulcus may not be present in around 20% of normal individuals, and difficult to identify in livers that are diseased. The easy with which the Rouviere's sulcus can be identified makes it a dependable extrahepatic biliary landmark during laparoscopic cholecystectomy. By dissecting ventral to Rouviere's sulcus, the surgeons ensure that they are operating away from the danger area. Given the increased frequency of complication of laparoscopic cholecystectomy and the consequences of bile duct injuries, Rouviere's sulcus should be a valuable addition to the surgeon's anatomical armamentarium. However certain cases may still present as a challenge for the surgeons owing to aberrant anatomy, fibrosis, inflammation or other causes, the surgeon should resort to procedures such intra operative cholangiogram or the surgeon can also ask help of a senior more experienced surgeon and the surgeon should not be afraid to convert the laparoscopic to open procedure.

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