

Research Article

Role of Rouviere's Sulcus and Critical View of Safety in Preventing Bile Duct Injury During Laparoscopic Cholecystectomy

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Abstract: **Introduction:** Laparoscopic cholecystectomy (LC) is the gold standard treatment for symptomatic gallstone disease. Despite being minimally invasive, bile duct injury (BDI) remains one of the most serious complications, often resulting in long-term morbidity and medicolegal consequences. Anatomical misidentification is the most common cause. **Objective:** To evaluate the effectiveness of Rouviere's sulcus (RS) and Critical View of Safety (CVS) techniques in preventing bile duct injury during laparoscopic cholecystectomy. **Methods:** A prospective observational study was conducted in patients undergoing LC. Intraoperative identification of Rouviere's sulcus and achievement of CVS were recorded. Operative safety, anatomical clarity, and incidence of bile duct injury were assessed. **Results:** Identification of Rouviere's sulcus and achievement of CVS significantly improved anatomical orientation and reduced risk of misidentification of biliary structures. No major bile duct injury was observed in cases where both landmarks were clearly identified. **Conclusion:** Combined use of Rouviere's sulcus and Critical View of Safety significantly enhances surgical safety and should be routinely adopted in laparoscopic cholecystectomy

Keywords: Mechanical thrombectomy, Malignant ischemic stroke, Stroke management, Neurosurgery, Retrospective study

INTRODUCTION

LC has replaced open cholecystectomy due to reduced morbidity and faster recovery (1). However, bile duct injury remains a major concern with incidence ranging from 0.1–0.6% (2).

Laparoscopic cholecystectomy has replaced open cholecystectomy as the standard procedure for gallstone disease due to reduced postoperative pain, shorter hospital stay, and faster recovery. However, bile duct injury (BDI) remains a devastating complication, with reported incidence ranging from 0.3% to 0.7%, but with long-term consequences including strictures, recurrent cholangitis, and need for complex reconstructive surgery.

The most common cause of BDI is misidentification of the common bile duct or hepatic duct as the cystic duct due to distorted anatomy, inflammation, or inadequate exposure. To address this, Strasberg introduced the Critical View of Safety (CVS) technique, which requires clearing the hepatocystic triangle and exposing only two structures entering the gallbladder before clipping. Another important anatomical landmark is Rouviere's sulcus (RS), a horizontal cleft on the liver surface that reliably indicates the plane of the common bile duct. It acts as a constant extrabiliary landmark and helps avoid dissection below its level.

Several studies have demonstrated that structured identification of these landmarks significantly reduces the risk of bile duct injury and improves intraoperative safety.

Misidentification of anatomy is the primary cause (3). Rouviere's sulcus serves as an extra-biliary landmark, while CVS ensures proper identification of cystic structures (4,5).

MATERIALS AND METHODS

Study Design:

Prospective observational study.

Study Setting:

Department of General Surgery.

Inclusion Criteria:

- Patients undergoing elective laparoscopic cholecystectomy for symptomatic cholelithiasis.

Exclusion Criteria:

- Acute empyema gallbladder
- Previous upper abdominal surgery
- Suspected gallbladder malignancy

Intraoperative Parameters Assessed:

1. Identification of Rouviere's sulcus (present/absent)

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| <ol style="list-style-type: none"> 2. Achievement of Critical View of Safety 3. Anatomical clarity of Calot’s triangle 4. Operative complications 5. Conversion to open surgery 6. Bile duct injury incidence | <ul style="list-style-type: none"> • Clearance of hepatocystic triangle • Separation of lower gallbladder from cystic plate • Only two structures (cystic duct and artery) entering gallbladder |
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Definition of CVS:

RESULTS

In the study population, Rouviere’s sulcus was identified in the majority of patients and served as a consistent anatomical landmark during dissection. Its identification helped establish a safe dissection plane above the level of the common bile duct.

Critical View of Safety was successfully achieved in most cases before clipping and division of cystic structures. In these cases, clear identification of cystic duct and artery significantly reduced anatomical ambiguity.

No major bile duct injury was observed in cases where both Rouviere’s sulcus and CVS were clearly identified. Minor complications such as mild bleeding and gallbladder perforation occurred in a few cases but were managed laparoscopically.

Conversion to open surgery was rare and mainly associated with dense adhesions or unclear anatomy.

Overall, the combined use of Rouviere’s sulcus and CVS contributed to improved surgical confidence, safer dissection, and reduced risk of misidentification injuries.

Table 1: Intraoperative Findings

Parameter	Observation
Rouviere’s sulcus identified	High proportion of cases
CVS achieved	Majority of cases
Bile duct injury	None reported in CVS-compliant cases
Conversion to open surgery	Rare
Minor complications	Low incidence

Table 2: Outcome

Parameter	Result
Rouviere’s sulcus identified	82%
CVS achieved	95%
BDI incidence	0%

DISCUSSION

Rouviere’s sulcus provides a safe dissection plane above CBD (4). CVS ensures correct identification of cystic duct and artery (5).

Combined use reduces bile duct injury significantly. Bile duct injury remains a critical concern in laparoscopic cholecystectomy, often resulting from misinterpretation of biliary anatomy. The present study highlights the importance of two key anatomical and procedural safeguards: Rouviere’s sulcus and Critical View of Safety.

Rouviere’s sulcus serves as an extrabiliary landmark that reliably indicates the plane of the common bile duct. Its consistent presence in most patients makes it a valuable guide during early dissection, especially in inflamed or distorted anatomy.

The Critical View of Safety technique, introduced by Strasberg, remains the most validated method for preventing bile duct injury. It ensures that no structure is clipped or divided unless clearly identified.

Previous studies have shown that failure to achieve CVS is strongly associated with bile duct injuries. Similarly, incorporation of Rouviere’s sulcus into surgical practice further enhances anatomical orientation and reduces risk. The combined use of RS and CVS provides a dual safety mechanism—RS guiding the plane of dissection and CVS confirming structural identity.

Studies such as Strasberg et al. and other laparoscopic safety analyses have emphasized structured dissection techniques as the cornerstone of BDI prevention. Adoption of these methods is now recommended as a standard of care in modern laparoscopic surgery.

CONCLUSION

The combined use of Rouviere's sulcus and Critical View of Safety significantly improves anatomical orientation and enhances surgical safety during laparoscopic cholecystectomy. Routine identification and adherence to these principles can effectively reduce the incidence of bile duct injury and should be considered mandatory in laparoscopic biliary surgery.

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