

Rouviere's Sulcus Identification To Achieve Safe Laparoscopic Cholecystectomy

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Abstract

Background: Laparoscopic cholecystectomy is the gold standard treatment for symptomatic gall stones, continues trials are going on to minimize morbidity of this procedure.

Objective: To evaluate the value of R.S identification in reduction of complications of laparoscopic cholecystectomy after identification of Rouviere's sulcus regarding:

1. Bile duct injury.
2. Duration of operation.
3. Hospital stay.

Materials and methods: A series of consecutive 200 patients disclosed in the department of Surgery at Al-Kindy Teaching Hospital and Saint Raphael Private Hospital with uncomplicated symptomatic gallstones treated by laparoscopic cholecystectomy by recognizing RS and CVS.

Results: The average duration of surgery after identifying RS and attainment of CVS was 28 minutes. Female is 79% and most common type of sulcus is open type 57.5%. There was no incidence of bile duct injury after identification of RS and achievement of CVS.

Conclusion: Rouviere's sulcus (if present) is a vital anatomical landmark for the safe laparoscopic cholecystectomy. Realization of CVS should be tried in all laparoscopic cholecystectomy.

Keywords: Bile duct injury, Critical view of safety, Laparoscopic cholecystectomy, Rouviere's sulcus.

INTRODUCTION

Laparoscopic cholecystectomy was first consummate by Professor Erich of Germany on September 12, 1985 and today regarded the standard treatment of cholelithiasis.(1)

laparoscopic cholecystectomy as the 'gold standard' treatment for symptomatic gallstones, surgeons have had to outside an increased risk of injuries to the bile ducts due to the essential restrictions of laparoscopy, with increasing importance on patient safety in recent years, it has been recommended to identify and follow some landmarks which may guide the surgeons from where to begin the dissection by identifying the plane of the common bile duct (CBD) even before the dissection begins.(2)

The most common complication laparoscopic cholecystectomy, was injury to the bile ducts or hepatic arteries, even when performed by experienced surgeons, the accurate identification of the hepato-biliary anatomy is crucial in laparoscopic cholecystectomy.(3)(4)

The highest number of biliary injuries are believed to occur due to misidentification of biliary anatomy as a result of misinterpretation and/or a absence of understanding the anatomy. The identification of anatomical structures at laparoscopy is further problematic, as these structures exist in a 3-D axis as opposed to the surgeon's 2-D view.(5)(6)(7)

In addition, the bile duct can be injured due to altered anatomy as a result of acute cholecystitis, variant anatomy, hemorrhage and surgical inexperience. (8)

Historically, Calot's triangle (defined as an anatomical triangle bounded by the cystic duct, the common hepatic duct and the cystic artery) has been utilized as the benchmark for the safest approach to laparoscopic cholecystectomy in addition to a useful yet less well-recognized internal extrabiliary anatomical landmark in cholecystectomy is Rouviere's Sulcus (RS) seen in figure 2. (9)

Rouviere's sulcus was initially termed in 1924 by a French surgeon, M.H. Rouviere's sulcus sometimes called the incisura hepatica dextra, or Gans incisura who noted a fissure on the posterior surface of the liver, running transversely from the caudate process to the right lobe.(10)

A common landmark or reference point being increasingly described in recent reports is the Rouviere's sulcus. This sulcus, which was hardly seen and described in the open surgery era, is seen very clearly during laparoscopic cholecystectomy due to the pressure of CO2 insufflation opening up the sulcus widely and due to the enhanced illumination and image quality of the digital endoscopic cameras. (5)

However, if one considers the anatomy of the Rouviere's sulcus, there are nearly no data about it in the referential anatomical literature, its frequency not well-defined and its morphology not exactly described. Whatever is previously known about the sulcus comes to us from some similar studies on liver anatomy and just noted that this sulcus was present in the majority of specimens, but the importance of the sulcus was stressed that the sulcus is used as the first landmark from where the dissection should begin during laparoscopic cholecystectomy and described the sulcus as open and closed types depending on whether the right hepatic pedicle was visible in the sulcus or not. (1)(11)

The floor of Rouviere's sulcus usually contains branches of the right hepatic artery, right portal vein and right hepatic bile duct. Rouviere's sulcus lies in the plane of the common bile duct (CBD), giving it significance as an important anatomical landmark to guide surgeons undertaking hepatobiliary procedures, particularly cholecystectomy. Rouviere's sulcus as having a variable length and also presenting as being partially fused and further reported that the sulcus lies oblique to the anterior, inferior and external edge of the liver in 97% and horizontal in 3% of cases. Specifically, the sulcus has been reported to be a valuable landmark in laparoscopic cholecystectomy as it "points" to the neck of the gallbladder (the narrow area that then tapers into the cystic duct) and can therefore be used as a reference point to expedite identification and dissection in Calot's triangle, thus safely identifying the cystic duct and artery. (9)(11)

The Rouviere's sulcus becomes simply recognizable when anterosuperior and leftward traction of the gallbladder neck are under-taken. Identification of the Rouviere's sulcus will alert the surgeon to the superior extent of the CBD; thus, dissection above the plane of the Rouviere's sulcus will contribute to avoiding CBD injuries. In the presence of conditions such as cirrhosis, fatty liver or hilum, or with a chronically contracted gallbladder, misidentification of the bile ducts can occur, and the distorted anatomy may obscure Rouviere's sulcus or cause it to be misleading.(12) (13)

Since no detailed anatomical classification of Rouviere's sulcus exists in the available literature, this study was undertaken to record 170 videos of laparoscopic cholecystectomy procedures in which the Rouviere's sulcus was visible, and 30 video in which Rouviere's sulcus was not present, to describe its variations, to measure its dimensions such as length, width and depth, and then to propose a simple classification of the Rouviere sulcus to which surgeons could refer easily in the future when describing it. The open type was defined as a right hepatic pedicle was recognized and the sulcus was open throughout its length. Fused type was defined as one in which the pedicle was not visualized or if the sulcus was open only at its lateral end, and the absent type where the sulcus was not identified at the operation.(5)(12)

The aim of this study is to evaluate the complications of laparoscopic cholecystectomy after identification of Rouviere's sulcus and compare it with other group where the sulcus is not identified regarding:

1. Bile duct injury.
2. Duration of operation.
3. Hospital stay.

PATIENTS AND METHODS

Study design and patients' population: This was a prospective descriptive study of 200 patients (158 females 79% and 42 males 21%) who presented with symptomatic gallstone disease and underwent laparoscopic cholecystectomy.

According to identification of RS our samples was divided into 2 groups:

Group 1: RS is identified 170 patients (open + closed) 85%.

Group 2: RS not present 30 patients (15%).

The study directed from January 2017 till November 2018 at Alkindy Teaching Hospital and saint Rapheyal private Hospital.

Inclusion criteria: Patients with symptomatic uncomplicated gallstone disease.

Exclusion criteria: Patients with disturbed anatomy due to adhesions of advanced malignancy in the porta hepatis and those with previous abdominal surgery who converted to open cholecystectomy, elderly patients with comorbidities.

Preoperative patients' evaluation and preparation: Detailed history for all patient's data was recorded in special paper format including (age, chief complaint, past medical and surgical history). Physical examination including detailed abdominal examination. Full laboratory investigations: general urine examination complete blood count, blood group & cross match, blood sugar, blood urea, serum creatinine, liver function test, viral screen, coagulation profile and, other investigations done according to the specific condition. Imaging: each patient should have detailed abdominal ultrasound.

Operative technique: Four-port technique for laparoscopic cholecystectomy was used. Two 10-mm ports and two 5-mm ports were used, 10-mm ports in the umbilical and epigastric region and 5-mm ports in the right hypochondrium and anterior axillary line (subcostal). Pneumoperitoneum was created by inserting Veress needle in the infraumbilical region. After creating pneumoperitoneum, a 10-mm port was introduced and a telescope was put in. After the abdominal survey, rest of the ports were put under direct vision, i.e., the 10-mm port in the epigastric region, 5-mm port in the right hypochondrium, and another 5-mm port in the anterior axillary line (subcostal). The patient was placed in reverse Trendelenburg's (Fowler's) position with the patient's head up and tilted to the left and the surgeon standing on left side of the patient. Gallbladder was grasped from the fundus through a 5-mm port and retracted. Once the view of the abdominal cavity is clear we search for RS which is evident in 170 cases Group 1 (open + closed) and not visualized in 30 cases Group 2 not present.

Rouviere's sulcus was identified, dissection of Calot's triangle was done above the level of this sulcus and CVS was created. Cystic artery and duct were defined. Cystic duct and cystic artery were clipped separately using Liga clips. Gallbladder removal was done from a 10-mm port (epigastric). Surgical field Was washed with normal saline to remove all the clots and spilled biliary content, if any. If RS not visualized (group 2) removal of the gallbladder after dissection of calot's triangle in traditional way.

Complete hemostasis was achieved. tube drain left in subhepatic space. All port sites were closed with non-absorbable sutures. All patients were followed up after 1 week with history and clinical examination for any postoperative complications.

Time of surgery is defined as the time from introduction of the first port till closure of the port incision. Criteria of discharging patients from hospital means the patients should have soft abdomen, vitally stable and start oral nutrition.

Statistical Analysis: Data were organized in electronic format into Excel. Data were then processed to SPSS Version 22 and analyzed for Chi-squared and One-way ANOVA with support of a statistician. Multivariate analysis was performed to evaluate whether there is an independent association between the frequencies of sulcus type. P-value of <0.05 was considered significant.

RESULTS

Demographics: Out of 200 patients who underwent laparoscopic cholecystectomy, 158 (79%) patients were female and 42 (21%) patients were male, with a mean age of 35.25±5 (range 23-56 years).

Table 1 Distribution of patient's gender in symptomatic gall stone disease.

Patient gender	Number	Frequency	P value
Male	42	21%	< 0.05
Female	158	79%	
total	200	100%	

Outcome Data: Open type was found in 115 patients (57.5%). Fused type was found in 55 (27.5%) of patients. The sulcus was not Present in 30 (15%) of patients.

Table 2 Sulcus type distribution over study patients group

Sulcus type	Number of patients	frequency	P value
Open	115	57.5%	< 0.05
Fused	55	27.5%	
Not present	30	15%	

Table 3 Time of surgery after identifying RS and achievement of CVS

Duration in minutes	Group 1	Group 2	P value
10-20	90		0.043
20-30	42		
30-40	32	12	
40-50	6	18	
Total	170	30	

Table 4 Time of hospital stay

Hospital stay in days	Group 1	percentage	Group 2	percentage	P value
1	150	88.3%	10	33.3%	< 0.05
2	18	10.6%	16	53.3 %	0.082
3-7	2	1.1%	4	13.4 %	0.23

The cause behind prolonged hospital stay in Group 1 two cases and Group 2 four cases because of postoperative patients still have mild abdominal tenderness, mild fever, tachycardia, not jaundiced, ultrasound study showed mild sub hepatic collection < 150cc, managed conservative till discharged. No surgery needed for all cases of bile leak.

Table 5 Number of patients with minor bile leak

Bile leak	Group 1	percentage	Group 2	percentage	P value
Intraoperative	0	-	0	-	0.14
Postoperative (leak)	2	1.17%	4	13.3%	

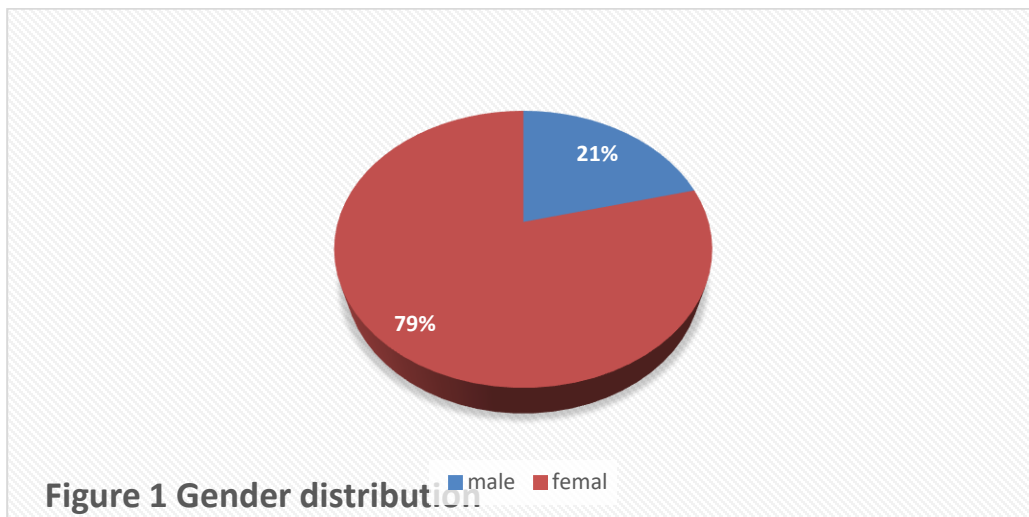


Figure 1 Gender distribution

Discussion

The gains of laparoscopic cholecystectomy have been discussed extensively globally. Though, this technique has introduced complications which are either more complex or were not known in the time of open surgery.(14) One of the most grave complications which has been a staple of fear is bile duct injury.(15,16)

In initial period, laparoscopic cholecystectomy was concomitant with greater than 2% risk of injury to the biliary tract which fallen to 0.3-0.4% with growing experience. (17) (18)(19)

Moreover, in laparoscopic years the pattern of biliary injury has become more complex and proximal (more towards the porta hepatis). The major morbidity related to this technique appeared to be due to the lack of familiarity of the "laparoscopic anatomy" of the gallbladder pedicle, two dimensional vision and lack of tactile feedback.(20)

Hugh recognized some inbred factors in the procedure that exclusively influence to surgical error and the most significant is three-dimensional disorientation on the part of surgeon, to avoid this, he used the empiric principles settled by the nautical and aviation trades, one of which is to start from a secure point and used Rouviere's sulcus as an extra biliary fixed point to start dissection.(21)

In our study we found that frequency and type of Rouviere's was well known.

Another study by Dahmane, et al. which studied a 40 macroscopically healthy undamaged liver involved during autopsies from cadavers of both sexes found the frequency was 82%, Rouviere's sulcus has been found by Hugh, et al.(22) in 78% of the livers, by Singh, et al.(23) exhibited a frequency of (84.5%) of Rouviere's sulcus. (10)

In our study we found that identifying Rouviere's sulcus during laparoscopic cholecystectomy can avoid major bile duct injuries because it lies in the fact that cystic duct and the cystic artery lay anterosuperior to the sulcus and the common bile duct lies under the level of Rouviere's sulcus and we start dissection above this level. We found that safe dissection might be difficult due to the consequences of acute or recurrent cholecystitis, with inflammation, edema, and fibrosis of the structures leading to obscuration of the anatomical landmarks.

Hugh had shown minimal common bile duct injury during laparoscopic cholecystectomy by start the dissection ventral to the sulcus, so the use of Rouviere's sulcus as a fixed extrabiliary landmark especially during difficult operation can be so useful Rouviere's sulcus has numerous advantages over Calot's triangle for safe dissection during tough laparoscopic cholecystectomy. (21)

In our study we found that Rouviere's sulcus is not affected by recurrent inflammation and fibrosis in contrast to calot's triangle.

Calot's triangle in this setting is often solid and cannot be expanded, and it can be hard to achieve a critical view of safety.(24)

Rouviere's sulcus might be used as a confirmatory landmark and is particularly valuable when identification of structures within Calot's triangle remains difficult. As compared with RS, the role of CVS in preventing bile duct injury has been largely appreciated and studied in preventing bile duct injury. (5)

In our study, we have combined the above mentioned landmarks to study their importance in safe execution of laparoscopic cholecystectomy. The importance of this combination has not been studied before according to the best of our familiarity.

Heistermann et al achieved CVS in 97 out of 100 patients and cholecystectomies were successfully completed with a minor incidence of cystic stump leak. Incidence of bile duct injury was 1%, while the conversion rate was 3%.(25)

Yegiyants and Collins also achieved CVS in 3,000 patients and reported only one bile duct injury (0.033%) which occurred during the dissection of Calot's triangle prior to achieving the critical view. (26)

Similarly, Avgerinos et al attained CVS in 998 out of 1,046 patients. Five minor bile duct leaks (0.47%) were reported which resolved spontaneously. Their conversion rate was 2.7%.(27)

Rawlings et al studied the importance of CVS in 54 patients who underwent single port laparoscopic cholecystectomy and reported no incidence of bile duct injury and came to a conclusion that dissection to obtain the CVS should be the goal in every patient (Table 4). (28)

In our present study, we laid importance on identification of RS before commencement of dissection of Calot's triangle and keeping the dissection above the level of sulcus to establish CVS before clipping and transection of cystic duct.

Although achievement of CVS is widely accepted, there are little data about the significance of RS. We created CVS in 200 patients after identifying RS in 170 case group 1 (open + closed) and 30 case not present in group 2 The incidence of bile duct injury among these patients was zero, based on clinical features. Minor bile leak occurred in only 2 in group 1 in group 2 four cases and managed conservatively.

Our study had shown that the horrible complications of biliary tract injuries can be avoided which greatly reduces the morbidity and mortality associated with it.

The outcomes in the present study demonstrate that laparoscopic cholecystectomy has minor incidence of biliary tract injury according to the technique mentioned in this study. Regarding the time of operation and duration of hospital stay this impact is not handled by any of the literature before.

Table 6 studies showing impact of CVS creation with/without identification of RS

Series	Type of study	RS identification	CVS created	Bile duct injury	Conversion to open cholecystectomy
Heistermann et al(25)	Case series (n=100)	no	Yes (97 case)	1 minor leaks	3%
Yegiyants and Collins (26)	Case series (n=300)	no	Yes	1	
Avgerinos et al (27)	Case series (n=1046)	no	Yes (998 case)	5 minor leaks	2.7%
Rawling et al (28)	Case series (n=54)	no	Yes	nil	-
Malwinder et al (29)	Case series	yes	yes	nil	-
Group 2 (Presents)	Case series (30)	no	Yes	4 minor leak	-
Group 1 (Presents)	Case series (170)	Yes	yes	2 minor leak	-

CONCLUSION:

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.

The easy recognition of Rouviere’s sulcus makes it a dependable landmark during severe acute inflammation.

By dissecting ventral to Rouviere’s sulcus, the surgeons ensure that they are operating away from the danger area.

We recommend to encourage additional studies to reduce the complications of laparoscopic cholecystectomies keeping in mind the significance of RS and CVS.

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