Critical view of safety and Rouviere's sulcus: extrahepatic biliary landmarks as a guide to safe laparoscopic cholecystectomy

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Introduction Bile duct injury is a serious complication of cholecystectomy. To fulfill the criteria for a critical view of safety requires Calot's triangle to be cleared free of fat and fibrous tissue. Rouviere's sulcus is a 2–5-cm sulcus running to the right of the liver hilum anterior to the caudate lobe.

Aim Our aim is to study critical view of safety and Rouviere's sulcus as extrahepatic landmarks and their benefits in avoiding common bile duct injury.

Patients and methods From January 2015 to December 2018 (35 months), in New Damietta University Hospital, 300 patients with calculous cholecystitis undergoing laparoscopic cholecystectomy were included in this study.

Results Rouviere's sulcus was present in 293 (97.7%) patients: open type was found in 175 (58.3%) patients, whereas closed type was found in 118 (39.3%) of patients. The sulcus was not present in seven (2.3%) of patients. A critical view of safety was inspected in all patients (100%). There was conversion to open cholecystectomy in two (0.7%) patients owing to severe adhesions which cannot be dissected laparoscopically. No mortality was recorded in the follow-up period.

Conclusion Rouviere's sulcus and critical view of safety technique are very helpful extrahepatic landmarks to avoid common bile duct injury and perform safe laparoscopic cholecystectomy.

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Introduction

Cholelithiasis was first described in 1420 by a Florentine pathologist Antonio Benivenius [1]. Carl Johann August Langenbuch, a German surgeon, was the first to perform open cholecystectomy on 15 July 1882 [2], whereas Phillip Mouret performed the first laparoscopic cholecystectomy in 1987 [3].

Cholecystectomy is one of the most commonly performed surgeries in the world, with more than 750 000 yearly in the USA alone. Bile duct injury is a serious complication of cholecystectomy. With start of laparoscopic technique era in the early 1990s, an increase in bile duct injury was recorded (0.2% to ~0.5%) [4]. Several factors have been shown to increase the risk of biliary injury, for example, patient factors (obesity, male sex, older age, and adhesions), local factors (severe gallbladder inflammation/infection, hemorrhage, and aberrant anatomy) as well as surgeon competency [5].

Careful identification of cystic structures within Calot's triangle is the most important key to reduce biliary tract injury. Strasberg was the first to coin the term 'critical view of safety' in 1995, and this approach of identification of cystic structures has been accepted by many surgeons as the gold standard technique to reduce biliary tract injury [6].

To achieve the criteria for a critical view of safety necessitates Calot's triangle to be cleared free of fat and fibrous tissue, for the lowest part of the gallbladder to be dissected free from the cystic plate (liver visible), and only two visible structures entering the gallbladder [6].

Internal anatomical landmarks and fixed extrabiliary landmarks assist the surgeon, especially in difficult situations. Via visible anatomical landmarks, combined with other well-recognized strategies, such as the dissection of Calot's triangle to realize the 'critical view of safety' [7], the surgeon will decrease the risk of injury of biliary tract, mainly in the setting of acute inflammation. Another less well-recognized internal anatomical landmark in cholecystectomy is Rouviere's sulcus. The identification of Rouviere's sulcus is an additional strategy that can be used to avoid biliary tract injuries [8].

Rouviere's sulcus is a 2–5-cm sulcus extending to the right of the liver hilum anterior to the caudate lobe. It

holds the right hepatic pedicle (Fig. 1). The sulcus ascertains the plane of common bile duct exactly. It can be recognized in 80% of cases [10].

This sulcus is taken as the starting reference point for the commencement for a safe dissection. The plane of this sulcus should be searched for and kept in mind throughout laparoscopic cholecystectomy. This extrabiliary sulcus is a fixed landmark on the liver not biased by any pathology [11].

Our aim is to study critical view of safety and Rouviere's sulcus as extrahepatic landmarks and their benefits in avoiding common bile duct injury.

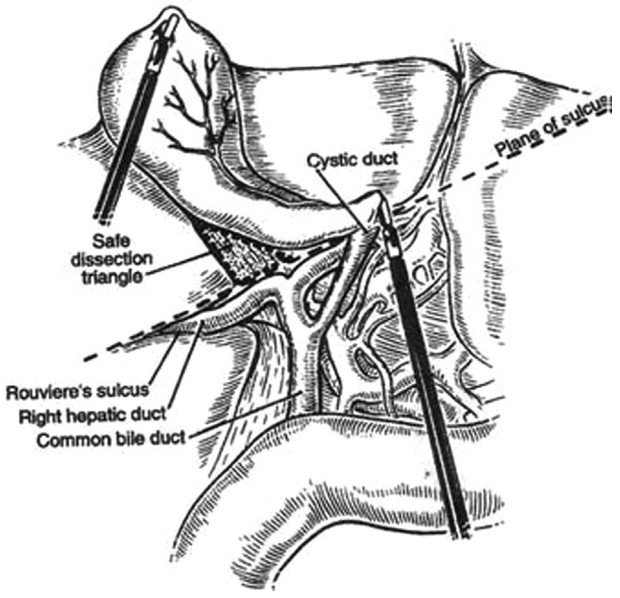
Patients and methods

From January 2015 to December 2018 (35 months), in New Damietta University Hospital, 300 patients with calcular cholecystitis scheduled for laparoscopic cholecystectomy were included in our study after their informed consent with approval from the ethical committee in Al Azhar Faculty of Medicine, New Damietta. All patients had a preoperative abdominal ultrasound, liver function tests, renal function tests, blood glucose level, coagulation profile, and complete blood count. Laparoscopic cholecystectomy was done under general anesthesia with the classical four-port method. A fixed team of surgeons performed all the operations.

From the left side of the patient, laparoscopic cholecystectomy was performed by the four-port technique. The first port is a 10-mm supraumbilical camera port inserted directly or with the open technique and insufflating with CO_2. The other three ports were inserted under direct vision. Visual exploration of the abdomen was performed, and then gallbladder was retracted up to the right axilla. The Calot's triangle was explored with the lateral and inferior retraction of Hartman's pouch. Rouviere's sulcus was identified, before starting dissection. The frequency and the type of the sulcus were recorded. The open type (Fig. 2) was defined as the one where a right hepatic pedicle was identified and the sulcus was open throughout its length. Fused type (Fig. 3) was defined as the one in which the pedicle was not visualized or if the sulcus was open only at its lateral end, and the absent type (Fig. 4) was defined as the one where the sulcus was not identified at the operation.

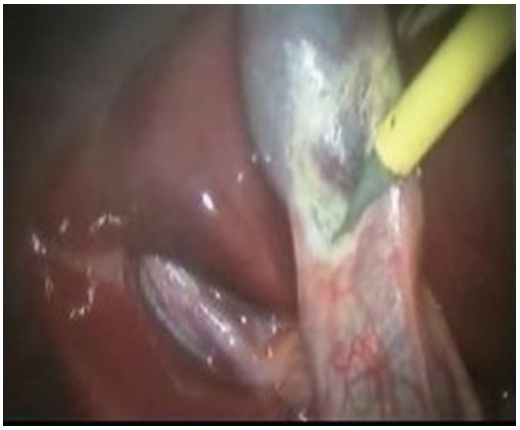
Dissection of cystic duct and artery was done after identification of Calot's triangle, and in anterosuperior

Figure 1



Rouviere's sulcus [9].

Figure 2



Rouviere's sulcus, open type.

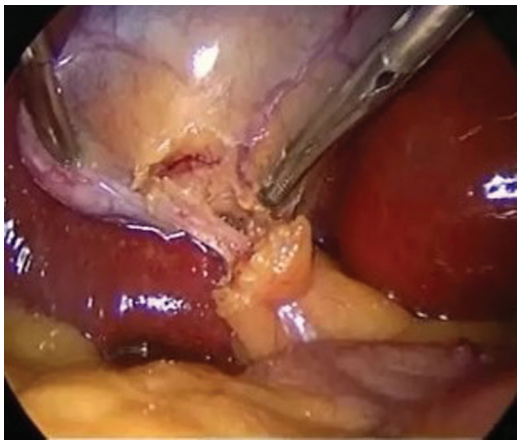
Figure 3

Rouviere's sulcus, closed type.

Figure 4

Absent Rouviere's sulcus.

Figure 5



Critical view of safety.

direction to Rouviere's sulcus. Using hook with monopolar electrocautery, skeletonization of cystic duct and artery was performed to show critical view of safety (Fig. 5). They were then clipped and cut. Dissection of the gallbladder from its bed was done using electrocautery and blunt dissection, until completely removed under vision from epigastric port. Sites of ports were closed, after insertion of a tube drain.

Statistical analysis

Patients' data were presented as frequency and percentage for categorical variables, mean (median) and SD for numerical variables. Groups were compared by independent samples Student *t*-test and χ^2-test for numerical and categorical data, respectively. All data and statistical analyses were handled by statistical package for the social sciences (SPSS, IBM, SPSS Inc. Chicago, USA) computer package version 18.

Results

A total of 300 patients with calcular cholecystitis were included in the study, which was conducted in New Damietta University Hospital, from January 2015 to December 2018 (35 months). Of 300 patients who underwent laparoscopic cholecystectomy, 205 (68.3%) patients were females and 95 (31.7%) patients were males, with a mean age of 46.09±7.14 years (range: 18–55 years).

There were 282 (94%) patients complaining from chronic calcular cholecystitis, 13 (4.3%) had empyema of the gallbladder, and five (1.7%) patients had acute cholecystitis. Endoscopic retrograde cholangiopancreatography (Post-ERCP) adhesions were reported in seven (2.3%) patients.

Rouviere's sulcus was present in 293 (97.7%) patients: open type was found in 175 (58.3%) patients, whereas closed type was found in 118 (39.3%) of patients. The sulcus was not present in seven (2.3%) of patients.

A critical view of safety was inspected in all patients (100%). In two (0.7%) patients, accessory bile duct was detected in the gallbladder bed and clipped. There were 25 (8.3%) patients with accessory artery from gallbladder bed, identified and clipped. There was no major bleeding during operation. The median operative time was 40 min (range: 20–75 min). No minor or major bile duct injuries were reported in the intraoperative or postoperative period. Wound infection was detected in two (0.7%) patients treated with antibiotics and daily dressing. Only one (0.3%) patient was treated conservatively owing to pancreatitis in postoperative period. There was conversion to open cholecystectomy in two (0.7%) patients owing to severe adhesions, which could not be dissected laparoscopically. Overall, 95 (31.7%) patients were discharged on the same day, 195 (65%) patients on the second day, and 10 (3.3%) patients on the third day after surgery. No mortality was recorded in the follow-up period. Descriptive data of the studied populations are presented in Table 1.

Discussion

The era of laparoscopic cholecystectomy was associated with a marked increase in biliary tract injuries. In spite of the improvement of laparoscopic cholecystectomy techniques, biliary tract injury remains to be an significant problem today, although its true incidence is unknown. The popular cause of grave biliary tract injury is unclear anatomy [7].

In 1995, Strasberg *et al.* [6] documented an analytical review of extrabiliary anatomy and announced a

Table 1 Descriptive data of studied populations

Variables	Males (95; 31.7%)	Females (205; 68.3%)	Total (300)	Test	*P* value
Age	46.23±7.30; 18–55	46.02±7.08; 22–54	46.09±7.14; 18–55	0.22	0.82
Presentation					
Chronic cholecystitis	91 (95.8)	191 (93.2)	282 (94.0)	1.80	0.40
Empyema	2 (2.1)	11 (5.4)	13 (4.3)		
Acute cholecystitis	2 (2.1)	3 (1.5)	5 (1.7)		
Post-ERCP	2 (2.1)	5 (2.4)	7 (2.3)	0.03	0.85
Rouviere's sulcus					
Present	91 (95.8)	202 (98.5)	293 (97.7)	2.15	0.14
Absent	4 (4.2)	3 (1.5)	7 (2.3)		
Sulcus type					
Open	50 (52.6)	125 (61.0)	175 (58.3)	3.39	0.18
Closed	41 (43.2)	77 (37.6)	118 (39.3)		
Accessory bile duct	0	2 (1.0)	2 (0.7)	0.93	0.33
Accessory artery from gallbladder bed	6 (6.3)	19 (9.3)	25 (8.3)	0.74	0.38
Operative time [median (range)]	40 (30–65)	40 (20–75)	40 (20–75)	1.48	0.13
Wound infection	0	2 (1.0)	2 (0.7)	0.93	0.33
Conversion to open	1 (1.1)	1 (0.5)	2 (0.7)	0.31	0.57
Discharge day					
The same day	30 (31.6)	65 (31.7)	95 (31.7)	3.88	0.14
Second day	59 (62.1)	136 (66.3)	195 (65.0)		
Third day	6 (6.3)	4 (2.0)	10 (3.3)		

method of identification of the cystic structures named as the 'critical view of safety'.

The critical view of safety has three necessities. First, Calot' triangle must be cleared of fat and fibrous tissue. It is not necessary to expose the common bile duct. The second, the lowest part of the gallbladder be detached from the cystic plate (liver bed), the flat fibrous surface to which the nonperitonealized side of the gallbladder is attached. The third necessity is that two structures, and only two, should be seen entering the gallbladder. Once these three criteria have been achieved, critical view of safety has been accomplished [6].

In a single institution from 2002 to 2007 [12], 1046 patients underwent laparoscopic cholecystectomy, where critical view of safety was used in 998 cases. The conversion rate to open cholecystectomy was 2.7%. There were five bile leaks, which resolved with conservative measures. No major biliary tract injuries were documented.

Heistermann *et al.* [13] documented in a study including 100 patients who had laparoscopic cholecystectomy by means of critical view of safety. The aim of the study was to prove the availability to obtain critical view of safety and establish it with photo documentation. In spite of a high incidence of acute cholecystitis and previous abdominal operations, 97 of 100 cholecystectomies were completed through laparoscopic approach after photo documentation of critical view of safety. There was one postoperative complication in the form of biliary leak from cystic duct stump rupture.

Elwan and Ibrahim [14] reported that Rouviere's sulcus was present as open type in 85.5%. Rouviere's sulcus can be considered as an extrabiliary landmark to perform safe laparoscopic cholecystectomy.

Hugh *et al.* [15], in their study, documented that there was a decrease in biliary tract injuries during laparoscopic cholecystectomy if dissection begins antrosuperior to Rouviere's sulcus [16]. Peti and Moser [17] described a case report in which identification of Rouviere's sulcus helped in prevention of biliary tract injury.

In this study, the operative time ranged from 20 to 75 min. Rouviere's sulcus was present in 293 (97.7%) patients, where open type was found in 175 (58.3%) patients, and closed type was found in 118 (39.3%) of patients. The sulcus was not present in seven (2.3%) of patients. A critical view of safety was inspected in all patients (100%). There was conversion to open cholecystectomy in two (0.7%) patients owing to severe adhesions which could not be dissected safely laparoscopically. No major complications were occurred intraoperatively or postoperatively.

We consider that Rouviere's sulcus and critical view of safety technique are very helpful extrahepatic

landmarks to avoid common bile duct injury and perform safe laparoscopic cholecystectomy.

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Conflicts of interest
There are no conflicts of interest.

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