Importance of Rouviere’s Sulcus in Laparoscopic Cholecystectomy

Ashesh Kumar Jha, Rekha Dewan, Kaustabh Bhaduria
Department of Surgery, Dr. Baba Saheb Ambedkar Medical College and Hospital, Delhi, India

Abstract

Background: Rouviere’s sulcus is a 2–5 cm fissure on the liver between the right lobe and caudate process. The benefit of finding the Rouviere’s sulcus during laparoscopic cholecystectomy is supported by the fact that the cystic duct and artery lay anterosuperior to the sulcus, and the common bile duct (CBD) lays below the level of the Rouviere’s sulcus. Hence, it can serve as an extrabiliary anatomical reference point during laparoscopic cholecystectomy to identify the location of CBD. Materials and Methods: This prospective observational study was carried out on 99 patients during a period of 1 year. During laparoscopic cholecystectomy, Rouviere’s sulcus was identified after retracting the fundus of the gallbladder toward the right shoulder. Its morphology in terms of open type, close type, or scar-like shapes was recorded, and if the CBD outline could be visualized, then its relation with the Rouviere’s sulcus was noted. Results: Among all 99 study patients, Rouviere’s sulcus could be identified in 63 cases (63.63%), whereas it could not be seen in 36 cases (36.36%) \((P < 0.007)\). It was of open type in 68.25% (43 cases), close type in 25.39% (16 cases), and scar like in 6.35% (4 cases) \((P < 0.0001)\). The Rouviere’s sulcus was found to be above the level of CBD line in 50 patients (79.36%) and at the same level in 11 patients (17.46%), and in two patients, (5.97%) CBD line could not be visualized. Conclusion: Identification of Rouviere’s sulcus during laparoscopic cholecystectomy can serve as an additional reference point to avoid major bile duct injury. In the era of laparoscopy, it can be better visualized after creating the pneumoperitoneum and retracting the fundus of the gallbladder.

Keywords: Bile duct, cholecystectomy, extrabiliary, laparoscopy

Résumé

Contexte: Le sulcus de Rouvière est une fissure de 2 à 5 cm sur le foie entre le lobe droit et le processus caudé. L’avantage de trouver la Rouvière sulcus au cours de la cholécystectomie laparoscopique est soutenu par le fait que le canal cystique et l’artère sont antéro-supérieurs au sulcus, et le le canal cholédoque (CBD) se situe sous le niveau du sulcus de Rouvière. Par conséquent, il peut servir de point de référence anatomique extrabiliaire pendant la cholécystectomie laparoscopique pour identifier l’emplacement du CBD. Matériels et méthodes: Cette étude observationnelle prospective a été réalisée sur 99 patients pendant une période de 1 an. Au cours de la cholecystectomy laparoscopique, le sulcus de Rouvière a été identifié après rétraction le fond de la vésicule biliaire vers l’épaule droite. Sa morphologie en termes de type ouvert, fermé ou cicatriciel a été enregistrée, et si le contour CBD pouvait être visualisé, alors sa relation avec le sulcus de Rouvière était notée. Résultats: Parmi les 99 patients de l’étude, Le sulcus de Rouvière a pu être identifié dans 63 cas (63,63%), alors qu’il n’était pas visible dans

Introduction

Laparoscopic cholecystectomy is one of the most common surgical procedures performed in this part of the world. The benefits of laparoscopic cholecystectomy as compared to open surgery are well known.\(^1\) Moreover, it is considered as the gold standard for the treatment of symptomatic gallstones. However,
the rate of bile duct injuries remains to be slightly higher than in open cholecystectomies.\cite{8} Many surgical approaches and principles have been recommended to minimize the bile duct injuries.\cite{3,4} The principles of critical view of safety is the widely recommended method to avoid bile duct injury in this procedure.\cite{9} However, in cases with dense adhesions in the Calot’s triangle, it is almost impossible to achieve critical view of safety. Therefore, apart from the critical view of safety, the usage of some additional extrabiliary reference point for the identification of common bile duct (CBD) should also be encouraged. The benefit of such a landmark is that it may remain unaffected even in the inflammatory conditions of the gallbladder or CBD.

One of such extrabiliary anatomical reference points is Rouviere’s sulcus, which may serve as a guide to identify the location of CBD during laparoscopic cholecystectomy. Rouviere’s sulcus is a 2–5 cm fissure on the liver between the right lobe and caudate process. The features of Rouviere’s sulcus are not well described in the traditional anatomical texts. Rouviere’s and Delmas\cite{6} described it as sulcus of “Processus caudatus.” Reynaud et al. observed the incisura Dextra of Glans in 73% of the cases.\cite{7} Rouviere’s sulcus has been found by Hugh et al.\cite{8} in 78% of the liver and by Zubir et al. in 68% of cases.\cite{9} The benefit of finding the Rouviere’s sulcus during laparoscopic cholecystectomy is supported by the fact that the cystic duct and artery lay anterosuperior to the sulcus, and the CBD lays below the level of the Rouviere’s sulcus. Peti and Moser\cite{10} described that the identification of Rouviere’s sulcus can serve as an important anatomical landmark to avoid bile duct injuries during laparoscopic cholecystectomies. Despite its potential to serve as an important anatomical reference point to know the location of CBD, there is a relative scarcity of literature regarding its surgical importance during laparoscopic cholecystectomy. Hence, this study was undertaken to note its frequency, morphology, and its relation with the CBD.

**Materials and Methods**

This prospective observational study was carried out in the Department of Surgery, Dr. Baba Saheb Ambedkar Medical College and Hospital, Rohini, Delhi, during a period of 1 year. All diagnosed cases of symptomatic cholelithiasis within the age group of 18–70 years, planned for laparoscopic cholecystectomy consenting to participate in this study, were included in the study. Ethical clearance was obtained from the institutional ethical committee. Informed consent was obtained from all the participants. Laparoscopic cholecystectomy was done by standard four-port technique in all patients by the same laparoscopic surgeon. During laparoscopy, Rouviere’s sulcus was identified after retracting the fundus of the gallbladder, and its morphology in terms of open type, closed, or scar-like shapes was recorded, and if the CBD outline could be visualized, then its relation with the Rouvière’s sulcus was noted. Open type of sulcus was defined as a cleft in which the medial end was open toward the right hepatic pedicle. In close-type sulcus, its medial end was closed toward the right pedicle, whereas its lateral end remained open. In scar type, it appeared like a linear scar-like structure. Dissection in the Calot’s triangle was done following the principles of the critical view of safety. Any significant intraoperative or postoperative event was also recorded. Cases of laparoscopic cholecystectomy converted to open were excluded from the study. Patients with bleeding disorders, fatty liver, chronic liver disease, portal hypertension, cirrhosis, and infectious diseases of the liver were also excluded from the study.

**Sample size**

Rouvière’s sulcus: a guide to safe dissection in laparoscopic cholecystectomy was conducted by Zubir et al.,\cite{9} and Rouvière’s sulcus could be identified in 68.13% of patients. Taking this as a reference value, the minimum required sample size with 10% margin of error and 5% level of significance is 84 patients. Taking a dropout rate of 15%, the total sample size taken is 99.

The formula used is: \( N \geq \frac{(p [1 − p])/(ME/Zα)^2}{\alpha} \)

where \( Z_α \) is value of \( Z \) at two-sided alpha error of 5%, ME is margin of error, and \( p \) is the proportion of patients in whom Rouvière’s sulcus was visualized.

**Statistical analysis**

Categorical variables are presented in terms of number and percentage (%), and continuous variables are presented as mean ± standard deviation (SD) and median. Qualitative variables are correlated by the Chi-square test/Fisher’s exact test. The data were entered in MS Excel spreadsheet, and analysis was done using the Statistical Package for the Social Sciences (SPSS) (Version-16, IBM, Chicago, IL, USA).

**Result**

Among all the operated 99 cases, 79.20% (80 cases) were female and 18.81% (19 cases) were male (\( P < 0.0001 \)). The age of presentation of symptomatic cholelithiasis was predominantly in the fourth decade of life (33.67%). The mean

Mots clés: canal biliaire, cholecystectomie, extrabiliaire, laparoscopie
In the study conducted by Hugh et al.,[8] out of 402 cases of laparoscopic cholecystectomy, Rouviere’s sulcus was present in 319 (79.3%) cases, and it was absent in 80 (20.7%) cases. In 221 (54.9%) cases, it was of open type sulcus, and 98 (24.4%) cases had scar type sulcus. Zubir et al.[9] in their study of 160 patients could visualize Rouviere’s sulcus in 109 (68.13%) patients during laparoscopic cholecystectomy. Open type of Rouviere’s sulcus was observed in 48 patients, whereas 61 had fused type of sulcus. In our study, Rouviere’s sulcus was well defined in two-third of the patients and “absent” in one-third of the patients. Similarly, other researchers reported varying incidences of the presence of the Rouviere’s sulcus in their study. Zubir et al. noted sulcus in 68.13% of cases, Hugh et al. in 78%, Dahmane et al. in 82%, and Hugh reported in 90% of cases.[9,8,13,14]

Adequate and proper training in a laparoscopic surgery, delineation of anatomy in Calot’s triangle following the principles of critical view, judicious use of electrocautery, avoiding the blind application of clips, and cautery in Calot’s triangle are the measures advocated to avoid a bile duct injury.[15,16] The main cause of inadvertent injury of CBD is due to mistaking CBD as the cystic duct. Hence, it seems prudent to start with meticulous inspection of the area, in order to obtain the first impression of the extrahepatic bile duct using some extrabiliary reference point and thereafter proceeding with dissection in Calot’s triangle. Some other landmarks including cystic lymph node and gallbladder neck have also been advocated for identifying the cystic duct and safe dissection.[17]

When the gallbladder fundus is retracted during laparoscopy, the Rouviere’s sulcus can be exposed, and with the advent of better optical system providing a clear and magnified view, its anatomy can be appreciated more precisely, and its relation to the nearby structure can also be ascertained more precisely. Rouvière’s sulcus corresponds to the level of portal-hepatis where the right pedicle enters the liver, and hence, it has been suggested that all the dissections are to be kept above the level of this sulcus to avoid injury to the major bile duct.[6] Furthermore, being an extrabiliary reference point means its presence can still be noted even in the inflammatory conditions of the biliary system. In addition, the cystic artery and cystic duct lay invariably anterosuperior to the sulcus.[18]

A study in 2002 revisited the factors that predispose to bile duct injury in laparoscopic cholecystectomy, and the most significant was spatial disorientation on the part of surgeon. To avoid this, he used empiric principles developed by the maritime and aviation industries, one of which is to start from a fixed point and used Rouvière’s sulcus as an extrabiliary fixed point to start dissection,[14] and they found it to be a useful anatomical landmark for this purpose.

**Discussion**

Apart from the well-established critical view of safety strategy to minimize the CBD injury during laparoscopic cholecystectomy, the need to have some extrabiliary anatomical landmark to help to locate the CBD should not be underestimated. Herein, we present our experience of 99 cases of laparoscopic cholecystectomy along with the frequency and shape of the Rouvière’s sulcus and its relation to the CBD.

In this study, the age of presentation of cholelithiasis was predominantly in the fourth decade of life (33.6%). Our data are in accordance with the studies conducted by Randhawa et al. and Rosen and Broody.[11,12] Most of the patients with cholelithiasis were found to be of female gender with the female-to-male ratio of 4.21:1. Rosen and Broody[12] also found female preponderance in cases of cholelithiasis in their studies. In our study population, 79 (79.59%) patients had single gall stones, whereas 20 (20.41%) had multiple gall stones.

In our study, Rouvière’s sulcus was present in 63 study participants. It was found to be lying above the level of CBD in 50 (79.36%) patients, and CBD at the level of the sulcus in 11 (17.46%) patients, and in 2 (5.97%) patients, CBD line could not be visualized. Open, close, and scar type of sulcus were found in 68.25%, 25.39%, and 6.35% of cases, respectively.

| Table 1: Incidence of Rouviere’s sulcus |
|----------------------------------------|
| Rouviere’s sulcus  | Number of patients (%) |
| Present            | 63 (63.63)              |
| Absent             | 36 (36.36)              |
| Total              | 99 (100.00)             |

| Table 2: Morphology of Rouviere’s sulcus |
|------------------------------------------|
| Type of Rouviere’s sulcus               | Total number of patients (%) |
| Close                                   | 16 (25.39)                   |
| Open                                    | 43 (68.25)                   |
| Scar                                    | 4 (6.35)                     |
| Total                                   | 63 (100.00)                  |

Age of the patients was 38.585 (SD ± 8.485) years and a median of 36. Female-to-male ratio in this study group was 4.21:1. After retracting the fundus of the gallbladder and before the commencement of dissection in Calot’s triangle, Rouvière’s sulcus could be identified in 63 cases (63.63%), whereas it could not be seen in 36 cases (36.36%) (P < 0.007) [Table 1]. Among these 63 patients with Rouvière’s sulcus, it was of open type in 68.25% (43 cases), close type in 25.39% (16 cases), and scar like in 6.35% (4 cases) (P < 0.0001) [Table 2].

Among these 63 patients, the Rouvière’s sulcus was found to be above the level of CBD line in 50 patients (79.36%) and at the same level in 11 patients (17.46%), and in two patients (5.97%), CBD line could not be visualized.

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era of laparoscopy, it can be better visualized after creating the pneumoperitoneum and retracting the fundus of the gallbladder. Its anatomy and its relation to nearby structure, namely CBD, can be better appreciated with the advent of better laparoscopic instruments.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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