Significance of Rouviere’s Sulcus in Hepatobiliary Surgery: A Cadaveric study

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ABSTRACT

Background: Rouviere’s sulcus (RS) was first identified in 1924 by Henri Rouviere. It lies oblique to the anterior and inferior border of the liver and holds the right portal pedicle.

Material and Methods: The study was conducted in the Department of Anatomy of a Medical College in Maharashtra, India, on 45 cadaveric livers. The morphological observations made were: presence/absence RS; direction of RS (oblique/horizontal/vertical); sulcus type (deep/slit/scar); length, width and depth; presence of right hepatic pedicle; distance of the hepatic vessels from edge of the sulcus.

Results: 40 livers showed the presence of Rouviere’s Sulcus. It was absent in five specimens. Direction was horizontal in 40%, oblique in 57.5% and vertical in 2.5%. 26 livers showed a deep type of sulcus, 12 showed the slit type and 2 showed scar type. 29 livers showed the right hepatic pedicle entering the RS. Average length, depth, of the RS was 2.35 cm and 1.07 cm respectively. The average width was 0.32 cm at medial end, 0.22 cm at midpoint and 0.1 cm at lateral end. Present study has added the details of depth of vessels from the edge of RS, which was not recorded in earlier studies. Depth of vessels from the edge of the sulcus was average 5 mm (0.5 cm) for the right branch of the hepatic artery and was 12 mm (1.2 cm) for the right branch of portal vein.

Conclusion: Rouviere’s sulcus is a reference landmark for surgeons during laparoscopic surgeries on gall bladder and during hepatic resection to avoid injuries. This study wishes to provide detailed morphological data of the Rouviere’s Sulcus to hepatobiliary surgeons including depth of hepatic vessels in the RS as an added parameter to aid them in their surgical endeavor.

KEYWORDS: Rouviere’s sulcus, Anatomical Landmark, Morphology, Depth, Hepatobiliary Surgery.

INTRODUCTION

Rouviere’s sulcus or the incisura hepatica dextra or Gans incisura identified first in 1924 by Henri Rouviere, a French anatomist[1]. He used it as a reference point for safe liver dissection. Rouviere’s sulcus is a sulcus
extending to the right of the porta hepatis, anterior to caudate lobe, lying oblique to the anterior and inferior border of the liver and holds the right portal pedicle. A once little known landmark Rouviere’s Sulcus (RS) has now become a common reference point for surgeons during laparoscopic surgeries of gall bladder and also during hepatic resection [2]. Laparoscopic cholecystectomy, a minimally invasive surgical procedure is the preferred surgical treatment of gallstones nowadays. Previously done studies by various authors have given data regarding the presence or absence (incidence) of RS. Reynaud et al noted the presence of RS in 73% of livers [3]. Hugh et al in 78% of livers [4] and Dahmane et al in 82% of normal livers [5]. Hugh et al were the first to draw attention to its importance during laparoscopic cholecystectomy [6] because it accurately indicated the plane of the common bile duct, stressing that the sulcus be used as the first landmark, ventral to which the dissection should begin during laparoscopic cholecystectomy to ensure fewer common bile duct injuries. Zubair et al described type of the sulcus as open and closed types [7] depending on whether the right hepatic pedicle was visible in the sulcus or not. Dahmane et al gave details regarding the dimensions of the sulcus such as its length and breadth, and what was contained in the floor of the sulcus—the right hepatic pedicle [5].

The present study was carried out to get detailed morphology of the Rouviere’s Sulcus, the contents of the sulcus, and the depth of the vessels in the sulcus keeping in mind the importance of the sulcus as an anatomical landmark to reduce complications during hepatic surgery and laparoscopic cholecystectomy.

MATERIALS AND METHODS
The study was conducted in the Department of Anatomy of Dr. D.Y. Patil Medical College Hospital and Research Centre Pimpri, Pune, Maharashtra, India, on forty-five formalin embalmed adult cadaveric livers. The following morphological observations and measurements were made:

- Presence or absence of RS
- Direction of RS whether it was oblique or horizontal or vertical
- Whether it was a deep sulcus or a slit or a scar
- Its length, width, depth
- Presence of right hepatic pedicle
- Distance of the hepatic vessels from edge of the sulcus

All measurements were carried out using a combination of vernier calipers, metric scale and silk thread.

OBSERVATIONS AND RESULTS:

Presence of RS: Out of the forty-five formalin embalmed cadaveric livers dissected, forty livers showed the presence of RS (incidence 88.88%). RS was absent in five specimens. (Table no 1)

Direction of RS: In the present study the Horizontal direction of RS was seen in 16 specimens (40%), 23 showed oblique direction of RS (57.5%) and one showed a vertical RS (2.5%). (Table no 2)

Type of sulcus: The RS was classified into sulcus, slit or scar variety according to if it was a deep cleft or a narrow gap or only a white scar. The deep sulcus was further identified into two varieties one with medial end of sulcus open or the one with medial end closed. In the present study 26 livers showed a deep sulcus (65%) (Fig no. 1) out of which 22 were open at the medial end near the porta hepatis and in them the right portal pedicle was clearly visible; 4 of the livers showing deep sulcus were open at the lateral end, the medial end was fused (Fig no. 2). 12 livers showed the slit type of RS (30%) (Fig no. 3) and 2 livers showed scar type of sulcus (5%). (Table no 1, 3)

Measurements of RS: In the present study the average length of the RS was 2.35 cm, the longest being 4.2 cm. The average breadth/width of RS was 0.32 cm at medial end, 0.22 cm at midpoint and 0.1 cm at lateral end. Average depth of sulcus was 1.07 cm, the deepest being 1.9 cm. (Table no 2)

5. The right hepatic pedicle was seen entering the RS in 29 livers (72.5%) (Fig no. 4)
6. Depth of vessels from the edge of the
sulcus was average 0.5cm for the right branch of the hepatic artery and was 1.2cm for the right branch of portal vein. (Fig no.5)

**Fig. 1:** Deep sulcus type of Rouviere’s Sulcus.

**Fig. 2:** Deep Rouviere’s Sulcus with closed medial end.

**Fig. 3:** Slit type of Rouviere’s Sulcus.

**Fig. 4:** Right portal pedicle at the floor of the RS. (A Branch of Portal vein  B Branch of Hepatic artery).

**Fig. 5:** Measurement of Depth of vessels from edge of RS.

**DISCUSSION**

During laparoscopic Cholecystectomy Rouviere’s sulcus is clearly visible and is used as an anatomical landmark. The importance of identifying Rouviere’s sulcus lies in the fact that the cystic duct and the cystic artery lie anterosuperior to the sulcus, in conformation with the Calot’s triangle. Using Rouviere’s sulcus as a landmark to start the dissection of the Calot’s triangle during laparoscopic cholecystectomy ensures fewer bile duct injuries [8]. Hugh et al. in their study, documented that there was a decrease in biliary tract injuries during laparoscopic cholecystectomy if dissection begins anterosuperior to Rouviere’s sulcus [6]. The incidence of bile duct injury in laparoscopic cholecystectomy is 0.3% in the study by Kim et al [9].

The presence of Rouvière’s sulcus (RS) in various studies was found to be 52% by Rouviere[1], 80% by [2], 78% by Hugh[4,6], 68.13% by Zubair [7], 82% by Dahmane [5], 75% by Kim [9], 90% by Arora et al [8], 100% by Singh[10], 82.67% by Lazarus [11] and 97% by Elwan [12] respectively. In the present study RS was found in 88.88% of specimens comparable to the findings of Arora et al. (Table 1.)

The RS was further classified as per the guidelines by Zubair et al into sulcus, slit or scar variety [7]. The deep sulcus was further classified into two varieties one with medial end of sulcus open or the one with medial end closed. In the present study 26 livers showed a deep sulcus (65%) out of which 22 were open at the medial end near the porta hepatis and in them the right portal pedicle was clearly visible; 4 of the livers showing deep sulcus were open at the lateral end and fused medially.12 livers
Table 1: Rouviere’s Sulcus: Incidence and Morphology in various studies.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Incidence %</th>
<th>Type of study</th>
<th>Type of RS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rouviere [1]</td>
<td>1924</td>
<td>52</td>
<td>Cadaveric/Operative</td>
<td>Deep sulcus</td>
</tr>
<tr>
<td>Hugh et al [4,6]</td>
<td>1997</td>
<td>78</td>
<td>Operative</td>
<td></td>
</tr>
<tr>
<td>Dahmane et al [5]</td>
<td>2013</td>
<td>82</td>
<td>Fresh autopsied</td>
<td>Slit 70</td>
</tr>
<tr>
<td>Zubair et al [7]</td>
<td>2009</td>
<td>68.13</td>
<td>Operative</td>
<td>30 12</td>
</tr>
<tr>
<td>Thapa et al [13]</td>
<td>2015</td>
<td>75</td>
<td>Operative</td>
<td></td>
</tr>
<tr>
<td>Kim et al [9]</td>
<td>2016</td>
<td>75</td>
<td>Operative</td>
<td>62 12 0</td>
</tr>
<tr>
<td>Arora et al [8]</td>
<td>2016</td>
<td>90</td>
<td>Operative</td>
<td></td>
</tr>
<tr>
<td>Singh &amp; Prasad [10]</td>
<td>2017</td>
<td>100</td>
<td>Operative</td>
<td>71 23 6</td>
</tr>
<tr>
<td>Al Nazer [14]</td>
<td>2018</td>
<td>79.3</td>
<td>Operative</td>
<td></td>
</tr>
<tr>
<td>Elwan [12]</td>
<td>2020</td>
<td>97.7</td>
<td>Operative</td>
<td></td>
</tr>
<tr>
<td>Present Study</td>
<td>2021</td>
<td>88.88</td>
<td>Cadaveric</td>
<td>65 30 5</td>
</tr>
</tbody>
</table>

Table 1 showed the slit type of RS (30%). 2 livers showed scar type of sulcus (5%). (Table 1).

Studies done by Dahmane [5], Singh [10], Lazarus [11], have observed the direction of RS to be mostly horizontal, curved and rarely vertical. In the present study 16 livers showed horizontal RS (40%) comparable to the work done by Lazarus [11], 23 showed oblique direction of RS (57.5%) and one showed a vertical RS (2.5%) comparable to the work done by Singh [10]. Table no 2.

The detailed measurements of the length and depth of the RS are available in the studies of Dahmane (fresh autopsied) [5], Singh (per operative) [10], and Lazarus (cadaveric) [11]. In the present study the average length of the RS was 2.35 cm, the longest being 4.2 cm which is comparable to the study of Dahmane et al [5]. Average depth of sulcus was 1.07 cm, is comparable to the study of Singh [10], the deepest being 1.9 cm. The average width of RS was 0.32 cm at medial end, 0.22 cm at midpoint and 0.1 cm at lateral end. These measurements are slightly different from the measurements of Singh [10] and Lazarus [11] the only two available studies for comparison. (Table no 2)

Table 2: Rouviere’s Sulcus: Direction and Measurements in different studies.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Direction of RS %</th>
<th>Average Length (cm)</th>
<th>Average Depth (cm)</th>
<th>Average Width (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dahmane et al [5]</td>
<td>Horizontal 3, Oblique/ Curved 97, Vertical 0</td>
<td>2.8</td>
<td>0.6</td>
<td>-</td>
</tr>
<tr>
<td>Singh and Prasad [10]</td>
<td>70, 31</td>
<td>2.03</td>
<td>0.96</td>
<td>0.97</td>
</tr>
<tr>
<td>Lazarus [11]</td>
<td>Horizontal 41.33, Oblique/ Curved 41.33, Vertical 0</td>
<td>3.16</td>
<td>0.78</td>
<td>0.16</td>
</tr>
<tr>
<td>Present study</td>
<td>40, 57.5</td>
<td>2.35</td>
<td>1.07</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Table 3: Comparison of Deep Sulcus subtypes.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Deep sulcus (Incidence%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Open type</td>
</tr>
<tr>
<td>Lazarus [11]</td>
<td>33/75 (44%)</td>
</tr>
<tr>
<td>Singh &amp; Prasad [10]</td>
<td>60 (84.5%)</td>
</tr>
<tr>
<td>Present study</td>
<td>22 (84.6%)</td>
</tr>
</tbody>
</table>

Singh et al in their study found hepatic vessels in 75% of deep open type sulcus and in 9% in deep closed type sulcus. The present study showed the hepatic and portal vessels entering in the RS in 29 livers (72.5%). (Table no 3)

Present study has added the details of depth of vessels from the edge of RS, which was not recorded in earlier studies. Depth of vessels from the edge of the sulcus was average 5 mm (0.5 cm) for the right branch of the hepatic artery and was 12 mm (1.2 cm) for the right branch of portal vein. There are no studies available for the comparison of these measurements.

CONCLUSION

As already known the Rouviere’s sulcus is now a reference point for surgeons during...
laparoscopic surgeries on gall bladder and during hepatic resection. It is used as the first landmark from where the dissection should begin during laparoscopic cholecystectomy to avoid common bile duct injuries. This study wishes to provide detailed morphological data of the Rouvière’s Sulcus to hepatobiliary surgeons including depth of hepatic vessels in the RS as an added parameter to aid them in their surgical endeavor.

Conflicts of Interests: None

REFERENCES
