

Morphology and Morphometry of Rouviere's Sulcus: A Cadaveric Study

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Abstract

Background: The Rouviere's Sulcus is a fissure that is typically 2–5 cm in length and is located to the right of the liver hilum. It is visible on the inferior liver surface. It is a dependable reference for safe laparoscopic cholecystectomy and assists in determining the plane of dissection for Calot's triangle, as it correlates internally to the plane of the right portal pedicle. The common bile duct (CBD) is a critical structure that is situated immediately beneath the sulcus. Consequently, surgeons prevent damage to the CBD by maintaining their position above Rouviere's sulcus during dissection. Not many studies have documented its existence in the literature, despite its considerable clinical importance. The objective of the investigation was to determine the prevalence and investigate the morphology and morphometry of Rouviere's sulcus. **Material and Methods:** This observational research was conducted in the Anatomy department of a super specialty hospital medical institution. In the current investigation, 30 formalin-fixed adult liver specimens were analyzed to determine the presence or absence of RS. The measurements were evaluated using a digital Vernier caliper. **Results:** RS was seen in 25 (83.33%) of the 30 liver segments examined, while it was absent in 5 (16.66%). The RS was oblique in 13 specimens (43.33%), transverse in 8 specimens (26.66%), and absent in 9 specimens (30%). Vertically orientated RS was not found among any of our specimens, and Type 1A RS was the most frequently observed subtype. **Conclusion:** When the surgeon is required to dissect ventral to the sulcus during severe acute inflammation, the RS serves as a reliable landmark to ensure that the surgeon operates away from the hazard area of Calot's triangle. The significance of RS knowledge in ensuring a safe level of dissection during gallbladder surgery, as well as preventing bile duct injuries, is underscored by the identification of RS in 83% of specimens in our study.

Keywords: Rouviere's Sulcus, Laparoscopic Cholecystectomy, Bile Duct Injury, Morphology, Morphometry.

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INTRODUCTION

Rouviere's Sulcus (RS),^[1] also known as Incisura hepatica dextra or Gans incisura, was initially identified and documented by French anatomist Henri Rouviere.^[2] The presence of the RS in the majority of livers is significant because it serves as an important guide for a secure laparoscopic cholecystectomy. This is due to the fact that it serves as an additional biliary reference point, which is facilitated by the creation of a pneumoperitoneum, which is frequently used for insufflation with carbon dioxide. This inflation leads to the RS's increased prominence and the convenient recognition of the RS in order to avoid surgical complications.^[3]

In comparison to surgical cholecystectomy, laparoscopic cholecystectomy is a less invasive procedure that results in a shorter hospital stay, a shorter recovery period, and less discomfort for the patient. Infection of the viscera, hemorrhage, and damage to the bile duct and significant blood vessels are among the most prevalent complications associated with laparoscopic cholecystectomy. Despite significant progress in the procedure, the rate of bile duct injuries during laparoscopic cholecystectomy remains at approximately 0.5%. This is likely due to the slightly complex detection of anatomical structures in laparoscopic surgery, which occurs in a three-dimensional plane but is

perceived by the surgeon as a two-dimensional space.^[4,5] Other factors that may result in an injury during laparoscopic cholecystectomy include infection, inflammation during acute cholecystitis, unclear or distorted anatomy, and hemorrhage.^[6] Rouviere's sulcus (RS) is a fissure that extends from the caudate process to the right lobe of the liver for an uncertain length, and is located on the inferior surface of the right lobe of the liver. It may be transverse or oblique in orientation.^[7] RS is a critical clinical reference in laparoscopic cholecystectomy due to the fact that the cystic duct and the cystic artery are antero-superior to it, while the common bile duct is located anterior to it in the same plane. During these surgeries, its identification is crucial for preventing damage to the hepatobiliary ducts and ensuring the correct location and ligation of the cystic artery. The right posterior portal pedicle is circumscribed within the RS, which makes it a critical clinical landmark in surgeries that involve

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right liver resection. Additionally, the RS is situated anterior to liver segment I.^[8]

In order to prevent injury to the right posterior pedicle, which is a prevalent component of the RS, cholecystectomy is performed prior to the RS when performing the segmental resection of the right lobe of the liver. This is done with segment V. This is advantageous during segmentally orientated right hepatic resection for elective vascular control.^[9] The RS is a significant anatomical landmark that is less well-known and less studied, but it can assist in preventing damage to the hepatobiliary ducts and vessels during hepatobiliary surgeries. The current study was conducted to determine the prevalence and document the morphology and morphometry of Rouviere's sulcus, as it has not been extensively studied and there is a limited documentation of this sulcus in anatomical or surgical literature.

MATERIALS AND METHODS

After obtaining waiver of consent from ethical committee, this observational study was done in the department of Anatomy, of a Super speciality hospital medical institution. In the current investigation, 30 formalin-fixed adult liver specimens were analyzed to determine the presence or absence of RS. The measurements were evaluated using a digital Vernier caliper.

Inclusion criteria

Male and female adult liver specimens that were formalin fixed were included.

Exclusion criteria

Liver lobectomy, macroscopic pathological alterations such as cysts, nodules and cirrhosis (shrunken liver).

The specimen was cleaned by flowing tap water to clean all surfaces after being removed from the abdominal cavity. In order to facilitate their handling, the specimens were permitted to dry. Each of the samples were numbered and preserved in distinct formalin-filled containers. The existence or lack of RS was observed on the right and left hemispheres, as well as all surfaces of every specimen. The sulcus type was also investigated if it was present. The presence or absence of RS and the measurements of 30 formalin-fixed adult liver specimens were evaluated using a digital Vernier caliper. The classification system created by Singh and Prasad (2017)³ was used to capture the direction and type of RS. Furthermore, the dimensions of length, breadth, and depth were recorded using thread, which was subsequently projected onto a digital Vernier caliper to evaluate the measurements. A study was conducted on the morphology of RS, and it was classified according to the degree of its infiltration into the hepatic substance.³

- Type 1 - A deep sulcus that is greater than 1 mm in depth.
- Type 1 was subdivided into:
 - Type 1A - Medially, the deep sulcus continues with the hilum.

Type 1B - The hilum did not continue with the deep sulcus, which is fused medially.

- Type 2 - A superficial and narrow slit-like sulcus that

lacks a measurable depth using a measurement scale (<1mm).

- Type 3 - A scar that resembles a fused line.
- Type 4 - Characterized by the absence of a sulcus.

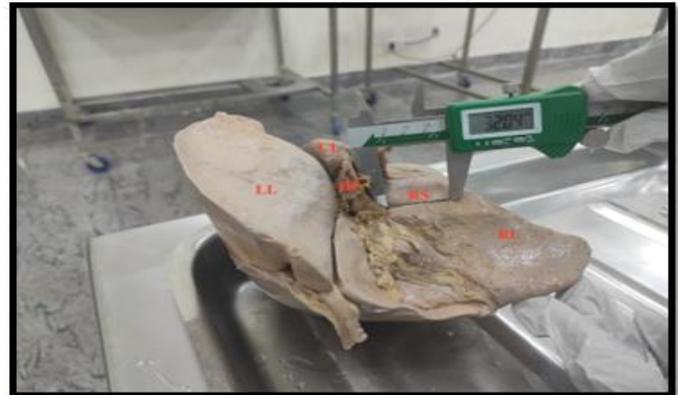


Figure 1: Type 1A Rouviere's sulcus. The sulcus was open at its medial extremity and was consistent with the hilum of the liver, demonstrating a transverse sulcus.

LL=Left Lobe, RL=Right lobe,RS=Rouviere's sulcus, HP=Hepatic portal, CL=Caudate Lobe



Figure 2: Type 1B Rouviere's sulcus. The medial extremity of the deep fissure appeared to be closed as a result of the union of liver parenchyma at that time, revealing an oblique sulcus.



Figure 3: Rouviere's sulcus Type 2. Slit-like sulcus. The sulcus is visible but it is not profound.



Figure 4: Rouviere's sulcus Type 3. Sulcus that resembles a scar.



Figure 5: Type 4. Rouviere's sulcus is absent.

The data that was collected was tabulated and recorded, and the average result was determined. The relevance of all parameters under investigation was assessed by comparing them to those from prior studies.

Table 1: Distribution of study samples according to frequency and direction of Rouviere's sulcus

		Number of specimens, n (%)
Frequency (n=30)	Present	25 (83.33%)
	Absent	5 (16.66%)
Direction (n=21)	Transverse or horizontal	8 (26.66%)
	Oblique	13 (43.33%)

Table 2: Morphological types of Rouviere's sulcus (n=30)

Type of RS	Number of specimens, n (%)
Type 1A	13 (43.33%)
Type 1B	4 (13.33%)
Type 2	4 (13.33%)
Type 3	4 (13.33%)
Absent	5 (16.66%)

Type 1A RS was the most frequently observed subtype in the examined specimens, with 13 out of 30 specimens (43.33%) exhibiting this subtype. This suggests that it may be the prevalent histological pattern between the types evaluated. Types 1B, 2, and 3 were identified in four specimens (13.33%), indicating that they have an equal but lower prevalence than Type 1A. It is important to note that RS was not present in five specimens (16.66%). [Table 2]

RESULTS

RS was detected in 25 (83.33%) of the 30 liver specimens examined, while it was absent in 5 (16.66%). The RS was oblique in 13 specimens (43.33%), transverse in 8 specimens (26.66%), and absent in 9 specimens (30%). Vertically orientated RS was not observed in any of the specimens. [Table 1]

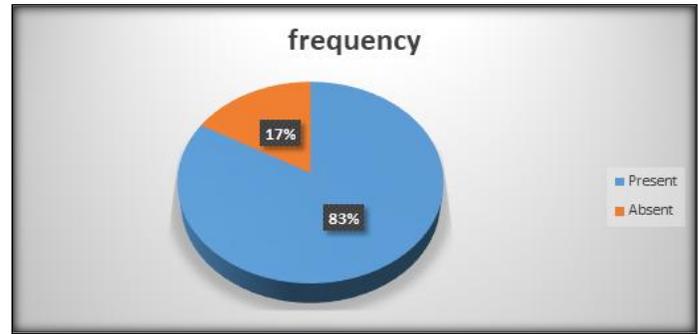


Figure 6: frequency of Rouviere's sulcus

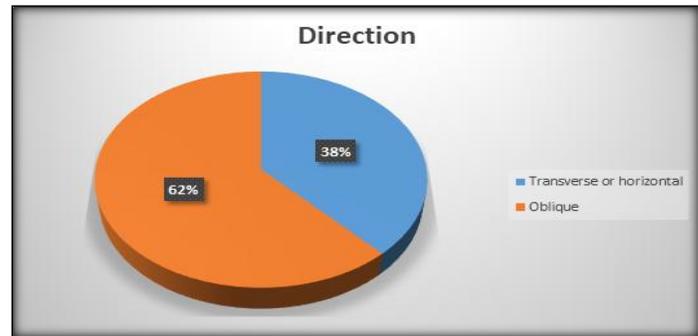


Figure 7: Direction of Rouviere's sulcus.

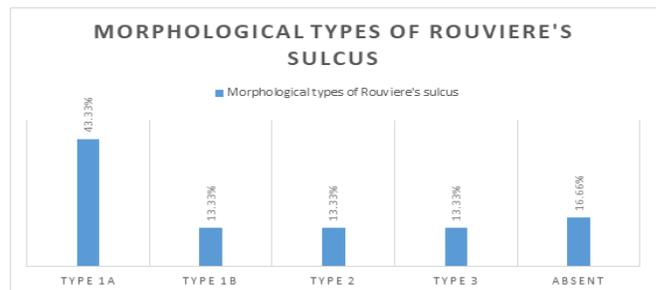


Figure 8: Morphological types of Rouviere's sulcus (n=30)

Table 3: Morphometric measurements of Rouviere's sulcus (n=21)

Parameters	Mean±SD	Median	Minimum	Maximum
Length (mm)	26.2±10.8	27.4	10.34	49.66
Breadth (mm)	2.4±1.7	1.61	0.86	6.97
Depth				
Medial most (mm)	5.1±3.9	4.68	0.51	17.19
Intermediate (mm)	3.8±3.4	2.93	0.66	16.46
Lateral most (mm)	1.9±1.8	1.93	0.16	7.59

The specimens' mean length was 26.2 ± 10.8 mm (range: 10.34–49.66 mm), with a median of 27.4 mm, as indicated by the morphometric analysis. The breadth exhibited a significant degree of variability, with an average of 2.4 ± 1.7 mm (range: 0.86–6.97 mm).

The medial-most depth was the most significant (5.1 ± 3.9 mm, range: 0.51–17.19 mm), followed by the intermediate depth (3.8 ± 3.4 mm, range: 0.66–16.46 mm), and the lateral-most depth was the smallest (1.9 ± 1.8 mm, range: 0.16–7.59 mm). This pattern indicates a progressive reduction in depth from the medial to the lateral aspect. [Table 3]

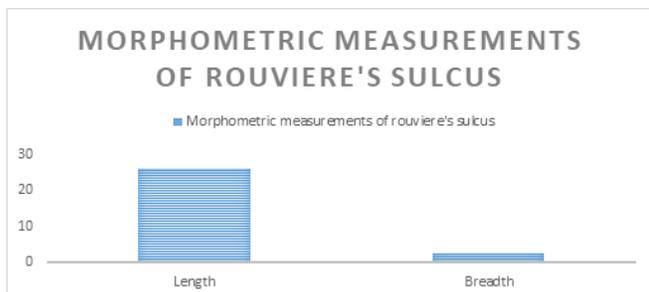


Figure 9: Morphometric measurements of Rouviere's sulcus (Length and Breadth).

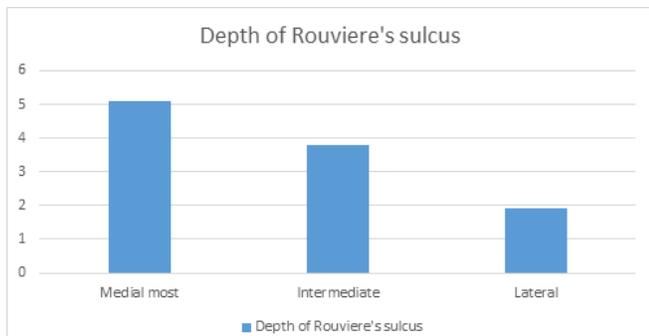


Figure 10: Morphometric measurements of Rouviere's sulcus (Depth)

DISCUSSION

The liver and biliary system's anatomy has been rendered more detailed and safer through significant advancements in imaging techniques. This has resulted in the facilitation of both open and laparoscopic surgical procedures. The primary cause of iatrogenic injuries is the improper identification of normal anatomical structures and variations in anatomical structures while operative procedures, particularly in minimally invasive interventions.^[8] RS is a

cleft that is located on the inferior aspect of the right lobe of the liver. The medical literature has not provided a detailed description of this sulcus, and an appropriate categorization has not been established. The recording of morphological and morphometric parameters, relationships, and other significant findings of the RS would be beneficial to surgeons in the prevention of iatrogenic injuries.

RS was detected in 25 (83.33%) of the 30 liver specimens examined in the current analysis, while it was absent in 5 (16.66%) of the specimens. Similar incidences have been identified in prior investigations. The frequency was 82% in a study conducted by Dahmane et al⁸, 100% in a study conducted by Singh M et al,^[3] and 82.66% in a study conducted by Lazarus et al.^[10] In their investigation, Al Nazer et al,^[11] demonstrated a frequency of 79.3%.

In our investigation, the direction of RS was oblique in 13 specimens (43.33%), transverse in 8 specimens (26.66%), and absent in 9 specimens (30%). Vertically orientated RS was not observed in any of the specimens. Vertically orientated RS was not observed in any of the liver specimens that were examined. In a study conducted by Dahmane et al⁸, the RS was indicated to be tangentially orientated in 97% of the 40 liver specimens and transversely orientated in 3%. In the study conducted by Singh M et al,^[3] on 100 livers, oblique RS was detected in 30% of the livers, while horizontal RS was detected in 70% of the livers. A study conducted by Lazarus et al,^[10] exhibits a comparable number of RS that are transversely and obliquely orientated. While both are absent in 7.33%, they account for 41.33% each.

Morphological types

Type 1A RS was the most frequently observed subtype in the specimens under investigation, with 13 from the 30 specimens (43.33%) exhibiting this pattern. This suggests that it may be the most prevalent pattern within the types that were considered. Four specimens (13.33%) were found to contain Types 1B. Type 1 was observed in 32 (53.33%) specimens, while Type 1B was observed in 5 (8.33%) of specimens, according to a study done by Gowda et al.^[7] These results were lower than those reported in investigations conducted by Dahmane et al⁸ (70%), Singh M et al,^[3] (71%), and Al Nazar et al (54.9%).^[11]

Type 2 has been found in 4 specimens (13.33%), indicating that these categories have an equal but lower prevalence than Type 1A. Type 2 RS was observed in 7 specimens (11.66%) by Gowda et al.^[7] Our results were higher than those of Dahmane et al⁸ (0%),^[8] but they were lower than those of Lazarus et al,^[10] (25.33%), Singh M et al (23%),^[3] and Al Nazar et al (24.4%).^[11] Four specimens (13.33%) were classified as Type 3. In 8.33% of cases, Gowda et al,^[7] reported the presence of type 3 RS. Dahmane et al,^[8] discovered the presence of the organism in

12% of the specimens, Singh M et al,^[3] in 6% of the specimens, and Lazarus et al,^[10] documented the presence of the organism in 6.67% of the specimens. Understanding the types and frequencies of various RS is crucial and

beneficial when employing RS as a landmark in laparoscopic cholecystectomy and other pertinent hepatobiliary operations. Five specimens (16.66%) were devoid of RS.

Table 4: Morphological types of Rouviere's sulcus compared with previous studies

Author (year)	Sample size	Frequency of RS	Type of RS		
			Type 1	Type 2	Type 3
Dahmane et al, ^[8] (2013)	40	82	70	-	12
Thapa et al, ^[12] (2015)	200	75	66	25	-
Kim et al, ^[13] (2016)	369	75	62	12	-
Singh M et al, ^[3] (2017)	100	100	71	23	6
Al-Nazer et al, ^[11] (2018)	402	79.3	54.9	24.4	-
Lazarus et al, ^[10] (2018)	75	82.67	50.67	25.33	6.67
Present study(2023)	30	83.33	56.66	13.33	13.33

Morphometry: Rouviere's initial research indicated that this sulcus could be found in more than "1/3rd of the entire width of the right lobe of the liver," but he did not provide any measurements.^[1] The majority of the studies that have documented the morphometry of RS have been conducted on individuals during laparoscopic surgeries, and it is challenging to take accurate measurements during surgery. Consequently, the studies that are conducted to figure out the morphometry of RS must be conducted on cadaver liver specimens, which are more easily and accurately measured.^[11,14] The RS in this investigation had an average length of 26.2±10.8 mm and a breadth of 2.4±1.7 mm. In terms of depth measurements, the medial-most depth was the greatest (5.1 ± 3.9 mm), followed by the intermediate depth (3.8 ± 3.4 mm), and the lateral-most depth was the smallest (1.9 ± 1.8 mm). The average length, breadth, and depth of the RS in the investigation conducted by Gowda et al,^[7] were 2.84, 0.18, and 0.62 cm, respectively. The RS average length in the current research was 2.8 cm, which was comparable to

the study conducted by Dahmane et al.^[8] It was also less than the average length in a study conducted by Lazarus et al,^[10] which was 3.16 cm. However, it was greater than the average length mentioned in the study conducted by Singh M et al (2.03).^[3] The average breadth of RS in the current study was 0.24 cm, which was in close proximity to the findings of Lazarus et al,^[10] (0.18) and Gowda et al,^[7] (0.18cm) but less than the findings of Singh M et al (0.97).^[3]

The depth of Rouviere's sulcus, a groove on the liver's surface, varies at various locations along its length. The "medial most," "intermediate," and "lateral" depths are indicators of the depth of the groove. The term "medial most depth" denotes the depth of the sulcus as it reaches the porta hepatis, which is frequently the deepest point. In comparison to the intermediate and lateral depths, the medial-most depth was the greatest in the present study in terms of depth measurements, measuring 0.51cm. This study is the first to report variations in the profundity of RS, to the best of our knowledge.

Table 5: Morphometry of Rouviere's sulcus

Author (year)	Sample size	Mean Length (cm)	Mean Breadth(cm)	Mean Depth(cm)
Dahmane et al. (2013)	40	2.8	-	0.6
Singh and Prasad (2017)	100	2.03	0.97	0.96
Lazarus et al. (2018)	75	3.16	0.16	0.78
Present study (2023)	30	2.62	0.24	Medial most- 0.51 Intermediate- 0.38 Lateral – 0.19

Surgical Importance: RS has been identified as an extra-biliary landmark that may mitigate iatrogenic injuries that result from hepatobiliary interventions, as the incidence of bile duct injuries has increased with the advent of laparoscopic cholecystectomy. This research has the potential to assist surgeons and hepatologists in the secure execution of right segmental liver resection. The bile duct, hepatic artery, and portal vein are encircled by the Glisson's capsule of liver, a fibrous sheath that persists as a capsule at the hilum. A prior understanding of the anatomy of RS may be beneficial when performing segmental resection of the liver using the Glissonian approach, primarily for segments V, VI, and VII, with RS as a guide. In 70% of patients, Damhne et al,^[8] reported branches of the right posterior segmental pedicle in RS. Therefore, the identification and localization of RS can be used to implement elective

vascular control during a segment-oriented procedure to right hepatic resection. Although pure laparoscopic anatomical segmental resection is challenging to execute, Kim et al,^[13] described the Glissonian approach at Rouviere's sulcus as a landmark, in conjunction with a modified liver hanging maneuver, which could be both safe and beneficial for laparoscopic anatomical segment VI resection.

Limitations: In addition to the fact that we had a relatively small number of only 30 livers, the applicability of this prevalence is influenced by the fact that RS may not be constant in extensive cirrhosis of the liver, obese liver, and other diseases that cause liver scarring. The position, structure, and size of the gallbladder may be altered during laparoscopic surgeries due to excessive traction of the gallbladder fundus superiorly or significant inflammation and adhesions of the gallbladder.

CONCLUSION

A precise understanding of the anatomy of the RS as an extra-biliary landmark is crucial for reducing the risk of accidental damage during laparoscopic cholecystectomy and right hepatectomy. When the surgeon is required to dissect ventral to the sulcus during severe acute inflammation to ensure that they are operating away from the hazard area of Calot's triangle, RS is a reliable landmark. Consequently, the RS serves as an invaluable supplementary reference point for the surgeon during surgical procedures.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Deshatty DD, Shruthi BN, Kavitha S, Madhumitha LM. Morphometry and Morphology of Rouviere's Sulcus of Liver for Laparoscopic Cholecystectomy--A Cadaveric Study. *Journal of Evolution of Medical and Dental Sciences*. 2021;10(19):1403-8.
2. Rouviere H. On the configuration and the significance of groove of the caudate process. *Newsletter and Memoir of the Anatomical Society of Paris* 1924;94:355-8.
3. Singh M, Prasad N. The anatomy of Rouviere's sulcus as seen during laparoscopic cholecystectomy: a proposed classification. *J Min Access Surg* 2017;13(2):89-95.
4. Connor S, Garden OJ. Bile duct injury in the era of laparoscopic cholecystectomy. *Br J Surg* 2006;93(2):158- 68.
5. Wu YV, Linehan DC. Bile duct injuries in the era of laparoscopic cholecystectomies. *Surg Clin North Am* 2010;90(4):787-802.
6. Lockhart S, Singh RG. Rouviere's sulcus-aspects of incorporating this valuable sign for laparoscopic cholecystectomy. *Asian J Surg* 2018;41(1):1-3.
7. Gowda P, Udipi S. Morphological Study of Rouviere's Sulcus: An Important Landmark in Laparoscopic Cholecystectomy and Right Segmental Liver Resection. *National Journal of Clinical Anatomy*. 2022;11(1):49-53.
8. Dahmane R, Morjane A, Starc A. Anatomy and surgical relevance of Rouviere's sulcus. *The Scientific World Journal*. 2013;2013(1):254287.
9. Singh K, Ohri A. Anatomic landmarks: their usefulness in safe laparoscopic cholecystectomy. *Surgical Endoscopy and Other Interventional Techniques*. 2006; 20(11):1754-8..
10. Lazarus L, Luckrajh JS, Kinoo SM, Singh B. Anatomical parameters of the Rouviere's sulcus for laparoscopic cholecystectomy. *Eur J Anat*. 2018;22(5):389-95.
11. Al-Naser MK. Rouviere's sulcus: a useful anatomical landmark for safe laparoscopic cholecystectomy. *IntJ Med Res Health Sci*. 2018;7(1):158-61.
12. Thapa PB, Maharjan DK, Tamang TY, Shrestha SK. Visualisation of Rouviere's sulcus during laparoscopic cholecystectomy. *JNMA J Nepal Med Assoc*. 2015;53(199):188-91.
13. Kim JK, Kim JY, Park JS, Yoon DS. Clinical significance of Rouviere sulcus during laparoscopic cholecystectomy. *HPB*. 2016;18:515-6.
14. Troidl H. Disasters of endoscopic surgery and how to avoid them: error analysis. *World journal of surgery*. 1999; 23 (8):846-55.