Journal of Clinical and Translational Research 2024; 10(1): 9-17

Journal of Clinical and Translational Research

Journal homepage: http://www.jctres.com/en/home

ORIGINAL ARTICLE

Subtotal cholecystectomy as an approach to preventing injury in the left-sided gallbladder in the emergency surgery setting: A case study

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ARTICLE INFO

Article history:
Received: November 04, 2023
Accepted: December 05, 2023
Published online: February 1, 2024

Keywords
Left-sided gallbladder
Acute cholecystitis
Subtotal cholecystectomy
Partial cholecystectomy
Case report

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ABSTRACT

A left-sided gallbladder is an unusual anatomic variation that makes gallbladder surgery challenging. Two systematic reviews on surgery for left-sided gallbladder highlighted high iatrogenic bile duct injury rates of 4.4% and 7.3%. This paper reports a female in her 40s with symptoms of acute calculous cholecystitis admitted to a secondary health-care center. After inserting four ports through standard sites for conventional gallbladder surgery, laparoscopic inspection revealed a phlegmonous left-sided gallbladder. No discordant situs of abdominal viscera was noted. Laparoscopic surgery was converted to open subtotal closed-tract cholecystectomy. No post-operative complications related to the surgical site were observed. A left-sided gallbladder affected by severe inflammation and infection is an extraordinary condition that should be considered as a risk factor. If an inflamed left-sided gallbladder is encountered, emergency subtotal cholecystectomy is an alternative to total cholecystectomy when the circumstances to adopt the strategies of a culture of safety in cholecystectomy for complete removal of the gallbladder are unfavorable.

Relevance for Patients: Subtotal cholecystectomy in patients with left-sided gallbladder reduces the risk for bile duct injuries, outweighing the potential side effects stemming from this surgical approach.

1. Introduction

Anatomical variants within the biliary ductal system are common [1,2]; contrarily, aberrations are rare. The true left-sided gallbladder is one of them, with an estimated incidence rate of <0.3% [3,4].

A recent systematic review summarized 53 case reports and case series on managing the left-sided gallbladder [5]. Briefly, cholecystectomy for symptomatic gallstones was performed in 90 (80.4%) of 112 total patients. A major iatrogenic injury to the common duct requiring hepaticojejunostomy occurred in four patients (4.4%). Another review paper revealed a higher bile duct injury rate (7.3%) in 55 patients during left-sided cholecystectomy [6].

Despite the high rates of bile duct injury in this subpopulation of patients, a left-sided gallbladder has not yet been elucidated as a surgical factor requiring pre-operative and (or) intraoperative consideration in applying the gallbladder bailout surgery principle, which is always directed at iatrogenic injury prevention [7-9]. This is especially important in an emergency general surgery setting. In this paper, we aim to describe an incidental surgical finding from a clinical case of an urgent subtotal cholecystectomy for a left-sided gallbladder. Insufficient awareness of the potential dangers associated with this anatomical variation of the gallbladder can expose a patient to a substantially higher risk of having life-changing consequences related to biliary or vascular injuries.

DOI: https://doi.org/10.36922/jctr.00128

2. Materials and Methods

2.1. Case presentation

A right-handed female patient in her 40s with severe central epigastric and right-sided hypochondrium pain was admitted to the emergency general surgery ward of the acute care hospital. The pain was associated with vomiting and diarrhea. Her only concomitant diseases were essential hypertension, which was controlled using 5 mg ramipril daily, and constipation. Her body mass index was 35.8 kg/m^2 on admission.

The patient was afebrile (37.1°C), with a satisfactory oxygen saturation level at 98%, sinus heart rhythm at 81 beats/min, and high arterial blood pressure at 179/98 mmHg. Further objective examination revealed severely tender right hypochondrium, central epigastrium, and positive Murphy's sign.

Her white blood cell count was 16.1 × 10^9/L. Her neutrophils comprised 89.4% leukocytes (14.4 × 10^9/L). The total serum bilirubin concentration was within the standard range (9 μmol/L; 0.53 mg/dL). However, her serum γ-glutamyl transferase concentration was 3.8 times above the standard level of <40 U/L. Her serum C-reactive protein concentration was within the standard range (4 mg/L). Hyperlactatemia of 3.8 mmol/L was also detected in the patient. The radiographs did not reveal pneumoperitoneum or chest infection.

The radiologist performed a transabdominal ultrasound scan within 24 h of admission. Signs of fatty liver disease with hepatomegaly and cholecystolithiasis were reported. Two annotated ultrasonograms are illustrated in Figure 1.

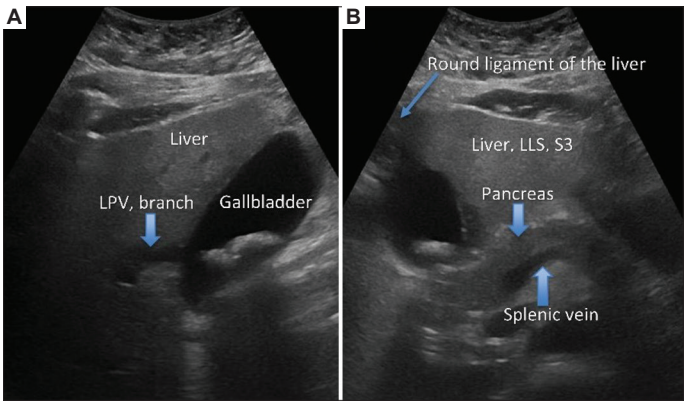

Figure 1. Transabdominal ultrasonography of the gallbladder and surrounding anatomical structures: (A) longitudinal view of the gallbladder reveals a distended organ and large calculi in its neck; the block arrow is directed at the tubular structure which, by our interpretation, is a branch of the left portal vein; (B) transverse view of the gallbladder shows a calculus within it; most importantly, the head and the body (the upper block arrow) of the pancreas, and splenic vein behind this organ (the lower block arrow) are visible. A line arrow is directed at a hypoechogenic area, a site of the round ligament of the liver.
Abbreviations: LLS: Left lateral section; LPT: Left portal vein; S3: The third segment of the liver.

2.2. Differential diagnosis

A working diagnosis of acute calculous cholecystitis was apparent; however, four diagnostic detail points should be briefly overviewed. First, according to Tokyo Guidelines 2007 (TG07), 2013 (TG13), and 2018 (TG18), grading the acute cholecystitis severity should be emphasized during admission and pre-operative diagnosis. Our case should have been classified as acute moderate cholecystitis – grade 2 – as it was associated with a duration of acute symptoms of >72 h [10].

Second, precise radiological characterization of the gallbladder and its site is crucial in managing acute cholecystitis. However, detecting an atypical gallbladder anatomical location is difficult (although possible) when performing an urgent transabdominal ultrasound scan (further details are provided in the discussion). Therefore, the left-sided gallbladder is identified during surgery in over 80% of cases [5].

Third, intraoperative characterization of the anatomy of the gallbladder, liver, and its ligaments facilitates decision-making during laparoscopic or open surgery. Also, it is essential in education and academic surgery. In the absence of *situs viscerum inversus*, the sinistroposition, a true left-sided gallbladder (our patient), usually with hypoplastic segment 4 of the liver, should be differentiated from the medioposition of the gallbladder [11], when it is medially displaced to lie on the undersurface of the quadrate lobe (i.e., inferior subsegment of segment 4) of the left hemiliver.

Fourth, a right-sided round liver ligament is another rare anatomical variant, which can be associated (but not always; our patient is an example) with the left-sided gallbladder and frequent intrahepatic vascular and biliary anomalies [12].

2.3. Therapeutic interventions

A standard conservative treatment scheme, including antibiotics, was established for this patient. We infused 100 mg of tigecycline and 240 mg of gentamycin through the peripheric vein, and a regular tigecycline dose of 50 mg every 12 h for 5 days was prescribed. Pyrexia during the hospital stay, local signs of peritoneal irritation, and serum C-reactive protein raised to 88 mg/L were key indicators to consider an urgent index admission laparoscopic cholecystectomy on the 4th day of hospitalization. Informed consent was obtained as a part of the routine pre-operative actions.

After inserting the first 11-mm diameter port below the umbilicus, a capnoperitoneum of up to 12 mmHg was achieved. Standard sites of the right upper quadrant of the abdominal wall were used to insert the other three ports for conventional cholecystectomy. Laparoscopic inspection revealed a distended thick-walled phlegmonous gallbladder on the left side of the round and falciform ligaments of the enlarged liver on the anterior wall of the distal portion of the stomach (Figure 2). A proximal portion of the gallbladder anterior to the hepatic hilum, inflamed tissues of the hepatoduodenal ligament, unclear segmental anatomy (such as the presence or absence of segment 4) despite the apparent sulcus on the visceral surface of the liver, and a sizeable umbilical fissure

DOI: https://doi.org/10.36922/jctr.00128

of the liver were other features of the case's surgical anatomy. Also, it was the first time an experienced consultant surgeon operated on a patient with a true left-sided gallbladder. An additional 5-mm diameter port was inserted into the peritoneal cavity through the left upper quadrant of the abdominal wall. An attempt was made to detach the gallbladder's fundus from the visceral surface of segment 3 of the liver. However, this procedure was aborted. A decision was made to convert a laparoscopic to open surgery through an upper midline laparotomy.

The fundus-first technique was further employed to detach 80% of the hepatic wall of the gallbladder from the cystic plate, which was edematous and hemorrhagic. Thereafter, the gallbladder's fundus was opened, infected bile was suctioned out, and moderate-sized gallstones were removed from the cavity of the gallbladder. When a good backflow of fresh bile was noticed from the internal orifice of the cystic duct, situated quite superiorly, a final decision was made to perform a subtotal cholecystectomy.

No attempt was made to dissect the cystic pedicle. The gallbladder was transected circumferentially at the level of the Hartmann's pouch. The remnant was closed using two continuous polyglactin 910 (Vicryl® 2/0) and polydioxanone (PDS II 2/0) sutures to obliterate the cavity of the remnant gallbladder. Floseal®, a human gelatine-thrombin matric sealant, was used to ensure hemostasis from the liver. The Portex®Robinson drainage system 20 Ch was used for the subhepatic space of the peritoneal cavity.

2.4. Outcome and follow-up

No surgical complications were observed. However, on post-operative day 2, a fever episode (38.1°C), supraventricular tachycardia (>200 beats/min), and hypotension were documented and managed according to hospital guidelines. Furthermore, on post-operative day 3, the patient was tested positive for influenza B. The patient was isolated in a side room with droplet precautions. The drain was removed from the peritoneal cavity on post-operative day 6, the day she was discharged from the hospital. Histopathological investigation of the excised part of the gallbladder of 60 × 33 × 24 mm dimensions revealed a 6-mm wall thickness, necrotic mucosa, and signs of diffuse chronic inflammation.

No other side effects and readmissions to the hospital occurred within 90 post-operative days. The patient underwent three-dimensional magnetic resonance cholangiopancreatography as an outpatient (Figure 3).

A follow-up visit to the surgical assessment unit on post-operative day 111 revealed that the patient had made an excellent post-operative recovery. We used the Gastrointestinal Quality of Life Index-10 (GIQLI-10, English; point range 0–40; a maximal score indicates perfect health) to assess the quality of life related to health [13]. The summative score was 28. However, only diarrhea (score 2 out of 4) had increased since the surgery, which was due to intake of high-fat or high-sugar foods. The other two low-score (1 out of 4) symptoms – strong burping/belching and tiredness/

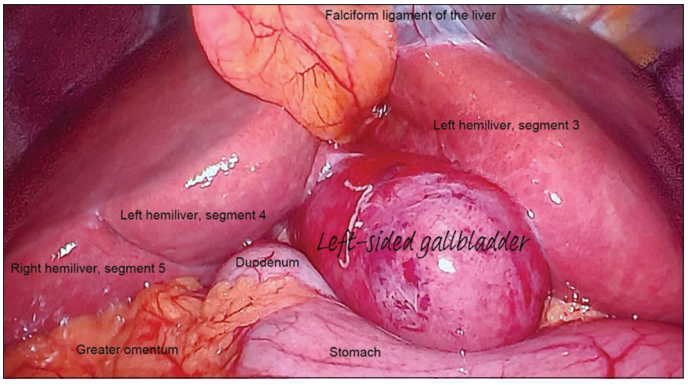

Figure 2. Laparoscopic inspection reveals a left-sided gallbladder and acute cholecystitis. The fissure on the visceral surface of the liver between segment 4 of the left hemiliver and segment 5 of the right hemiliver can be interpreted as an external hallmark of the Cantlie-Serege-Rex plane separating the right hemiliver from the left hemiliver.

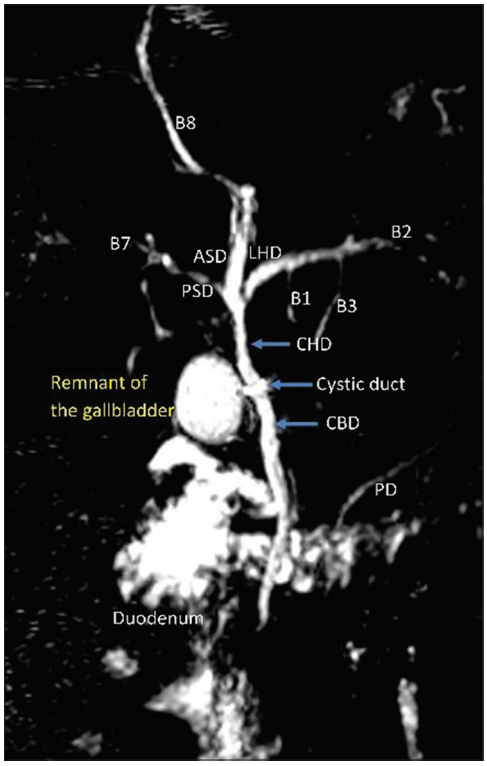

Figure 3. Magnetic resonance cholangiopancreatography (MRCP) on the 47th post-operative day. The gallbladder remnant is on the right side of the common hepatic and bile ducts, situating adjacent to them. This image suggests that the fusion of the cystic duct with the common hepatic duct is on the left of the main bile duct after a U-shaped turn from right to left anteriorly to the main bile duct. Other anomalies of the biliary ductal system are highly probable as the right hepatic duct (RHD) is not identifiable in MRCP images.
Abbreviations: ASD: Anterior sectional duct; CBD: Common bile duct; CHD: Common hepatic duct; LHD: Left hepatic duct; PD: Pancreatic duct; PSD: Posterior sectional duct; S3: The third segment of the liver; B1: Left-sided duct for caudate lobe; B2, B3, B7, and B8 are segmental bile ducts; B4, B5, and B6 are not highlighted.

DOI: https://doi.org/10.36922/jctr.00128

fatigue – were regarded as regular occurrences suffered similarly before subtotal cholecystectomy.

3. Discussion

The primarily aims of surgical care are to save the patient's life, prevent the patient from further disease complications or reduce the risk of sustaining them, improve the patient's quality of life, and eliminate the possibility of iatrogenic injury associated with surgery. Gallbladder surgery for benign biliary disease is an excellent example of this concept because injury to any classified bile duct is considered avoidable [14-16]. This paper highlights the decision-making during and the technical details of gallbladder surgery related to double conversion in an acute surgery setting with atypical gallbladder anatomy. Conversions from laparoscopic to open surgery and pre-planned total to subtotal cholecystectomy with the closure of the gallbladder remnant guaranteed no intraoperative risks, satisfactory surgical outcomes, and effective physical rehabilitation following the arduous gallbladder surgery. Seven other themes related to the left-sided gallbladder –precision in radiological diagnostics, the importance of laparoscopic inspection, detailed informed consenting, extraordinarily high bile duct injury rates, variations of ductal anatomy, intraoperative fluorescent cholangiography, and decision-making to perform a less-than-total gallbladder removal – emerged from the details of this case report.

First, pre-operative identification of the left-sided gallbladder is difficult, especially in emergency admission patients whose radiological investigations are restricted to a real-time ultrasound scan of the gallbladder [17]. Table 1 describes why it is difficult to reveal a left-sided gallbladder through standard examination and imaging techniques before surgery [3,18-22]. On the contrary, a left-sided gallbladder and the variations of the biliary tract – a frequent combination of biliary anomalies – can be diagnosed preoperatively using intravenous contrast-enhanced reconstructive three-dimensional computed tomography (CT)-cholangiography [23-25]. However, a three-dimensional CT-cholangiography is not a routine investigation in an acute care surgery environment. It can be considered when a congenital anomaly of the gallbladder is suspected during an ultrasound scan examination. The same logic is relevant for applying an urgent magnetic resonance cholangiopancreatography.

Second, a targeted laparoscopic inspection of the liver and gallbladder through a first port and the rationale for correctly using other laparoscopic ports and instruments are fundamental principles of safe laparoscopic surgery for all, as an element of uncertainty is a satellite of every surgery. Unfortunately, the gallbladder anatomy-related intraoperative problem was not identified and acknowledged during the primary inspection of the hepatobiliary area. This determined the standard insertion of the other three laparoscopic ports through the right upper quadrant of the abdominal wall. If the problem had been identified during the primary inspection, the second port would have been inserted into the peritoneal cavity through the left lateral quadrant laterally to create an adequate workspace between the round and falciform

Table 1. Comparison of selected characteristics of right-sided and left-sided gallbladders and their clinical implications

Characteristics	Right-sided gallbladder	Left-sided gallbladder	Explanation	Implications
Embryogenesis	The same primary structure for the gallbladder and one extrahepatic bile duct	The same primary structure for the gallbladder and one extrahepatic bile duct	It is a cholecystic axis; hepatic ducts appear much later as lateral buds	Locational variations of the gallbladder are rare: migration to the left side or primary formation on the left side of the liver
Incidence	≥99.7%	<0.3%	See embryogenesis	Increased risk of injuries during left-sided gallbladder surgery
Innervation	Sympathetic and sensory: coeliac plexus, T7–9 Parasympathetic: the right vagus nerve through its hepatic branch	Standard and identical to right-sided gallbladder	No evidence of different innervation of the left-sided gallbladder is available	The same dermatomes may be affected Boas' sign for both anatomical variations: a change detected by lightly drawing a pin down the back of the patient's chest
Pain	Right hypochondrium and epigastrium, with or without radiation to the back close to the tip of the right scapula	Identical afferent pain pathway	See innervation	Murphy's sign for both anatomical variations
US scanning	Conventional description includes the measurements of the gallbladder size, wall thickness, gallstones, and polyps	Not the main investigation to clarify the anatomical relationship with the liver (see CT scanning)	Left-sided gallbladder is an occasional event; other anatomical variations, such as floating gallbladder, are possible.	The aim: gallbladder disease diagnosis; US scan is the first and, in most cases, the last choice of testing approach to diagnosing cholecystolithiasis and acute cholecystitis
Standard IV contrast-enhanced CT scanning	Assessment of the gallbladder and surrounding anatomical structures in general surgical practice	Specific target when planning elective liver resection and transplantations	A positive predictive value of 60% for left-sided gallbladder using standard CT scan technique	Collective discussion with hepatobiliary radiologists is warranted regarding the application of specific CT scan protocols

Abbreviations: CT: Computed tomography; IV: Intravenous; US: Ultrasound

DOI: https://doi.org/10.36922/jctr.00128

ligaments, left lateral section of the liver, and the gallbladder [25]. The location of the third, fourth, and (if the need arises) fifth ports for traction of the gallbladder should be adapted according to the anatomical situation and surgeons' preferences. This point should be regarded as a reminder to the surgeons to inspect the liver and gallbladder after the insertion of the laparoscope through the periumbilical port and early recognize the abnormal position of the gallbladder to allow the standard port placements to be modified [26].

Third, the theoretical reasons for performing alternative gallbladder surgeries should be discussed with the patient comprehensively for informed consent [27]. The options for managing a left-sided gallbladder were not discussed with our patient preoperatively. Interestingly, the incidences of a left-sided gallbladder (not routinely discussed while providing information for informed consent) and major bile duct injury (discussed routinely) are similar. It is approximately 0.3%.

Fourth, comparisons of bile duct injury rates from both reviews on cholecystectomy for a left-sided gallbladder [5,6] with the CholeS Study Group [28] data for conventional cholecystectomy, are concerning. For example, four patients in the cholecystectomy for a left-sided gallbladder cohort had an injury to the bile duct with a rate of 7.3% [6], which is 4.3 times higher than the bile duct injury rate (1.7%) for the most difficult grade 4 and 5 cholecystectomies. Furthermore, it is almost 43 times higher than the bile duct injury rate (0.17%) for grade-3 difficulty-specific cholecystectomies and 29 times higher than the overall bile duct injury rate of 0.25% in the CholeS Study [28]. Such comparisons have methodological drawbacks; nonetheless, they indicate that a left-sided gallbladder and associated variations in biliary ductal anatomy present challenges in intraoperative decision-making and the technical execution of the surgical procedure [29].

Fifth, the atypical position of the gallbladder predetermines the cystic duct's atypical anatomical relationship with the main bile ducts, first- and second-order bile ducts, and the entire hepatic pedicle. Specifically, the left-sided gallbladder, anterior to the hepatic pedicle, changes Calot's triangle planes from horizontal and lateral to vertical and anterior, bringing the gallbladder closer to the extrahepatic biliary tract (Figure 3) [3]. Five topographical patterns of the fusion of the cystic duct with the extrahepatic bile duct, including common hepatic, lobar, and sectional, were described in 41 patients with a left-sided gallbladder [5]. In descending order by incidence, they were on the right side of the common hepatic duct after a U-shaped turn anterior to this duct (65.6%), on the left of the common hepatic duct (9.5%), with the left hepatic duct (9.5%), with the right hepatic duct (7.6%), and with the smaller order bile duct (sectional, most probable) to the right hepatic duct (2.4%). Furthermore, six patients (14.6%) had other minor biliary anomalies, and one had a duplicate common bile duct. The selected magnetic resonance cholangiopancreatography image (Figure 3) strongly suggests the fusion of the cystic duct on the left with the common hepatic duct after its U-shaped turn anterior to this duct. Also, the congenital absence of the right hepatic duct is highly probable. Therefore, dissection of the left-sided gallbladder close to its wall is key to preventing the patient from injuries to the highly probable anomalous extrahepatic bile ducts.

Variations of biliary anatomy at the hepatic hilum are more frequent in patients with left-sided gallbladder, especially in those with abnormal intrahepatic portal vein branching [23]. The understanding of infraportal bile duct anatomy, classified as joining the hepatic duct caudally to the transverse portion of the left portal vein [30], is of paramount importance for safe cholecystectomy planning. A few variations in infraportal courses of segmental and sectional bile ducts were reported. They should be considered before, as it is possible to identify them using contrast-enhanced computed tomography and magnetic resonance-based imaging, and during gallbladder surgery. The examples include infraportal B11 (it is one of the bile ducts of segment 1 which drains Spiegel's lobe) joining the left or common hepatic duct [30], right posterior sectional bile duct joining the right anterior sectional bile duct with an infraportal course [31], right posterior sectional duct joining the common bile duct [32], and infraportal B3 [33]. Encountering another infraportal bile duct of the left hemiliver is always possible, as a true left-sided gallbladder is more associated with the left-sided biliary tract variations. Thus, infraportal variations of biliary anatomy at the hepatic hilum are the second reason a surgeon should initiate the dissection of the left-sided gallbladder as close to its wall as possible to prevent infraportal bile duct injury [24]. It is a prerequisite for safe total cholecystectomy.

Sixth, an intraoperative fluorescent cholangiography method using indocyanine green and a near-infrared light source is a new imaging method in laparoscopic cholecystectomy to improve the visualization of the extrahepatic biliary anatomy (despite a long history of indocyanine green utilization in liver surgery) [34]. However, it should be noted that surgical care providers can use intraoperative imaging methods approved by the individual health-care organization.

Seventh, when in doubt, an anatomic dissection of the proximal portion of the gallbladder and cystic pedicle cannot be performed safely, or the hepatic wall of the gallbladder cannot be safely detached from surrounding tissues [25], a less-than-total gallbladder removal should be performed [3-6,25]. At present, two medical terms are used to name a less-than-total cholecystectomy – a subtotal cholecystectomy [9] and a partial cholecystectomy [35]. The question regarding the probability of symptomatic gallbladder remnant events in the future and the necessity of elective completion cholecystectomy remains open, as this depends on the number of specific factors associated with subtotal cholecystectomy. Examples of these factors include the type of completion of subtotal cholecystectomy (controversial conclusions) [7,35-38], the presence or absence of bile leak after subtotal cholecystectomy [39], and retained gallstones within the gallbladder remnant [40]. According to a systematic review, the overall incidence of retained gallstones, recurrent biliary events, and completion cholecystectomy ranges between 0.8% and 3% [8]. During the follow-up visit, our patient was instructed to contact the consulting surgeons if the symptoms resurfaced.

DOI: https://doi.org/10.36922/jctr.00128

Two limitations of this case study should be acknowledged. First, we were unable to obtain systematic data on the occurrence of the left-sided gallbladder in our institution, which is a large hepatobiliary and general emergency surgery center for the region. The absence of figures indicating clinical and histopathological correlations is another limitation of this paper. However, the key messages arising from this paper are fully supported by the clinical information provided and the discussion points.

4. Conclusions

Iatrogenic bile duct injury rates are the highest in the subpopulation of patients with left-sided gallbladder. A left-sided gallbladder, therefore, should be considered a risk factor. Subtotal cholecystectomy, especially in an emergency surgery setting, is an alternative to total cholecystectomy to avoid gallbladder surgery-related risks and prevent a patient from iatrogenic injuries to the bile ducts when a safe cholecystectomy cannot be performed due to a lack of clarity or knowledge on the extrahepatic biliary anatomy, which might deviate from the typical anatomy in patients with left-sided gallbladder. It is essential to discuss with patients about managing the left-sided gallbladder during the consent-taking step.

Acknowledgments

None.

Funding

Not applicable.

Conflict of Interest

The authors declare no competing interests in relation to the publication of this work.

Ethics Approval and Consent to Participate

This case report was not classified as an object for approval by the local ethics, research, or clinical audit committee according to local policies. Informed consent in written form was obtained from the patient before drafting the paper.

Consent for Publication

Informed consent was obtained from the patient.

Availability of Data

Additional data are available from the corresponding author upon reasonable request.

References

[1] Yoshida J, Chijiiwa K, Yamaguchi K, Yokohata K, Tanaka M. Practical Classification of the Branching Types of the Biliary Tree: An Analysis of 1,094 Consecutive Direct Cholangiograms. J Am Coll Surg 1996;182:37-40.

[2] Janssen BV, van Laarhoven S, Elshaer M, Cai H, Praseedom R, Wang T, *et al.* Comprehensive Classification of Anatomical Variants of the Main Biliary Ducts. Br J Surg 2021;108:458-62.
doi: 10.1093/bjs/znaa147

[3] Banchini F, Capelli P. Left Side Gallbladder: Clinical and Anatomical Implication. Liver Pathology. London, UK: IntechOpen; 2021.
doi: 10.5772/intechopen.92000

[4] Jung YK, Choi D, Lee KG. Laparoscopic Cholecystectomy for Left-Sided Gallbladder. Langenbecks Arch Surg 2022;407:207-12.
doi: 10.1007/s00423-021-02263-0

[5] Pereira R, Singh T, Avramovic J, Baker S, Eslick GD, Cox MR. Left-sided Gallbladder: A Systematic Review of a Rare Biliary Anomaly. ANZ J Surg 2019;89:1392-7.
doi: 10.1111/ans.15041

[6] Abongwa HK, De Simone B, Alberici L, Iaria M, Perrone G, Tarasconi A, *et al.* Implications of Left-sided Gallbladder in the Emergency Setting: Retrospective Review and Top Tips for Safe Laparoscopic Cholecystectomy. Surg Laparosc Endosc Percutan Tech 2017;27:220-7.
doi: 10.1097/SLE.0000000000000417

[7] Lunevicius R, Haagsma JA. Supplementary Material to 'Subtotal Cholecystectomy: Results of a Single-Centre, Registry-Based Retrospective Cohort Study of 180 Adults in 2011-2018. Version 1; 2020.
doi: 10.17632/khv3b7b6wf.1 Available from: https://data.mendeley.com/datasets/khv3b7b6wf/1 [Last accessed on 2024 Jan 15].

[8] Nzenwa IC, Mesri M, Lunevicius R. Risks Associated with Subtotal Cholecystectomy and the Factors Influencing Them: A Systematic Review and Meta-Analysis of 85 Studies Published Between 1985 and 2020. Surgery 2021;170:1014-23.
doi: 10.1016/j.surg.2021.03.036

[9] Lunevicius R. Review of the Literature on Partial Resections of the Gallbladder, 1898-2022: The Outline of the Conception of Subtotal Cholecystectomy and a Suggestion to Use the Terms "Subtotal Open-Tract Cholecystectomy" and "Subtotal Closed-Tract Cholecystectomy". J Clin Med 2023;12:1230.
doi: 10.3390/jcm12031230

[10] Okamoto K, Suzuki K, Takada T, Strasberg SM, Asbun HJ, Endo I, *et al.* Tokyo Guidelines 2018: Flowchart for the Management of Acute Cholecystitis. J Hepatobiliary Pancreat Sci 2018;25:55-72.
doi: 10.1002/jhbp.516. Erratum in: J Hepatobiliary Pancreat Sci 2019;26:534.

[11] Idu M, Jakimowicz J, Iuppa A, Cuschieri A. Hepatobiliary Anatomy in Patients with Transposition of the Gallbladder: Implications for Safe Laparoscopic Cholecystectomy. Br J Surg 1996;83:1442-3.

[12] Lin HY, Lee RC. Is Right-Sided Ligamentum Teres Hepatis Always Accompanied by Left-Sided Gallbladder? Case Reports and Literature Review. Insights Imaging 2018;9:955-60.

[13] Gastrointestinal Quality of Life Index-10. GIQLI-10 © Ernst Eypasch. All Rights Reserved. Contact Information and Permission to Use. Lyon, France: Mapi Research Trust; 2018. Available from: https://eprovide.mapi-trust.org [Last accessed on 2023 Jan 31].

[14] Halle-Smith JM, Hodson J, Stevens LG, Dasari B, Marudanayagam R, Perera T, *et al.* A Comprehensive Evaluation of the Long-Term Economic Impact of Major Bile Duct Injury. HPB (Oxford) 2019;21:1312-21.

[15] Gartland RM, Bloom JP, Fong ZV, DeRoo C, Dwyer K, Quinn G, *et al.* What have we Learned from Malpractice Claims Involving the Surgical Management of Benign Biliary Disease? A 128 Million Dollar Question. Ann Surg 2019;269:785-91.
doi: 10.1097/SLA.0000000000003155

[16] Farooq A, Bae J, Rice D, Moro A, Paredes AZ, Crisp AL, *et al.* Inside the Courtroom: An Analysis of Malpractice Litigation in Gallbladder Surgery. Surgery 2020;168:56-61.

[17] Hsu SL, Chen TY, Huang TL, Sun CK, Concejero AM, Tsang LL, *et al.* Left-sided Gallbladder: Its Clinical Significance and Imaging Presentations. World J Gastroenterol 2007;13:6404-9.
doi: 10.3748/wjg.v13.i47.6404

[18] Couinaud C. Surgical Anatomy of the Liver Revisited. Paris: C. Couinaud; 1989.

[19] Burnand KG, Black J, Corbett SA, Thomas WE, editors. Browse's Introduction to the Symptoms and Signs of Surgical Diseases. United States: CRC Press, Taylor and Francis Group; 2015.

[20] Zoulamoglou M, Flessas I, Zarokosta M, Piperos T, Papapanagiotou I, Birbas K, *et al.* Left-sided Gallbladder (Sinistroposition) Encountered during Laparoscopic Cholecystectomy: A Rare Case Report and Review of the Literature. Int J Surg Case Rep 2017;31:65-7.
doi: 10.1016/j.ijscr.2017.01.011

[21] Pereira R, Perera M, Roberts M, Avramovic J. Surgical Approach to a Left-Sided Gallbladder. BMJ Case Rep 2019;12:e230681.
doi: 10.1136/bcr-2019-230681

[22] Roli I, Colli F, Mullineris B, Esposito S, Piccoli M. Left Sided Gallbladder: A Case Report During Laparoscopic Cholecystectomy for Acute Cholecystitis. Int J Surg Case Rep 2020;77S: S34-6.
doi: 10.1016/j.ijscr.2020.10.046.

[23] Abe T, Kajiyama K, Harimoto N, Gion T, Shirabe K, Nagaie T. Resection of Metastatic Liver Cancer in a Patient With a Left-Sided Gallbladder and Intrahepatic Portal Vein and Bile Duct Anomalies: A Case Report. Int J Surg Case Rep 2012;3:147-50.
doi: 10.1016/j.ijscr.2012.01.003

[24] Ishii H, Noguchi A, Onishi M, Takao K, Maruyama T, Taiyoh H, *et al.* True Left-Sided Gallbladder with Variations of Bile Duct and Cholecystic Vein. World J Gastroenterol 2015;21:6754-8.
doi: 10.3748/wjg.v21.i21.6754

[25] Hirohata R, Abe T, Amano H, Kobayashi T, Nakahara M, Ohdan H, *et al.* Laparoscopic Cholecystectomy for Acute Cholecystitis in a Patient with Left-Sided Gallbladder: A Case Report. Surg Case Rep 2019;5:54.
doi: 10.1186/s40792-019-0614-9

[26] Armstrong CP. Hepatobiliary Anatomy in Patients with Transposition of the Gallbladder: Implications for Safe Laparoscopic Cholecystectomy. Br J Surg 1997;84:427.
doi: 10.1002/bjs.1800840356

[27] Mesri M, Nzenwa IC, Lunevicius R. Evaluating the Patient and Setting-Specific Factors That Influenced the Quality of Informed Consent in a Retrospective Cohort of Subtotal Cholecystectomy Patients. J Laparoendosc Adv Surg Tech A 2021;31:77-84.
doi: 10.1089/lap.2020.0376

[28] Griffiths EA, Hodson J, Vohra RS, Marriott P, CholeS Study Group, Katbeh T, *et al.* Utilisation of an Operative Difficulty Grading Scale for Laparoscopic Cholecystectomy. Surg Endosc 2019;33:110-21.
doi: 10.1007/s00464-018-6281-2. Erratum in: Surg Endosc 2018 Aug 22; Erratum in: Surg Endosc 2023;37:2415.

[29] Nguyen TH, Nguyen TS, Van Nguyen PD, Dang TN, Talarico EF Jr. Sinistroposition: A Case Report of True Left-Sided Gallbladder in a Vietnamese patient. Int J Surg Case Rep 2018;51:82-5.
doi: 10.1016/j.ijscr.2018.08.018.

[30] Sugiura T, Nagino M, Kamiya J, Nishio H, Ebata T, Yokoyama Y, *et al.* Infraportal Bile Duct of the Caudate Lobe: A Troublesome Anatomic Variation in Right-Sided Hepatectomy for Perihilar Cholangiocarcinoma. Ann Surg 2007;246:794-8.
doi: 10.1097/SLA.0b013e3180f633de

[31] Kitami M, Takase K, Murakami G, Ko S, Tsuboi M, Saito H, *et al.* Types and Frequencies of Biliary Tract Variations Associated with a Major Portal Venous Anomaly: Analysis with Multi-Detector Row CT Cholangiography. Radiology 2006;238:156-66.
doi: 10.1148/radiol.2381041783

[32] Ohkubo M, Nagino M, Kamiya J, Yuasa N, Oda K, Arai T, *et al.* Surgical Anatomy of the Bile Ducts at the Hepatic Hilum as Applied to Living Donor Liver Transplantation. Ann Surg 2004;239:82-6.
doi: 10.1097/01.sla.0000102934.93029.89

[33] Ozden I, Kamiya J, Nagino M, Uesaka K, Sano T,

Nimura Y. Clinicoanatomical Study on the Infraportal Bile Ducts of Segment 3. World J Surg 2002;26:1441-5.
doi: 10.1007/s00268-002-6544-9

[34] Serban D, Badiu DC, Davitoiu D, Tanasescu C, Tudosie MS, Sabau AD, *et al.* Systematic Review of the Role of Indocyanine Green Near-Infrared Fluorescence in Safe Laparoscopic Cholecystectomy (Review). Exp Ther Med 2022;23:187.
doi: 10.3892/etm.2021.11110

[35] NHS Digital. Classifications Browser OPCS-4.10. Available from: https://classbrowser.nhs.uk/#/book/OPCS-4.10 [Last accessed on 2023 May 08].

[36] Lunevicius R, Haagsma JA. Subtotal Cholecystectomy: Results of a Single-Center, Registry-Based Retrospective Cohort Study of 180 Adults in 2011-2018. J Laparoendosc Adv Surg Tech A 2021;31:1019-33.
doi: 10.1089/lap.2020.0713

[37] Van Dijk AH, Donkervoort SC, Lameris W, De Vries E, Eijsbouts QA, Vrouenraets BC, *et al.* Short- and Long-Term Outcomes after a Reconstituting and Fenestrating Subtotal Cholecystectomy. J Am Coll Surg 2017;225:371-9.

[38] Loh AY, Chean CS, Durkin D, Bhatt A, Athwal TS. Short and Long Term Outcomes of Laparoscopic Fenestrating or Reconstituting Subtotal Cholecystectomy Versus Laparoscopic Total Cholecystectomy in the Management of Acute Cholecystitis. HPB (Oxford) 2022;24:691-9.
doi: 10.1016/j.hpb.2021.09.018

[39] Lunevicius R, Nzenwa IC. Multiple Logistic Regression Model to Predict Bile Leak Associated with Subtotal Cholecystectomy. Surg Endosc 2023;37:5405-13.

[40] Chowbey P, Sharma A, Goswami A, Afaque Y, Najma K, Baijal M, *et al.* Residual Gallbladder Stones After Cholecystectomy: A Literature Review. J Minim Access Surg 2015;11:223-30.
doi: 10.4103/0972-9941.158156

Appendix

Patient's Perspective

I have had what I believed to be severe trapped wind for at least 12 years. I was in extreme discomfort and pain whenever I overindulged in rich food. I never visited the general practitioner to investigate; I just accepted this as part of life. The usual pain began at midday, and by 6 pm, I was in unbearable agony. I visited the accident and emergency center, and after initial triage and assessment by the surgical team, I was informed that I had an inflamed gallbladder and may need surgery. I was in the surgical assessment unit department for another 4 days receiving antibiotics to manage the inflammation. As the pain was not subsiding and my temperature remained elevated, it was decided that I would need surgery to remove the gallbladder. I was informed of the risks and was told that the surgeon would try for a keyhole surgery but that it could also lead to open surgery. After the surgery, I was informed of the situation and that I needed open surgery because my gallbladder was on the left side of my liver. I was in pain, but it was managed well by the doctors and nurses. I had an episode where my blood pressure dropped, and my heart went tachycardic, which was very scary. It was dealt with promptly and efficiently, and I have since been referred to a cardiologist for further investigation. My recovery has been smooth, with no complications. My life postoperatively is much better, and I have not had the pain I previously experienced. Despite not knowing that I had gallstones, I feel very lucky that it was diagnosed and the surgery was successful. I want to thank the surgeons for looking after me so well and bringing me back to health.

DOI: https://doi.org/10.36922/jctr.00128