Case Report

Look, but to the left: A rare case of gallbladder sinistroposition and comprehensive literature review

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1. Introduction

Sinistroposition gallbladder or a left-sided gallbladder (LSGB) is a seldom anatomic aberration in which the gallbladder is located below the left lobe of the liver [1]. This anatomi cal aberration can be divided into three different anatomical abnormalities, including situs viscerum inversus, right left-sided gallbladder, and true left-sided gallbladder [2].

Left-sided gallbladder (LSGB) is a term that describes an abnormally situated gallbladder, which exists in three different forms. The first form is a gallbladder that is located at the left upper quadrant of the abdomen as part of situs viscerum inversus (SVI); the entire content of the abdomen is situated in a mirrored position of the normal anatomical position. A LSGB that is not part of SVI is subcategorized into a true left sided gallbladder and a right sided gallbladder with abnormally located ligamentum teres. The former is located under segment III of the liver, to the left of ligamentum teres and the falciform ligament. The latter is considered a left sided gallbladder due to ligamentum teres abnormal translocation to the right side and is located under segment IVb of the liver [2].

The majority of the cases reported are correlated with a right-sided falciform ligament and are also known as a false left-sided gallbladder [3,4]. If the falciform ligament was not on the right side, it is known as a true-side gallbladder, which is incredibly rare [4].

In 1886, Hochstetter was the first to describe the LSGB without situs viscerum inversus [5]. Ever since it was discovered, its prevalence has remained low, ranging between 0.04% and 1.1% [6]. In this case, the LSGB is a solitary finding, in that the remaining viscera maintain their ordinary anatomical location.

Gallbladder diseases typically prompt urgent surgical intervention [7], which is when most cases of LSGB are in fact diagnosed. Moreover, it is usually associated with anatomical variation, including biliary tract anomaly, portal vein anomaly, liver segment IV atrophy, or alteration in the hepatobiliary anatomy [1]. This variation unfortunately confers a higher risk of bile tract injury during the surgery, requiring more delicate and careful operation [8].

Therefore, it is crucial to suspect the anomaly prior to the operation in order to prevent devastating injuries to the vascular and biliary structures. The unintentional ligation of the bile duct and left branch of the portal vein, for example, may compromise three-quarters of the liver blood supply, consequently leading to liver failure, biliary congestion, and eventually biliary leakage [9].

In our case, we report a rare finding of a left-sided gallbladder located underneath the left lobe of the liver and to the left of the falciform ligament with no other remarkable abnormalities. Consent was obtained from the patient prior to the writeup of the present case report. The current study has been reported in accordance with the SCARE criteria [9].
2. Case presentation

A 33-year-old married female presented to us with right hypochondrium pain radiating to both shoulders and back associated with nausea for the last 5 months. She noticed the episodes were increasingly distressing whenever she consumed fatty food. No comorbid conditions were present. General physical and systemic examination were unremarkable.

Her complete blood count and liver function tests were within normal limits. Abdominal ultrasound, however, presented multiple gallstones with no pericholecystic fluid, no gallbladder wall thickness and a normal calibre common bile duct (Fig. 1 and Fig. 2). However, this information was insufficient to conclude whether the gallbladder was an anatomic variant. It was only during the operative course that the aberrant anatomic location of the gallbladder was discovered.

She was planned for elective laparoscopic cholecystectomy. She tested positive for COVID-19 prior to surgery, and therefore the patient was deferred for surgery. Three weeks later, when the patient tested negative, she was admitted, and laparoscopic cholecystectomy was performed.

Per-operative findings after diagnostic laparoscopy showed a variant anatomy with the gallbladder located underneath left lobe of liver just below and to the left of falciform ligament (Figs. 3-5). The patient was discharged within 24 hours, and the recovery time was unremarkable.
3. Discussion

The gallbladder is a hollow organ that is responsible for the production and storage of bile and bile salts, and it is normally located in the right upper quadrant of the abdomen. Anatomically, the gallbladder lies beneath the liver segments IV and V and has an inferior peritoneal surface [10]. In most people, the gallbladder is located to the right of the falciform ligament, whereas in 0.04%–1.1% it is abnormally located to the left side [11].

Embryologically, three main processes explain the development of LSGB without SVI. The first process involves normal embryological development of the cholecystic bud from the hepatic diverticulum. The bud then migrates to the left side and becomes situated under the liver. The second processes describe the development of a gallbladder on each side of ligamentum teres. The left sided gallbladder persists while the right side does not affect the neural supply or the innervation as the central nervous system does not transpose. Therefore, gallbladder disease such as choledocholithiasis presents with typical signs and symptoms in 75% of patients with LSGB [14,15]. This, in addition to the fact that LSGB is rarely diagnosed by preoperative ultrasonography alone, most of the cases are only diagnosed intraoperatively. While ultrasonography falls short for LSGB, other imaging modalities such as magnetic resonance cholangiography and computerized tomography cholangiography are beneficial in detailing the anatomy and confirming a LSGB [14,16]. In practice, other findings can raise the suspicion of LSGB, including abnormal intrahepatic portal vein branching or an absent liver segment IV [8]. Furthermore, other anatomical variations in the hepatobiliary,

### Table 1

| Age and sex | Radiological findings | Surgical treatment | Intraoperative findings |
|-------------|-----------------------|-------------------|------------------------|
| Saafan et al. | US Abd: gallstones | Laparoscopic cholecystectomy with four-port technique | LSGB diagnosed |
| Nagendram et al. | US Abd: gallstones | Laparoscopic cholecystectomy | Gallbladder against left lobe of liver between segments III and IV, left of falciform ligament. Cystic duct was narrowed |
| Colovic et al. | US Abd: gallbladder stone and liver cyst | Open surgery for symptomatic liver cyst | LSGB incidentally diagnosed intraoperatively; attached to inferior surface of left lateral hepatic segment to the left of the round ligament |
| Colovic et al. | US Abd: gallbladder thickened and swollen | Open surgery | LSGB incidentally diagnosed intraoperatively; cystic duct anatomy was normal, joining the common bile duct from the right side |
| Pereira et al. | MR cholangiopancreatography: gallbladder left of falciform ligament and cystic duct entering common hepatic duct | Laparoscopic cholecystectomy | LSGB diagnosed |
| Hirohata et al. | CT Abd: gallbladder centrally dislocated, wall enhancement discontinued. MRI Abd: gallbladder thickened and swollen | Laparoscopic cholecystectomy with flexible and optimal port site | LSGB diagnosed, round ligament attached to right side of gallbladder |
| Printes et al. | US Abd: suggestive of biliary lithiasis | Laparoscopic cholecystectomy and umbilical herniorrhaphy | LSGB diagnosed, found in left hepatic lobe, with thin walls and stones |
| Di Bella et al. | – | – | LSGB diagnosed during explorative laparoscopy |
| Roli et al. | – | – | LSGB diagnosed during laparoscopy |
| Nguyen et al. | US Abd: cholelithiasis without dilatation of the bile ducts | Laparoscopic cholecystectomy | LSGB diagnosed during laparoscopy, cystic duct joined the common hepatic duct on the right side, and the cystic artery crossed anterior to the common bile duct in a right-to-left direction |
| Zoulamoglou et al. | US Abd: gallstone about 18 mm in diameter | Laparoscopic cholecystectomy | LSGB diagnosed during laparoscopy, cholecystectomy; attached to inferior hepatic segment III and left of the round ligament |

MR = magnetic resonance. US = ultrasound. CT = computed tomography. TB = tuberculosis.
gastrointestinal and the genitourinary system have been associated with LSGB, with those of the hepatobiliary system being more common. These variations include an underdeveloped or a duplicated common biliary duct, infra-portal bile duct, and pancreatic anomalies like annular pancreas and dorsal pancreatic agenesis. Gastrointestinal anomalies include duodenal malrotation and polypsia while the genitourinary anomalies include intrapelvic ectopic testes.

Although laparoscopic cholecystectomy of a LSGB is safe, it is associated with higher risk of complications such as common bile duct injury. Therefore, surgeons are advised to have a more careful approach by limiting diathermy use as well as careful division of structures to avoid potential intraoperative injury. Some studies even recommend additional measures such as the use of intraoperative cholangiogram as it might be useful in verifying the biliary tract anatomy. Modifying the laparoscopic port sites is also suggested by some studies to improve surgical outcomes and to minimise the risk of potential complications.

In order to better study the underlying anatomical aberration, we conducted a comprehensive literature search. The results obtained are delineated by Table 1 below.

4. Conclusion

Laparoscopic cholecystectomy is a generally safe procedure, even in the rare case of a LSGB. Most cases of a LSGB are diagnosed intraoperatively, and this sudden discovery during the procedure can increase the difficulty, duration, and stress of the procedure due to the other potential anatomic anomalies that LSGB is associated with in the hepatobiliary system. Therefore, the identification of the LSGB should ideally be done preoperatively, a strategy that is hindered by a few key factors: it is an extremely rare anatomic anomaly, it does not present with any characteristic clinical signs or symptoms, and it is not easily identifiable on ultrasonography’s relatively low-resolution. Surgeons should be aware that the techniques can be utilized intraoperatively in order to minimize the risk of complications and improve patient outcomes.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Sources of funding

N/A.

Ethical approval

N/A.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Disclosures

N/A.

Declaration of competing interest

N/A.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jamsu.2021.103016.

References

[1] H.K. Abongwaw, B. De Simone, L. Alberici, 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 27 (4) (2017 Aug) 220–227, https://doi.org/10.1097/SLE.0000000000000417. PMID: 28641470.
[2] T. Saafan, J.Y. Hu, A.E. Mahfouz, A. Abdelaal, True left-sided gallbladder: a case report and comparison with the literature for the different techniques of laparoscopic cholecystectomy for such anomalies, Int J Surg Case Rep 42 (2018) 280–286, https://doi.org/10.1016/j.ijscr.2017.12.029.
[3] S.R. Botomo, B.R. Veenstra, T.M. Komar, H.M. Richter, Single-incision cholecystectomy for left-sided gallbladder, JSLS 18 (2) (2014) 338–341, https://doi.org/10.4292/jsls-2014022518632.
[4] R. Kawai, K. Miyaia, N. Yusa, et al., True left-sided gallbladder with a portal anomaly: report of a case, Surg Today 42 (11) (2012) 1130–1134, https://doi.org/10.1007/s00595-011-0993-5. Epub 2011 Dec 10. PMID: 22160358.
[5] F. Hochstetter, Anomalien der Pfortader und der Nabelvene in Verbindung mit Defekt oder Linkslage der Gallenblase, Arch. Anat. Entwick (1886) 369–390.
[6] M.E. Iskandar, A. Radzio, M. Krikhely, L.M. Leitman, Laparoscopic cholecystectomy for a left-sided gallbladder, World J Gastroenterol 19 (35) (2013) 5925–5928, https://doi.org/10.3748/wjg.v19.i35.5925.
[7] T. Almas, M.F. Murad, M.K. Khan, et al., The spectrum of gallbladder histopathology at a tertiary hospital in a developing country: a retrospective study, Cureus 12 (8) (2020), e9627, https://doi.org/10.7759/cureus.9627. Published 2020 Aug 9.
[8] S. Nagendra, K. Lynes, A. Hamade, A case report on a left sided gallbladder: a rare finding during cholecystectomy, Int J Surg Case Rep 41 (2017 Nov 4) 398–400, https://doi.org/10.1016/j.ijscr.2017.11.004. PMID: 29546600. PMCID: PMC5698001.
[9] R.A. Agba, T. Franchi, C. Sohrabi, G. Mathew, for the SCARE Group, The SCARE 2020 guideline: updating consensus surgical Case Report (SCARE) guidelines, International Journal of Surgery 84 (2020) 226–230.
[10] Y. Maetani, K. Iioh, N. Kojima, et al., Portal vein anomaly associated with deviation of the ligamentum teres to the right and malposition of the gallbladder, Radiology 207 (3) (1998 Jun) 723–728, https://doi.org/10.1148/radiology.207.3.9609896. PMID: 9609896.
[11] M.W. Jones, M. Young, Anatomy, abdomen and pelvis, gallbladder [Internet] [cited 2021 Jun 15], StatPearls, StatPearls Publishing (2018). Available from: http://www.ncbi.nlm.nih.gov/pubmed/29083749.
[12] C. Mendoza-Calderón, J.W. Sotelo, A.R. Dávila-Arriaga, Gallbladder to the left side of the falciform ligament in absence of Situs inversus “Sinistroposition” – case series of 2 patients with this anomaly who underwent mini-laparoscopic cholecystectomy [cited 2021 Jun 14], International Journal of Surgery Case Reports [Internet] 50 (2018 Jan) 36–41. Available from, pmc/articles/PMC6572880.
[13] H. Ishii, A. Noguchi, M. Onishi, K. Takao, T. Maruyama, H. Tairyoh, et al., True left-sided gallbladder with variations of bile duct and choledochal vein [cited 2021 Jun 15], World Journal of Gastroenterology [Internet] 21 (21) (2015 Jun 7), 6754–8, pmc/articles/PMC4458786. Available from.
[14] R. Navuluri, M. Hoyer, M. Osman, J. Fergus, Emergent treatment of acute cholangitis and acute cholecystitis [cited 2021 Jun 15], Seminars in Interventional Radiology [Internet] 37 (1) (2020 Mar 1) 14–23. Available from, pmc/articles/PMC7056346.
[15] G.S. Quah, I.E. Ng, G. Punch, A.J. Richardson, True left-sided gallbladder: a rare anatomical anomaly and its associated surgical challenges [Internet] [cited 2021 Jun 15], Vol. 89, ANZ Journal of Surgery. Blackwell Publishing (2019). E033, https://pubmed.ncbi.nlm.nih.gov.proxy.library.roi.ie/29512298/. Available from.
[16] S. Sadhu, T.A. Jahangir, M.K. Roy, Left-sided gallbladder discovered during laparoscopic cholecystectomy in a patient with dextrocardia [cited 2021 Jun 14], Indian Journal of Surgery [Internet] 74 (2) (2012), 186–4, pmc/articles/PMC3909987. Available from.
[17] P.K. Reddy, R.V. Subramanian, S. Yuvaraja, Laparoscopic Cholecystectomy for Left-Sided Gallbladder (Sinistroposition) [cited 2021 Jun 15], JSLS: Journal of the Society of Laparoendoscopic Surgeons/Society of Laparoendoscopic Surgeons [Internet] 9 (3) (2005), 356–7, pmc/articles/PMC3015680. Available from.
[18] R. Colovic, N. Colovic, G. Barisic, H. Atkinson, Z. Krivokapic, Left-sided gallbladder associated with congenital liver cyst [cited 2021 Jun 15], HPB (2006 Apr), 157–4, pmc/articles/PMC2131415. Available from.
[19] R. Pereira, T. Singh, J. Avramovic, S. Baker, G.D. Eslick, M.R. Cox, Left-sided gallbladder: a systematic review of a rare biliary anomaly [Internet] [cited 2021 Jun 15], Vol. 89, ANZ Journal of Surgery. Blackwell Publishing (2019). E033–4, https://pubmed.ncbi.nlm.nih.gov.proxy.library.roi.ie/29512298/. Available from.
[20] G. Velimezis, N. Vassos, G. Kapogiannatos, D. Koronakis, C. Salpiggidis, E. Perrakis, et al., Left-sided gallbladder in the era of laparoscopic cholecystectomy: a single-center experience [cited 2021 Jun 15], The American surgeon [Internet] (2012 (12) (2015 Dec 1), 1249–52, https://journals.sagepub.com/doi/abs/10.1177/00034381503810227. Available from.
[21] R. Donthi, D.J. Thomas, D. Sanders, S.P. Schmidt, Report of laparoscopic cholecystectomy in two patients with left-sided gallbladders [cited 2021 Jun 15], JSLS: Journal of the Society of Laparoendoscopic Surgeons/Society of Annals of Medicine and Surgery 71 (2021) 103016
[22] I. Qureshi, Z. Awad, Aberrant presentation of the gallbladder during laparoscopic cholecystectomy [cited 2021 Jun 15], Journal of the Society of Laparoendoscopic Surgeons [Internet] 13 (4) (2009 Oct), 605–7, pmc/articles/PMC3030800/. Available from.

[23] R. Pereira, M. Pereira, M. Roberts, J. Avramovic, Surgical approach to a left-sided gallbladder, BMJ Case Rep 12 (8) (2019 Aug 15), e230681, https://doi.org/10.1136/bcr-2019-230681. PMID: 31420438; PMCID: PMC6700575.

[24] R. Hirohata, T. Abe, H. Amano, T. Kobayashi, M. Nakahara, H. Ohdan, T. Noriyuki, Laparoscopic cholecystectomy for acute cholecystitis in a patient with left-sided gallbladder: a case report, Surg Case Rep 5 (1) (2019 Apr 5) 54, https://doi.org/10.1186/s40792-019-0614-9. PMID: 30953262; PMCID: PMC6450998.

[25] T.R.M. Printes, I.E.C. Rabelo, J.F. Cauduro, E.C. Lopez, C.F.V. Dos Santos, T.F. C. Melo, H.G.A. Regino, A.A.P. Machado, Left-sided gallbladder (LSG) associated with true diverticulum, a case report, AME Case Rep 4 (2020 Oct 30) 26, https://doi.org/10.21037/acr-20-55. PMID: 33178998; PMCID: PMC7608725.

[26] A. Di Bella, A. Bruscino, G. Alemanno, C. Bergamini, A. Giordano, V. Iacopini, D. Bisogni, P. Prosperi, Urgent cholecystectomy in patient with left-sided gallbladder Case report and review of the literature, Ann Ital Chir (2020 May 25), 9:2239253X2003234X. PMID: 32503952.

[27] I. Roli, F. Colli, B. Mullineris, S. Esposito, M. Piccoli, Left sided gallbladder: a case report during laparoscopic cholecystectomy for acute cholecystitis, Int J Surg Case Rep 77S (Suppl) (2020) S34–S36, https://doi.org/10.1016/j.ijscr.2020.10.046. Epub 2020 Oct 19. PMID: 33172811; PMCID: PMC7876732.

[28] T.H. Nguyen, T.S. Nguyen, P.D. Van Nguyen, T.N. Dang, E.F. Talarico Jr., Sinistroposition: a case report of true left-sided gallbladder in a Vietnamese patient, Int J Surg Case Rep 51 (2018) 82–85, https://doi.org/10.1016/j.ijscr.2018.08.018. Epub 2018 Aug 21. PMID: 30149330; PMCID: PMC611038.

[29] M. Zoulamoglou, I. Flessas, M. Zarokosta, T. Pipiros, I. Papapanagiotou, K. Birbas, E. Konstantinou, T. Mariolis-Sapsakos, Left-sided gallbladder (Sinistroposition) encountered during laparoscopic cholecystectomy: a rare case report and review of the literature, Int J Surg Case Rep 31 (2017) 65–67, https://doi.org/10.1016/j.ijscr.2017.01.011. Epub 2017 Jan 7. PMID: 28110174; PMCID: PMC5247567.