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Challenges and Considerations in Performing Laparoscopic Cholecystectomy in a Patient with Total Situs Inversus a Case Report

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ABSTRACT

Laparoscopic cholecystectomy plays a central role in the treatment of patients with gallstones and is the gold standard for the management. Total situs inversus (TSI) is a rare congenital anomaly in which there is a transposition of the thoracic and abdominal organs, resulting in a mirror-image left-right configuration of the normal anatomical placement of organs. TSI affects less than 0.01% of the population. We present a case of a 68-year-old male with cholelithiasis and TSI, managed with laparoscopic cholecystectomy using the American mirror technique for cholecystectomy in such patients, reporting favorable outcomes for the patient. In conclusion, bibliographic reports and our personal experience in this case emphasize that the unique anatomical disposition in TSI requires modifications to

the surgical technique, necessitating a well-trained surgeon with a deep understanding of biliary anatomy and its variations.

Keywords: french mirror technique, american mirror technique, cholelithiasis, laparoscopic cholecystectomy, total situs inversus.

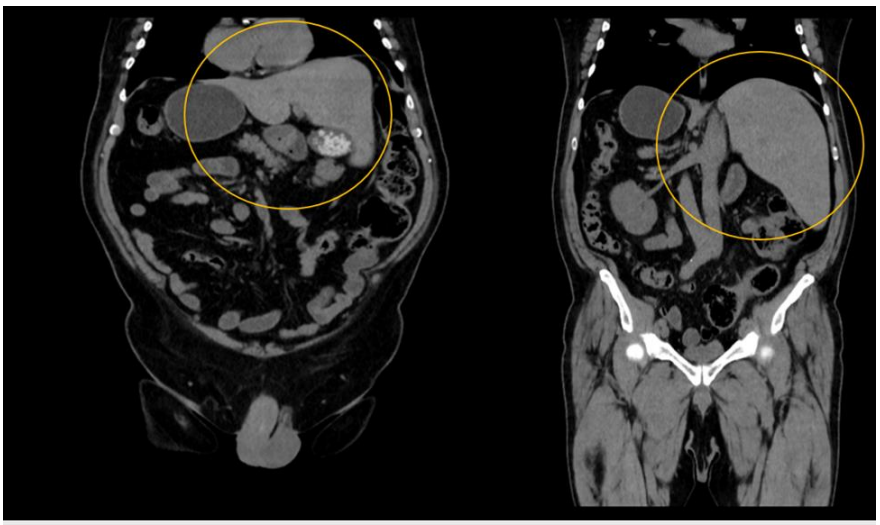
INTRODUCTION

Laparoscopic cholecystectomy plays a central role in the treatment of patients with gallstones and is the gold standard for the management of both complicated and uncomplicated cholelithiasis. [1]

Total situs inversus (TSI) is a rare congenital anomaly in which there is a transposition of the thoracic and abdominal organs, resulting in a mirror-image left-right configuration of the normal anatomical placement of organs.[2] Although the exact underlying causes remain not fully understood, this condition has been associated with genetic mutations on chromosomes 7, 8, and 14,3 and an autosomal recessive inheritance pattern has also been documented.[3] TSI affects less than 0.01% of the population, occurring in approximately 1 in 10,000 to 20,000 live births, with a higher prevalence in males than females (1.5:1). [4] The clinical presentation of cholelithiasis and cholecystitis occurs at a rate comparable to that observed in the general population. [5]

CASE REPORT

The patient is a 68-year-old male with a medical history significant for long-standing diabetes mellitus and hypertension. He was referred to the general surgery clinic by his family medicine unit due to a 4-year history of intermittent right upper quadrant abdominal pain, associated with the ingestion of dietary fats, consistent with biliary colic. As a result, a preoperative protocol for cholecystectomy was initiated. Imaging studies, including ultrasound, revealed findings suggestive of possible situs inversus, which was confirmed by simple tomography. Figure 1.

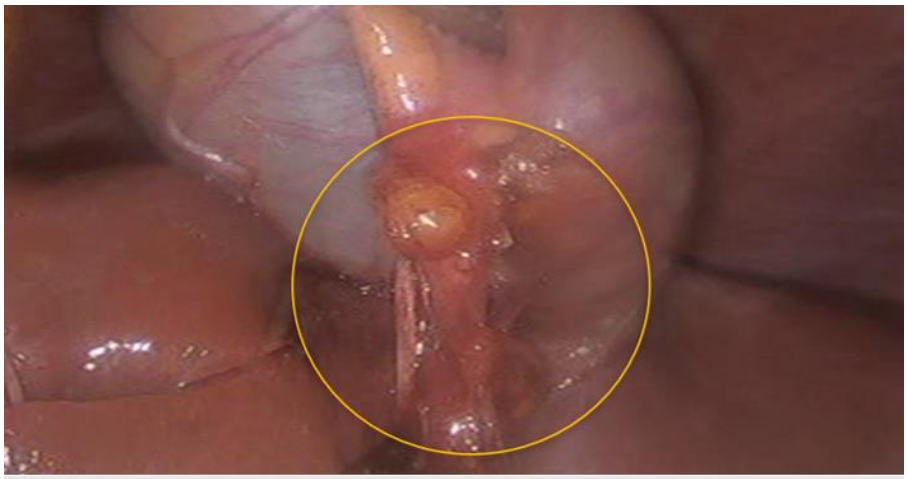


FIRUGE 1: Abdominal tomography, coronal section, total situs inversus is observed. Yellow markings show the left-sided positioning of the liver.

The preoperative evaluation was completed with laboratory and imaging studies, as well as a consultation with cardiology, which ruled out cardiac pathology, excluding transposition of the great vessels. The patient had preserved systolic function, no identified patent foramen ovale, and a low risk for pulmonary hypertension, allowing for the surgical procedure to proceed.

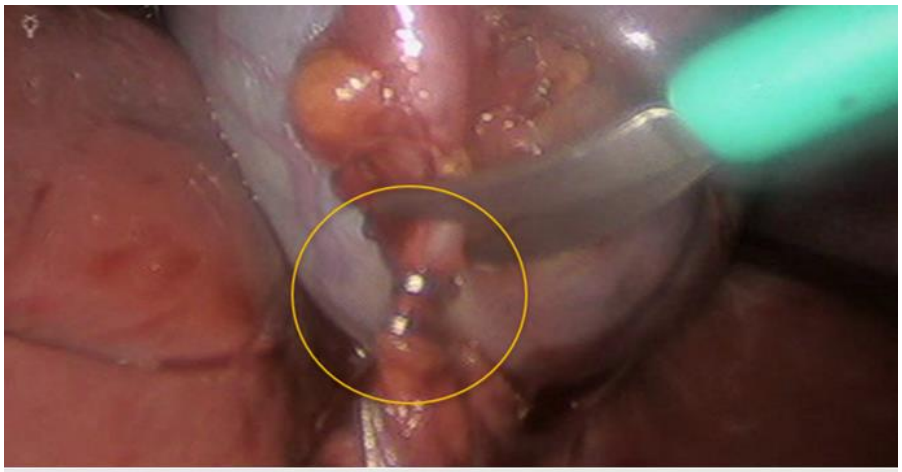
The surgery was performed under general anesthesia, with the patient placed in the supine position. The surgeon and the first assistant positioned themselves on the right side of the patient, while the second assistant and the surgical nurse positioned themselves on the left side. The laparoscopic video tower was placed in front of the surgeon, on the patient's left side. The laparoscopic approach began with a 10mm supraumbilical incision for the establishment of pneumoperitoneum, following the placement of a Veress needle, and insufflation of O2 to 12 mmHg. The vision port was then inserted, and laparoscopic exploration revealed the findings consistent with situs inversus. Under direct visualization, additional laparoscopic ports were placed in a mirror-image configuration, similar to a conventional laparoscopic cholecystectomy. Specifically, a 12mm port was placed in the subxiphoid region, a 5mm port in the left hypochondrium, and a second 5mm port in the left flank.

After traction was applied to the gallbladder fundus in a cephalad and left lateral direction, dissection of the hepatocystic area was initiated, maintaining dissection above the R4U line. The surgeon used his right hand, as in a conventional cholecystectomy. Once dissection of the hepatocystic area was completed, critical safety steps were performed, including the Strasberg critical view and a Doublet score of 6 points. Figure 2.



FIRUGE 2: Strasberg´s critical view of safety. Yellow mark highlights the all three components of critical view.

The cystic duct and artery were separately clipped with three 10mm endoscopic hemostatic clips before division of these structures. The 10mm LigaClipper was introduced through the subxiphoid port, and clip placement was controlled with the surgeon's left hand. Subsequently, the gallbladder was dissected from its bed and removed through the subxiphoid port using an Endobag. After confirming hemostasis, a Penrose drain was left in place in the Morrison's pouch, and the surgical procedure was concluded. Figure 3.



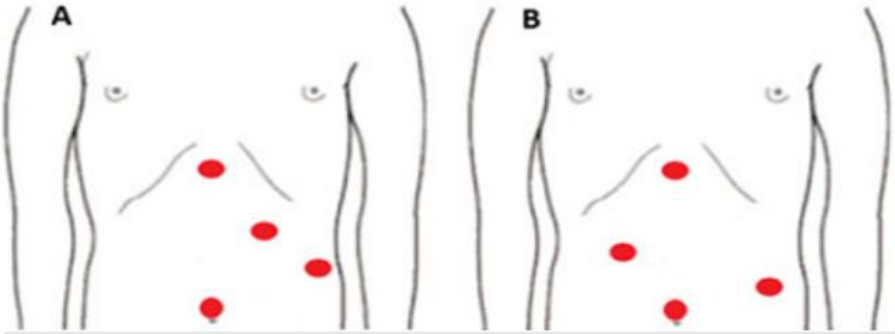
FIRUGE 3: Cystic duct clipped with titanium staples.

The patient had a favorable postoperative course. The drain was removed, and the patient was discharged 24 hours after surgery.

DISCUSSION

Laparoscopic cholecystectomy has been the standard of care for symptomatic cholelithiasis for over two decades; however, patients with total situs inversus can pose a challenge even for experienced surgeons. Therefore, thorough preoperative planning is recommended when dealing with such cases. [6]

The first reported laparoscopic procedure in a patient with this condition was in 1991, and subsequently, multiple cases have been reported, describing a variety of techniques used. [7] Several techniques have been described in the literature to facilitate dissection during laparoscopic cholecystectomy in patients with total situs inversus. [8] There are essentially two types of port placement in laparoscopy: the "American mirror technique" and the "French mirror technique," as described by Carrol9 and Dubois10, respectively, as illustrated in Figure 4.



FIRUGE 4: The two types of laparoscopic port placement: A) American mirror technique. B) French mirror technique.

The American mirror technique involves positioning the patient in the supine position, with the right arm or both arms flexed. The patient is placed in the Trendelenburg position, slightly to

the right. [9] Regarding laparoscopic port placement, they are positioned in a mirror-image configuration compared to a conventional laparoscopic cholecystectomy. In the "French mirror technique," the patient is placed in the supine position with the perineum at the edge of the table, hips and knees flexed, and the right arm or both arms abducted. The patient is then positioned in an inverted Trendelenburg position. The surgeon is located between the patient's legs or on the right side of the patient. [10]

In our patient, the American mirror port placement technique was chosen, with the surgeon's dominant hand being the right one, which was used for dissection through the epigastric port. This aligns with the findings reported by Chaouch et al., where the dominant hand was right in 91% of the cases, the American mirror technique was used in 97%, and dissection with the dominant right hand through the epigastric port was reported in 26% of the cases. [11] The duration of the surgery was 30 minutes, and the hospital stay was one day, consistent with the findings reported by Enciu et al., [12] where the duration of the surgery was recorded in 78 cases, yielding an average of 71.21 minutes. The postoperative hospital stay was recorded in 105 cases, with an average of 2.05 days, making our case shorter in both aspects compared to the reported values.

The most influential rule to avoid bile duct disruption is the "critical view of safety" established by Strasberg. [13] However, during laparoscopic cholecystectomy in TSI, we found ourselves looking through the Calot’s triangle from lateral to medial, exactly the opposite of what we would have done during a routine procedure on the right side, as that is what we are accustomed to. Regarding the demographics of the patients, the prevalence of gallstone disease tends to mirror that of the general population, affecting women more frequently. [14]

In terms of its pathogenesis, the homeodomain transcription factor 2 (Pitx2) plays a crucial role during embryogenesis by establishing the left-right axis in the lateral mesoderm and contributing to the asymmetric development of organs such as the heart, small intestine, and stomach. When Pitx2 is deleted, it disrupts normal organ morphogenesis, leading to asymmetric development of specific visceral organs, including the spleen and liver. However, the presence of situs abnormalities can be accompanied by various comorbidities. [15] In individuals with situs solitus, the prevalence of congenital heart disease is approximately 0.6%. In contrast, for those with TSI, this rate ranges from 3% to 9%, and rises to nearly 80% in cases of situs ambiguus. Additionally, vascular anomalies, such as interrupted inferior vena cava and preduodenal portal vein, have been documented in up to 20% to 42% of patients with situs abnormalities, respectively. Moreover, the occurrence of an aberrant hepatic artery is more common in patients with abnormal situs. [16] Biliary tract malformations are relatively common, occurring in 5.2% of cases, with biliary atresia being the most frequent. [17] Surgical management in patients with TSI presents a significant challenge due to the anatomical inversion. During the procedure, the altered orientation of the gallbladder and its structures complicates dissection. One of the most critical steps is the proper placement of trocars to achieve an adequate critical view of safety and minimize the risk of bile duct disruption. [18] It is crucial to emphasize that these patients are at an elevated risk of anesthetic complications, primarily due to the high incidence of congenital heart disease. Therefore, caution must be maintained, and specific measures should be implemented during anesthetic management. Reports show a higher predisposition to selective intubation of the left bronchus. [19]

Additionally, it is recommended to evaluate the patient for other cardiovascular and pulmonary conditions during the preoperative phase, whenever feasible. [20] Our patient underwent multiple preanesthetic and preoperative evaluations, including a consultation with the cardiology service, and an echocardiogram was performed, ruling out any congenital cardiovascular malformation.

The surgical procedure was performed without complications, and the patient was followed up in the outpatient clinic with no complications, subsequently being discharged.

CONCLUSIONS

Laparoscopic cholecystectomy is a safe and effective technique for patients with TSI. However, both bibliographic reports and our personal experience in this case emphasize that the unique anatomical disposition in TSI requires modifications to the surgical technique, necessitating a well-trained surgeon with a deep understanding of biliary anatomy and its variations. In our case, having prior knowledge of the patient's TSI diagnosis facilitated a thorough preoperative evaluation, ultimately resulting in a successful surgical procedure.

References

1. Pisano, M., Allievi, N., Gurusamy, K. et al. 2020 Pautas actualizadas de la Sociedad Mundial de Cirugía de Emergencia para el diagnóstico y tratamiento de la colecistitis litiásica aguda. World J Emerg Surg 15 , 61 (2020). https://doi.org/10.1186/s13017-020-00336-x

2. Lakhey P, Shrestha M, Sharma R, Lakhey PJ. Laparoscopic Cholecystectomy in Situs Inversus Totalis: A Case Report. Clin Case Rep. 2025 Feb 18;13(2):e70222. doi: 10.1002/ccr3.70222. PMID: 39967839; PMCID: PMC11833166.

3. Situs inversus totalis: revisión de tema con aproximación a la Genética y reporte de casos. Aljure Reales VJ, Álvarez Gallego GC, Ávila Espitia NC, Coleyb AA, Ángel Suárezb OG. Rev. Colomb Cardiol. 2017;24:40–47.

4. Situs inversus totalis en el entorno neonatal. Devera J, Licandro F, Ramos J, Taymoorian HT, Yap LG. Cureus. 2021;13:0. doi: 10.7759/cureus.13516.

5. Eitler K., Bibok A. y Telkes G., “Situs Inversus Totalis: A Clinical Review”, International Journal of General Medicine 15 (2022): 2437–2449.

6. Meza-Martinez DA, Palomino-Payan JA, Andrade-Ordoñez SJ, Fematt-Rodriguez BJ, Muñuzuri-Camacho MA, Gonzalez-Quezada A. Overcoming Anatomical Challenges: Laparoscopic Cholecystectomy in Situs Inversus Totalis. Cureus. 2023 Oct 2;15(10):e46371. doi: 10.7759/cureus.46371. PMID: 37800165; PMCID: PMC10549780.

7. Campos L., Sipes E. Colecistectomía laparoscópica en una mujer de 39 años con situs inversus. J. Laparoendosc. Surg. 1991;1:123–126. doi: 10.1089/lps.1991.1.123.

8. Du T, Hawasli A, Summe K, Meguid AA, Lai C, Sadoun M. Laparoscopic Cholecystectomy in a Patient with Situs Inversus Totalis: Port Placement and Dissection Techniques. Am J Case Rep. 2020 Sep 4;21:e924896. doi: 10.12659/AJCR.924896. PMID: 32886654; PMCID: PMC7491955.

9. Carroll BJ. "Laparoscopic cholecystectomy: the American technique." Operative strategies in laparoscopic surgery. Springer, Berlin: Heidelberg; 1995: 34–38.

10. Dubois F. "Laparoscopic cholecystectomy: the French technique." Operative strategies in laparoscopic surgery. Springer, Berlin: Heidelberg; 1995: 30–33.

11. Mohamed Ali Chaouch, Hichem Jerraya, Mohamed Wejih Dougaz, Ramzi Nouira & Chadli Dziri (2019): A Systematic Review of Laparoscopic Cholecystectomy in Situs Inversus, Journal of Investigative Surgery, DOI: 10.1080/08941939.2019.1622822.Heneghan, C., et al., Characterization of changes in blood vessel width and tortuosity in retinopathy of prematurity using image analysis. Medical image analysis, 2002. 6(4): p. 407-429.

12. Enciu O, Toma EA, Tulin A, Georgescu DE, Miron A. Look beyond the Mirror: Laparoscopic Cholecystectomy in Situs Inversus Totalis-A Systematic Review and Meta-Analysis (and Report of New Technique). Diagnostics (Basel). 2022 May 19;12(5):1265. doi: 10.3390/diagnostics12051265. PMID: 35626419; PMCID: PMC9140146.Narasimha-Iyer, H., et al., Automatic Identification of Retinal Arteries and Veins from Dual-Wavelength Images Using Structural and Functional Features. Biomedical Engineering, IEEE Transactions on, 2007. 54(8): p. 1427-1435.

13. Strasberg SM, Brunt LM La visión crítica de la seguridad. Ann. Surg. 2017;265:464–465. doi: 10.1097/SLA.0000000000002054.Foracchia, M., Extraction and quantitative description of vessel features in hypertensive retinopathy fundus images, in Book Abstracts 2nd Int. Workshop on Computer Assisted Fundus Image Analysis, E. Grisan, Editor 2001. p. 6-6.

14. Barbara L., Sama C., Labate AMM, Taroni F., Rusticali AG, Festi D., Sapio C., Roda E., Banterle C., Puci A., et al. Un estudio poblacional sobre la prevalencia de la enfermedad de cálculos biliares: el estudio Sirmione. Hepatología. 1987;7:913–917. doi: 10.1002/hep.1840070520.

15. Situs inversus totalis: reporte de un caso Fragoso-Sánchez JA, Castillo-Ramírez L, Sernas-Romero N. http://revistamedica.imss.gob.mx/editorial/index.php/revista_medica/article/view/173/441 . Rev Med Inst Mex Seguro Soc. 2015;53:652–655.

16. Situs inversus totalis: una revisión clínica. Eitler K, Bibok A, Telkes G. Int J Gen Med. 2022;15:2437–2449. doi: 10.2147/IJGM.S295444.

17. Colecistectomía y situs inversus totalis (con video) Meskauskas A, Trésallet C, Siebert M. SODA. 2023;9:100069.

18. Revisión sistemática de la colecistectomía laparoscópica en el sitio inverso. Chaouch MA, Jerraya H, Dougaz MW, Nouira R, Dziri C. J Invest Surg. 2021;34:324–333. doi: 10.1080/08941939.2019.1622822.

19. Comorbilidades en el situs inversus totalis: un estudio en un hospital. Chen W, Guo Z, Qian L, Wang L. Birth Defects Res. 2020;112:418–426. doi: 10.1002/bdr2.1652

20. Paciente con situs inversus totalis que se presenta para una apendicectomía laparoscópica de urgencia: consideraciones para un manejo anestésico seguro. Channabasappa SM, Mohan HS, Sarma J. Anesth Essays Res. 2013;7:127–129. doi: 10.4103/0259-1162.114019.