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Laparoscopic cholecystectomy in situs inversus totalis: A review article

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ABSTRACT

Background: Situs inversus totalis is a rare congenital anomaly characterized by transposition of organs to the opposite side of the body. Diagnosis and treatment of cholelithiasis in such cases pose a challenge to the operating surgeon because of an atypical clinical picture and the contra lateral disposition of the viscera.

Methods: A literature search using the PubMed and Cochrane databases identified articles focusing on the key issues of laparoscopy cholecystectomy in situs inversus.

Conclusions: Without doubt, laparoscopic cholecystectomy in these patients is technically more demanding but still feasible and should be performed by trained and experienced laparoscopic surgeons. Difficulty is encountered in skeletonizing the structures in Calot's triangle, which usually requires extra time than in patients with a normally located gall bladder.

Key words: *Situs inversus totalis, cholelithiasis, laparoscopic cholecystectomy*

Introduction

Situs inversus totalis (SIT) is a rare clinical entity that was first reported by Fabricius in 1600 [1]. It is a rare congenital anomaly with an autosomal recessive genetic pattern of inheritance, with the genetic defect mostly occurring within the second week of embryonic life. The incidence is almost equal in both genders [2]. Usually the condition is asymptomatic during adulthood unless it is associated with Kartegener's triad (bronchietasis, sinusitis, and situs inversus) and cardiac anomalies. The incidence is thought to be in the range of 1:10 000 to 1:20 000 [3]. The incidence of cholelithiasis is not higher in SIT [4]. Mouret performed the first laparoscopic cholecystectomy in 1987 [5]. Without doubt, laparoscopic cholecystectomy in these patients is technically difficult and necessitates proper orientation of the left upper quadrant, but it is still widely accepted as the treatment of choice for symptomatic cholelithiasis in patients with situs inversus [6,7]. We performed laparoscopic cholecystectomy in two cases of situs inversus totalis and reviewed the literature.

Methods

A search of the MEDLINE and Cochrane databases was conducted to identify the reports describing laparoscopic cholecystectomy in situs inversus. A total of 74 articles were selected and assessed. Manual cross-referencing was performed, and relevant references from selected papers were reviewed.

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Discussion

SIT is a rare clinical entity that was first reported by Fabricius in 1600 [1]. The incidence is in the range of 1:10 000 to 1:20 000 [3]. The incidence of gallbladder stone disease is the same in SIT and normal patients [8,9]. Due to the contralateral disposition of the viscera, the diagnosis of, and surgical approach to, these patients may pose diagnostic, as well as surgical, dilemmas. Most patients presented with left-sided upper abdominal or epigastric pain. However, about 10% of patients with left-sided cholelithiasis present with right-sided abdominal pain [9]. As the central nervous system may not share in the general transposition, this phenomenon has been observed for both visceral biliary pain and somatic pain in cases of cholecystitis [10].

A high index of suspicion is important for diagnosis and proper treatment, thus avoiding mishaps in patients with situs inversus. Situs inversus is suspected clinically if the heart beat is present in the right fifth intercostal space, liver dullness is present on the left side, and the right testicle hangs lower than the left [9]. Ultrasonography, abdominal CT, chest scan, and MRI will confirm the presence of visceral transposition [11, 12].

Approximately 40 cases of open cholecystectomy in the pre–laparoscopic era and approximately 79 cases of laparoscopic cholecystectomy in patients with situs inversus totalis have been reported in the literature thus far [1,2,3,6,7,9,13-73].

Laparoscopic surgery has become the gold standard for treatment of gallstones due to definite advantages, such as 1) use of small incisions, 2) lesser post-operative pain, 3) minimal bowel handling and early bowel movement, 4) earlier return to work, and 5) scarless surgery and better cosmesis. Various port positions include either four ports, three ports or a single port. The use of single-port laparoscopic surgery further potentiates all of these advantages.

In laparoscopic cholecystectomy for right-sided gallbladder stones, ports are made at several sites, such as the umbilical port (10 mm) and epigastric port (10 mm), with a direction towards the right side. One (5 mm) subcostal port is made along the midclavicular line and a 4th port is made lower down along the anterior axillary line. A monitor is placed on the right side of the patient, while the operating surgeon stands on left side of the patient. In the case of cholecystectomy in situs inversus totalis, the operative team stands on the right side, whereas the laparoscopic instruments are placed on the left side, as in a mirror image configuration. The pneumoperitoneum (CO2) is created by insertion of a veress needle through the subumblical area with a pressure of 12 mm Hg. Ports are made on the left half of the abdomen so that the surgeon can work in an ergonomical position. Careful dissection and skeletonizaion of both the cystic duct and artery is performed. Dissection is performed above the plane of Rouviene's sulcus to avoid any injury. Both cystic duct and artery are clipped carefully and divided by hook scissors. The gall bladder should be retrogradely separated from the liver bed by using monopolar/bipolar electrocautry or harmonic scalpels. The sheath of both 10 mm ports should be sutured to decrease the incidence of port-site hernias.

The most challenging factor for performing laparoscopic cholecystectomy in patients with situs inversus is the "mirror image" anatomy. Situs inversus with the two-dimensional effect of laparoscopy may lead to difficulties in orientation and dissection, thus increasing the risk of iatrogenic injuries [4]. The usual difficulties faced during this surgery include the following:

1. Due to the unusual anatomy, there are increased chances of iatrogenic injury.
2. Dissection is difficult for right-handed surgeons and easier for left-handed surgeons.
3. Surgeons should ensure that the common bile duct is located on the right side of Calot's triangle, and not on the left side.
4. The most important and difficult part of surgery is clip application because force application with the left hand is not as strong as with the right hand and there are chances of slipping of the clip.

According to all studies, the anatomical variations and reverse disposition of the biliary tree poses difficulty and careful skeletonizaion of the cystic duct and artery is essential to avoid iatrogenic complications. For right-handed surgeons, it is useful to reach the anatomy in terms of "medial" and "lateral" relations, rather than "left" and "right". Right-hand dominated surgeons can rearrange the port's position to perform the dissection and to apply a clip as we did in our 2nd case. We used

a 10 mm port at the midclavicular line instead of the standard 5 mm port to apply the clip. Right-dominated surgeons can slightly bend their bodies to dissect the structure of Calot's triangle using their right hand in the epigastric port, while allowing their assistant to retract Hartmann's pouch. An alternative way is that the lateral ports can be moved slightly caudally and the dissecting hand can be placed in one of these ports, while the left hand retracts the gallbladder fundus through the epigastric port. A peroperative-cholangiogram is performed by several surgeons to define the ductal anatomy of Calot's triangle, thus minimizing the common bile duct injuries [52].

Left-handed surgeons are comfortable with dissection and clip application [15]. However, the applied force is weak while clipping with the non-dominant left hand. It can also be dangerous, as clips may slip if they are loose.

Salama et al. [13] performed a laparoscopic cholecystectomy on a 10-year-old boy with situs inversus. He used the standard four ports. He reviewed fifty cases of laparoscopic cholecystectomy in situs inversus cases.

Borgaonkar et al. [58] performed laparoscopic cholecystectomy on a 47-year-old female with SIT. Cholecystectomy and appendicectomy were performed in the same patient by using the same four ports. A harmonic scalpel was used. The author reviewed 36 cases of laparoscopic cholecystectomy up to the year 2010. A total of 11 cases involved males and 25 cases involved females. Biliary anatomical variations were reported in 25% of the cases.

Pahwa et al. [63] operated upon a female patient with situs inversus who was suffering with gallstones. They performed a laparoscopic cholecystectomy. A subcostal 5 mm port was used for dissection, whereas an epigastric port was used for retraction of Hartmann's pouch and the surgery was completed successfully.

Evoli et al. [64] performed a laparoscopic cholecystectomy on a 48-year-old female with situs inversus by using four ports. They performed laparoscopic cholecystectomy by modifying the operative technique and used the left subcostal port (5 mm) for dissection with the right hand and the subxiphoid port for retraction of Hartmann's pouch by the left hand.

Lochman et al. [65] performed a laparoscopic cholecystectomy on a 75-year-old female patient, which took approximately 70 minutes. The surgeon was right-handed and the dissection was done through the medial epigastric port to avoid discomfort. Traction to Hartman's pouch was performed by a first assistant. The exact times of operation have not been typically reported in the literature. Similarly, the rate of conversion to open surgery in these cases has also not been reported thus far.

Iusco et al. [66] performed a laparoscopic cholecystectomy on a 52-year-old female with SIT who was suffering from gallstones. They used three ports instead of four ports and it was the first case where three ports were used.

Demiryilmaz et al. [67] reported two cases of laparoscopic cholecystectomy in situs inversus patients. No racial or gender predilection was given. They concluded that the dissection of Calot's triangle is easy due to better vision using a 30o telescope.

Arya et al. [68] operated on a 35-year-old female suffering from cholelithiasis with situs inversus. He used the standard four ports. The surgeon performed a dissection of Calot's triangle through an epigastric port, while the first assistant retracted Hartmann's pouch. Clipping was also carried out through the epigastric port. Thus, a right-handed surgeon must modify the technique for proper eye-hand coordination.

Ali et al. [69] performed a laparoscopic cholecystectomy on a 43-year-old female with situs inversus totalis suffering from gallstones by adjusting the position of the standard four ports. Postoperative outcome was satisfactory.

Stojcev et al. [70] performed a laparoscopic cholecystectomy on a 47-year-old male patient with situs inversus totalis suffering with gallstones using the standard four ports. They used a 30o telescope and the four standard ports in such a way as to provide an angle of 90o between the operating instruments.

Raghuveer et al. [71] used the position of the standard ports on the left side of the abdomen while operating upon a 55-year-old male. Dissection of Calot's triangle was carried out by standing on the caudal side of the patient while the patient was in the Lloyd-Davies position. There were no complications. They have reported 37 cases of laparoscopic cholecystectomy with-

out any complications. In this study, most cases were females and who were within the age group ranging from 20 to 80 years. According to this study, epigastric pain was reported in 30% of the cases and in 10% of the cases, pain was located in the right upper quadrant. In addition, the mirror image anatomy posed difficulty in orientation while performing the surgery. If the surgeon is right handed, then Hartmann's pouch can be retracted by an assistant and thus the surgeon can operate in an ergodynamic manner.

Moirangthem et al. [72] operated upon a 50-year-old female who presented with pain in her left upper quadrant, which radiated into the left scapular region. They also used four ports in the standard positions on the left side. To perform surgery in an ergonomic fashion and to avert complications, a Calot's triangle dissection clipping was carried out through the epigastric port with the right hand. They used a harmonic scalpel to perform the surgery and a drain was used. The total operating time was 75 minutes.

Sena et al. [73] performed a laparoscopic cholecystectomy on a 16-year-old female patient with situs inversus totalis. They reported that the diagnosis of acute cholecystitis was perplexing in patients with situs inversus totalis. Undoubtedly, the treatment of choice is laparoscopic cholecystectomy, but during this surgery the chances of iatrogenic injuries are quiet high. If the anatomy is not clear it is better to convert at the earliest time possible.

Single-port laparoscopic cholecystectomy is a recently adopted procedure and is performed to minimize morbidity and to improve cosmesis, as it is a virtually "scarless" surgery [2,7,59,60,61,62]. Although the single-port or single-incision procedure is cosmetically better, technically it is more difficult and also more costly. A single port can be created through or around the umbilicus. Single-port surgery can also be named as single-port access (SPA) surgery, single-incision laparoscopic surgery (SILS), or laparoscopic single-site surgery (LESS). The LESS procedure can be performed in two different ways. In the first one, a single incision is made to place multiple trocars. In the second, a single incision is made to place a single trocar designed to contain all of the instruments. There are many models of single-port devices manufactured by many companies, including SITRACC (Edlo, Porto Alegre, Brazil), Tri-port (Advanced Surgical Concepts, Wicklow, Ireland), X-Cone (Karl Storz, Tuttlingen, Germany) and SILS (Covidien Mansfield, USA) [62].

Han et al. [59] performed the first case of a single-incision, multiport laparoscopic cholecystectomy in a situs inversus patient in the year 2011 without any complications. The major advantage of this technique is that it is a scarless procedure. However, the learning curve is high for SILS, as the surgeon must adapt to new instruments, and the surgeon and assistant usually interfere with each other. Some of these disadvantages of the technique can be overcome by using semi-flexible camera systems and cross-angled hand devices.

Khiangte et al. [7] used a 2.5 cm completely intra-umbilical, vertical-skin incision to perform surgery on a 65-year-old male. A laparoscopic cholecystectomy was performed in SIT with the telescope inserted via the E.K. Glove port in the umbilicus. He has reviewed laparoscopic cholecystectomies performed with single incisions in situs inversus cases, as shown in Table 1.

Deveci et al. [74] performed a prospective randomized study of 100 patients to compare single-incision laparoscopic cholecystectomy (SILS) with three-port laparoscopic cholecystectomy (TPLC) and concluded definitively that the conversion rate, operating time and pain after the 1st postoperative procedure were higher

Table 1. Publications on situs inversus and single port/single incision cholecystectomies [6].

Reference no.	First author/year	Age/sex	Diagnosis	Access port used	Total/Partial
[59]	Han/2011	45/male	Cholelithiasis	Alexis wound retractor and glove	Total
[60]	Uludag/2011	49/male	Cholelithiasis	SILS port (Covidien)	Total
[61]	Ozsoy/2011	65/female	Acute cholecystitis	SILS port (Covidien)	Total
[62]	De Campos Martin/2012	59/female	Cholelithiasis	SITRACC Port	Total
[7]	Khiangte/2012	65/male	Cholelithiasis	E.K. Glove Port	Total

in SILS, as well as the cosmetic satisfaction. Thus, a SILS cholecystectomy performed by a senior surgeon is feasible and safe as a TPLC.

The Natural Orifice Transluminal Endoscopic Surgery (NOTES) (transgastric or transvaginal) has not reported the removal of gallstones in situs inversus totalis patients.

Surgeons have even performed appendicectomy, common bile duct exploration and gastric banding, along with cholecystectomy, in situs inversus cases [16,34,45].

The incidence of conversion to open surgery is higher in SIT patients due to associated biliary tract and vascular anomalies [1]. The incidence of major complications is comparable to that of laparoscopic cholecystectomy in normal gallstone patients.

Iatrogenic complications can be reduced during laparoscopic cholecystectomy in SIT patients by using the following guidelines:

1. All ports should be made in an ergonomic manner.
2. The operating surgeon should work from the caudal end with the patient in the Lloyd-Davies position.
3. The Hartmann's pouch can be retracted by the first assistant while dissecting takes place.
4. The lower limit of dissection should be Rouviene's sulcus.
5. Convert to open surgery immediately whenever difficulty is encountered.

Conclusions

Without doubt, changes in the anatomical disposition of the organ influence the diagnosis due to the atypical clinical picture; however, laparoscopic cholecystectomy is still feasible and can be performed in situs inversus totalis patients with complications comparable to laparoscopic cholecystectomy in normal right-sided gallstone patients.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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