

# Single-Incision Laparoscopic Cholecystectomy in Situs Inversus Totalis

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## ABSTRACT

**Background and Objectives:** Situs inversus totalis (SIT) is a rare congenital anomaly that can cause difficulties during standard laparoscopic cholecystectomy due to its mirror-image anatomy. These cases require more technically demanding procedures, and handedness of the surgeon may influence performance of these operations. Single-incision laparoscopic surgery (SILS) has been proposed as a less-invasive alternative to conventional laparoscopic surgery. We report the first case of successful SILS cholecystectomy in a patient with SIT and discuss technical aspects of the operation related to the handedness of the surgeon.

**Case:** A 49-year-old man who was known to have situs inversus totalis presented with symptomatic cholelithiasis. This patient was operated on by a right-handed surgeon. The surgeon and camera assistant were positioned on the right and left side respectively with the video monitor above the patient's left shoulder. The SILS port (Covidien), which has 3 operating channels, was placed in the abdomen via a 2-cm intraumbilical incision. SILS cholecystectomy was performed successfully. Dissection of Calot's triangle and the gallbladder bed was performed using a dissector and hook in the right hand without any technical problems.

**Conclusion:** SIT may confer an advantage over the orthotopic position for right-handed surgeons. SILS cholecystectomy can be performed safely in SIT.

**Key Words:** Situs inversus totalis, Single incision laparoscopic surgery, Right-handedness, Cholelithiasis.

## INTRODUCTION

Situs inversus totalis (SIT) is a rare congenital abnormality with an autosomal recessive genetic predisposition. It describes an anatomy that is a perfect mirror image of the normal physiologic positions of the visceral organs with preservation of anteroposterior relationships.<sup>1</sup> Its incidence varies from one in 5000 to one in 20 000, perhaps as a reflection of very different diagnostic methods.<sup>2</sup>

In the published literature, there have been only about 40 reports in the prelaparoscopic era and about 40 reports of standard laparoscopic cholecystectomy in patients with situs inversus. Although laparoscopic cholecystectomy can be performed safely in patients with SIT by an experienced laparoscopic surgeon, laparoscopic cholecystectomy in SIT is technically more demanding than in patients with orthotopic anatomy and requires reorientation of visuomotor skills to the left upper quadrant.<sup>3,4</sup>

Today, laparoscopic cholecystectomy is the gold standard for gallbladder removal and is the most common laparoscopic surgical procedure in the world.<sup>5</sup> During recent years, laparoscopic surgery has developed rapidly. Single-incision laparoscopic surgery (SILS), also known as laparoendoscopic single-site surgery or single-port access surgery, has been proposed as a less invasive alternative to conventional open or laparoscopic surgery. Several advantages have been proposed, including improved cosmesis (scarless abdominal surgery performed through an umbilical incision), less incisional pain, and the ability to convert to standard multiport laparoscopic surgery if needed.<sup>6</sup> A large number of individualized techniques for SILS for multiple different operations have been described. To date, however, cholecystectomy appears to be the surgical procedure to which the most significant efforts have been applied towards the development of techniques and equipment for SILS.<sup>7</sup>

Herein, we discuss some technical aspects of the operation single incision laparoscopic cholecystectomy in situs inversus totalis.

## CASE REPORT

A 49-year-old man, who was known to have situs inversus totalis, presented to the surgical clinic with a 1-year history

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DOI: 10.4293/108680811X13071180407032

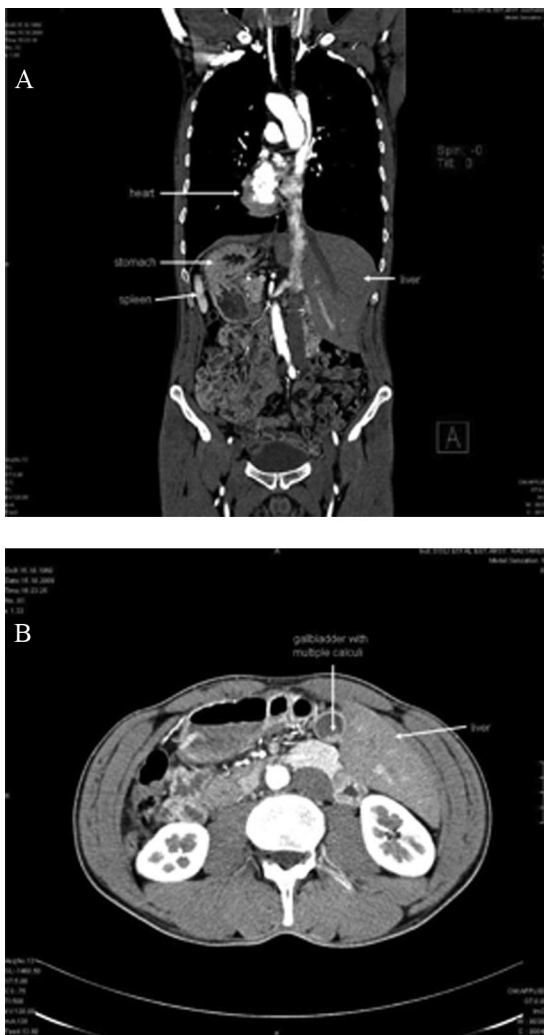
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of intermittent epigastric and left upper quadrant pain and concomitant digestive problems. Ultrasonography identified multiple gallstones that were millimetric in size, a common bile duct of normal diameter, and the presence of the liver and gallbladder in the left hypochondrium. A thoracoabdominal computed tomographic (CT) scan confirmed SIT (**Figure 1**). Laboratory studies were normal. After providing informed consent, the patient underwent SILS cholecystectomy.

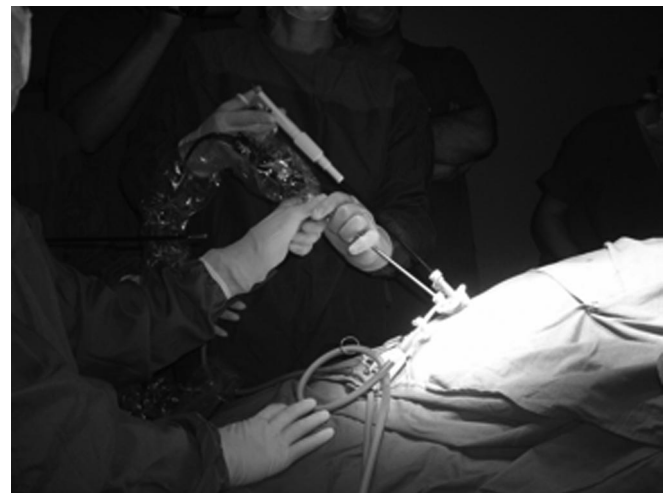
The patient was placed in the supine position. The surgeon was a right-handed operator (MU) having performed >100 standard laparoscopic cholecystectomies at the

time. The lead surgeon was positioned on the patient's right side, and the assistant holding the camera was on the left side with the video monitor above the patient's left shoulder (**Figure 2**).

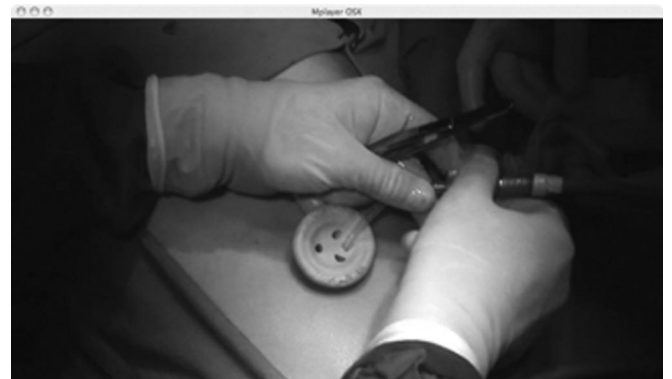
With the patient under general anesthesia, the umbilicus was everted using forceps. A vertical, 2-cm intraumbilical incision was carried out along the umbilical ring. Dissection was continued down to the linea alba, and a 2-cm fasciotomy was made to enter the peritoneal cavity. The 5-mm to 12-mm SILS Port (Covidien, Tyco Healthcare Group LP, Norwalk, Connecticut, USA) was placed into the abdominal cavity (**Figure 3**). This device has 3 operating channels and another channel for insufflation. The abdomen was insufflated to 12mmHg with the insufflation cannula. Three 5-mm cannulas were placed. The patient



**Figure 1.** Spiral computed tomographic scan of the patient. **A.** In coronal section, the liver is on the left side, and the heart, stomach, and spleen are on the right side, consistent with SIT. **B.** In the axial plane, the liver and gallbladder with multiple calculi are on the left side.



**Figure 2.** Operative setup for this patient with SIT. The surgeon was positioned on the patient's right side, and the assistant holding the camera was on the left side.



**Figure 3.** SILS port was placed through a vertical, 2-cm intraumbilical incision.

was positioned in a slightly anti-Trendelenburg position with some rotation to the right side. A 5-mm 30° video-scope was introduced through one cannula. The other 2 cannulas were used to introduce instruments. To achieve better exposure, a 2/0 polypropylene suture with a straight needle was passed through the abdominal wall into the left subcostal space. The suture was placed at the gallbladder fundus before it was pushed back out of the abdominal cavity. The suture was then externally retracted and fixed. A 5-mm disposable articulated grasper (roticulator Endo Grasp, 5-mm; Autosuture, Tyco Healthcare Group LP, Norwalk, Connecticut, USA) in the left cannula was used to retract the gallbladder neck and expose the elements of the triangle of Calot as in a standard cholecystectomy. Dissection of Calot's triangle was performed using either a standard or articulated dissector (roticulator Endo Dissect, 5mm; Autosuture, Tyco Healthcare Group LP, Norwalk, Connecticut, USA) in the right hand. The cystic duct was dissected entirely. The proximal cystic duct was ligated with two 5-mm clips (Endo Clip, 5mm; Autosuture, Tyco Healthcare Group LP, Norwalk, Connecticut, USA), a third clip was placed on the gallbladder side, and the cystic duct was divided with standard endoscopic scissors. The cystic artery was also ligated after proximal and distal isolation with 5-mm clips and then divided. Dissection of the gallbladder bed was performed using hook electrocautery. The surgical field was checked for bleeding. The 5-mm cannula was replaced by a 10-mm cannula to allow for introduction of an extraction bag. The suspended stitch was removed, and the gallbladder was placed in a Standard Endo-catch (Endo catch Gold, 10 mm; Autosuture, Tyco Healthcare Group LP, Norwalk, Connecticut, USA). The Endo-catch and the SILS port were then removed simultaneously. The umbilical fascia was closed with 2/0 polypropylene suture, and umbilical skin was restored with 4/0 monocryl (Ethicon) cutaneous stitches to its physiologic position. The operation was then completed without incident, and the total duration of surgery was 75 minutes. The postoperative period was uneventful, and the patient was discharged on postoperative day 1.

## DISCUSSION

Situs inversus totalis can be seen together with dextrocardia or levocardia. Partial rotations of the visceral organs ("situs ambiguous" or "partial situs inversus") and levocardia with situs inversus totalis are often associated with congenital heart diseases and other organ anomalies. Kartagener's syndrome occurs in approximately 20% of patients with dextrocardia and situs in-

versus; these patients have impaired ciliary movement resulting in sinusitis and bronchiectasis. In other cases of situs inversus totalis with dextrocardia, congenital heart diseases and other anomalies are rare, and patients generally lead a healthy life.<sup>1</sup>

Despite the fact that the intrahepatic biliary and venous anatomy in patients with SIT is a perfect mirror image of the normal liver, the arterial distribution appears to be quite different.<sup>4</sup> Arterial system anomalies are also mirror-image configurations of the normal anatomy.<sup>8</sup> The structure of the hepatoduodenal ligament is the same as that seen in the orthotopic patient.<sup>4</sup> However, in patients with situs inversus partialis, there is an increased possibility of associated biliary tract and vascular anomalies.<sup>3</sup> Although there is no evidence that the incidence of gallstones is greater in patients with SIT, a presentation with left upper quadrant pain can lead to diagnostic confusion.<sup>3,4</sup>

Previous reports have confirmed that SIT is not a contraindication for laparoscopic cholecystectomy, although the procedure is more difficult than in orthotopic patients.<sup>3,4,9</sup> Although no evidence suggests that there is an increased risk of bile duct injuries in these patients, the unfamiliar orientation and ergonomic challenges may result in increased operative time.<sup>4,9</sup> The most challenging factor for performing laparoscopic cholecystectomy in SIT is the mirror-image anatomy. This uninvited condition may lead to some problems with orientation and dissection during the procedure for a right-handed surgeon. For a right-handed surgeon using the left hand, instrument manipulation may be cumbersome and imprecise. Using the right hand causes technical difficulties stemming from having to cross the hands or instruments within the peritoneal cavity, or having to hyperflex the trunk.<sup>3,4</sup> To overcome this issue, several alternative modifications have been proposed: (1) retraction of Hartmann's pouch by the first assistant, while the surgeon dissects Calot's triangle using his right hand via the epigastric port, (2) use of the epigastric port to retract with the left hand and operate with the right hand through the lateral subcostal port, or (3) position the surgeon near the patient's 2 abducted lower limbs.<sup>9-11</sup> However, the left-handed surgeon has a clear advantage, because he is able to alternate performance of the dissection maneuvers between his right and left hands.<sup>4</sup>

SILS was developed to reduce the invasiveness of standard laparoscopy.<sup>5,7</sup> Several methods of port access have been described to perform SILS, including using one port with multiple working channels, or introducing 3 trocars

through the same umbilical incision. Although multiple groups have reported initial success with SILS, no consensus exists concerning an optimal technique for this method. Several studies have shown that SILS cholecystectomy is feasible, safe, and effective.<sup>5,7,12–14</sup> In addition, the learning curve is very short. Further studies in the form of randomized controlled trials are needed to evaluate the potential benefits of new techniques before its use can be widely recommended.<sup>7,12</sup> However, the procedure is more difficult than traditional laparoscopic surgery due to associated technical challenges, including crowding of the laparoscope and other instruments around the umbilicus, loss of triangulation between 2 instruments in the operative field, pneumoperitoneal leaks, intraabdominal smoke, and a virtual requirement of ambidexterity in the surgeon to perform relatively difficult maneuvers.<sup>14</sup> Improved instrumentation and the use of crossed-over articulating graspers and dissectors can achieve triangulation, but their use requires adjustments that may translate to longer operative times required for safe and precise dissection.<sup>5,7</sup> Because both the operating instruments and laparoscope are introduced through the same incision and along the same axis, the operator and assistant may often impede each other's movements. Instruments often interfere with each other, not only within the abdomen but also extraabdominally. This makes clear and accurate communication between the surgeon and the camera assistant essential, especially with regards to intraoperative complications like bleeding.<sup>12</sup> The SILS port (Covidien), which we used in this case, allowed easy insufflation, maintenance of pneumoperitoneum, and smoke evacuation.

In SILS, the instruments in the right hand are placed on the left side of the screen, and the left-hand instrument is placed on the right side of the screen due to frequent crossing of the instrument shafts at the point of entry into the abdominal cavity.<sup>5</sup> The surgeon also has to adapt to counterintuitive movements due to instrument-tip movements mirroring hand movement.<sup>5,15</sup> In an orthotopic patient, optimal dissection of Calot's triangle in SILS cholecystectomy can be performed with a dissector via the left trocar and a grasper in the right trocar to retract Hartmann's pouch. If a right-handed surgeon is not fully trained in dissection with the left hand, the manipulation may be cumbersome, and problems with the dissection may occur during standard laparoscopic cholecystectomy in a patient with SIT.

SILS cholecystectomy began being performed in our department only recently, and we are still on the learning curve. The surgeon who performed this operation is right-handed and still encounters technical difficulties with dissecting with

his left hand in SILS cholecystectomy in the orthotopic position. However, the right trocar is suitable for dissection of SIT in SILS cholecystectomy, because it is the mirror image of the orthotopic position. Therefore, the right cannula was used for dissection, and the operation concluded without any technical problems. Hartmann's pouch was retracted with an articulated grasper in the left trocar, and the dissection of Calot's triangle was performed with either a standard or an articulated dissector in the right hand. Clipping and cutting of the cystic duct and cystic arteries and hook-dissection of the gallbladder bed were also performed via the right trocar. Although standard laparoscopic cholecystectomy in SIT poses some technical difficulties for right-handed surgeons, SILS cholecystectomy confers some advantages for dissection with the right hand.

## CONCLUSION

We believe that in SILS cholecystectomy, SIT confers an advantage for the right-handed surgeon compared with the orthotopic position. SILS cholecystectomy can be performed safely in SIT.

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