

Single-Site “Marionette” Approach to Situs Inversus Cholecystectomy

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ABSTRACT

Introduction: Situs inversus totalis is a rare congenital condition that involves sagittal mirroring of all thoracic and abdominal organs. The mirrored anatomy poses a challenge to the surgeon performing intra-abdominal surgery. Several laparoscopic techniques have been described for cholecystectomy in these patients.

Case Description: A 50-year-old woman with situs inversus totalis presented with left upper quadrant pain, cholelithiasis, and clinical findings consistent with acute cholecystitis. She underwent laparoscopic cholecystectomy with a single-site, “marionette” technique. This entailed a single periumbilical incision with 2 trocars (for camera and dissecting instrument) with suture suspension of the infundibulum, body, and fundus of the gallbladder, to facilitate manipulation and visualization.

Discussion: Several case reports have described safe completion of laparoscopic cholecystectomy in the setting of situs inversus totalis by using either mirroring of the traditional 4-port arrangement or a single port, multichannel apparatus. This article describes a single-site, marionette technique that circumvents many of the ergonomic and technical shortcomings of approaches described elsewhere.

Key Words: Gallbladder, Situs Inversus, Single-Site Laparoscopic Cholecystectomy.

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INTRODUCTION

Situs inversus totalis is a rare congenital condition occurring in ~0.005% of live births and involves sagittal mirroring of all thoracic and abdominal organs.¹ Despite grossly abnormal anatomy, the condition infrequently results in significant sequelae and was likely underdiagnosed before the advent of advanced imaging techniques. The reversed intra-abdominal anatomy presents a challenging operative problem for the surgeon performing cholecystectomy. Because the laparoscopic approach to cholecystectomy has become the standard of care, several case reports have indicated that chole-

cystectomy can be safely completed in the setting of situs inversus totalis.^{2–4} Most of these case reports describe sagittal mirroring of the traditional 4-port configuration with dissection of the biliary anatomy performed with the left (usually nondominant) hand or the right (necessitating crossing of the dissecting and retracting instruments). Both approaches present ergonomic and technical challenges that may be avoided with the use of the single-site marionette technique, as described herein.

Single-incision laparoscopic cholecystectomy was originally described in 2009 as a means for improved cosmetic

outcomes.⁵ Although enthusiasm has waned for single-incision laparoscopic cholecystectomy because of longer operative times and increased complications, it may have a unique role in providing an answer to the challenges posed by cholecystectomy in the setting of situs inversus totalis.^{6,7} Many techniques have been described for single-site surgery, including a single port with multiple channels for instruments. At our institution, a suture suspension, or marionette, technique is used to perform single-site cholecystectomy.⁸ The method involves the use of a single incision with 2 trocars (1 for a camera and the other for a working hand) and suspension of the infundibulum, body, and fundus with sutures. Extracorporeal manipulation of the sutures allows repositioning and flipping of the gallbladder.

CASE REPORT

A 50-year-old woman with known situs inversus totalis presented to the emergency department with a complaint of left upper quadrant pain with associated nausea of 3 days' duration. She gave a history consistent with symptomatic cholelithiasis, although her previous episodes were less intense and had resolved spontaneously after several hours. Her surgical history included a laparoscopic appendectomy and a laparoscopic hysterectomy. Her vital signs were within physiologic limits. On physical examination her abdomen was soft and nondistended with tenderness to palpation in the left upper quadrant. Laboratory values were significant for bilirubin elevated to 1.9 mg/dL, which normalized to 0.9 mg/dL the next day. The remaining results of a comprehensive metabolic panel and complete blood count and lipase were within normal limits. Abdominal ultrasonography demonstrated cholelithiasis, with a single nonmobile gallstone located in the neck of the gallbladder, no gallbladder wall thickening or pericholecystic fluid, a common bile duct diameter of 5.9 mm, and a negative sonographic Murphy sign. The patient was diagnosed with acute cholecystitis, prescribed ceftriaxone and metronidazole, and offered laparoscopic cholecystectomy. Given her situs inversus totalis, the decision was made to attempt a single-incision, marionette cholecystectomy.

In the operating room, the patient was prepped and draped in the usual fashion. The primary surgeon stood to the patient's right, with the assistant to the left. A semicircular, supraumbilical incision was made, and the peritoneal cavity was entered with a 5-mm optical trocar. The abdomen was then insufflated to 15 mm Hg and the abdomen was explored. The liver was identified in the left

upper quadrant as expected, with the gallbladder to the left of the falciform ligament. An additional 5-mm trocar was placed via the same supraumbilical incision (separate fascial entry) cephalad and to the right of the original trocar. The suspension sutures were placed in a figure-of-eight fashion with a laparoscopic suture passer. The first 2-0 nylon suture was placed through the abdominal wall anterior and slightly cephalad to the fundus of the gallbladder, to provide upward retraction. The second suture was then passed through the epigastrium, into the body of the gallbladder and out the left lateral abdominal wall. The last suture was also passed through the epigastrium, into the infundibulum of the gallbladder, and out the left lateral abdominal wall (**Figure 1**). With the ports and sutures in place, the cholecystectomy was undertaken. The peritoneum was stripped and the cystic artery and duct were exposed (both tracking medial to lateral as expected). A critical view of safety was obtained (**Figure 2**). Clips were applied to the cystic artery and duct, and then they were transected (**Figure 3**). An ultrasonic scalpel was used to take the gallbladder off the cystic plate (**Figure 4**). The infundibular suture was grasped, and the remaining sutures were cut at the level of the skin. The gallbladder was externalized via the umbilical incision. Fascia was closed with 0 Vicryl and skin with a subcuticular 4-0 Vicryl. Total operative time was ~45 min. The patient tolerated the procedure well and was discharged on postoperative day 1. She had no complaints or complications at her 2-week follow-up visit. Final pathology demonstrated cholelithiasis with chronic cholecystitis.

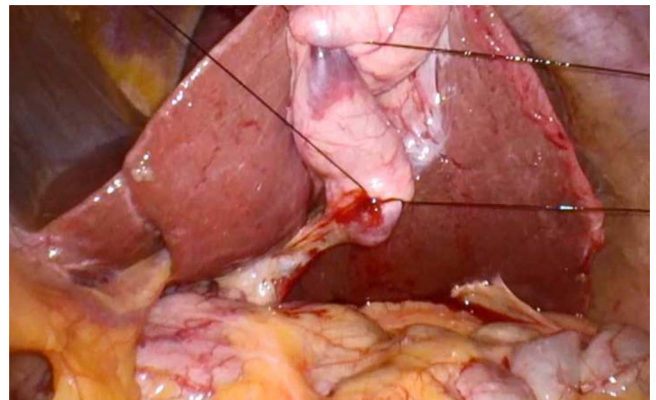


Figure 1. Marionette technique of suture retraction. Sutures are placed through the gallbladder body and infundibulum and suspended between the epigastrium and left lateral abdominal wall.

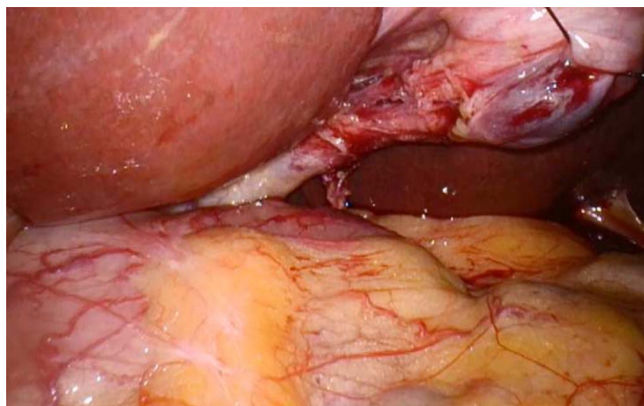


Figure 2. Dissection of the triangle of Calot to obtain a critical view for safety. The infundibulum is retracted laterally (left) to facilitate isolation of the cystic duct.



Figure 3. The cystic duct is clipped before transection.

DISCUSSION

In 2006, more than 500,000 laparoscopic cholecystectomies were performed in the United States.⁹ Given the high frequency at which cholecystectomy is performed, rare conditions, such as situs inversus totalis, may be encountered. Although a laparoscopic approach has been demonstrated to be safe in situs inversus totalis, mirrored port placement provides ergonomic and technical challenges. The surgeon must either perform the dissection primarily with the (often nondominant) left hand while retracting with the right, or must dissect primarily with the dominant right hand, necessitating significant crossing of instruments.^{10,11} Each of these approaches is less than ideal. In addition, port placement is fixed in the mirrored 4-port technique. This is usually not problematic in the familiar setting of a gallbladder situated on the right side, but the unfamiliar location of it on the left side (while operating with the nondominant hand or crossed instruments) can

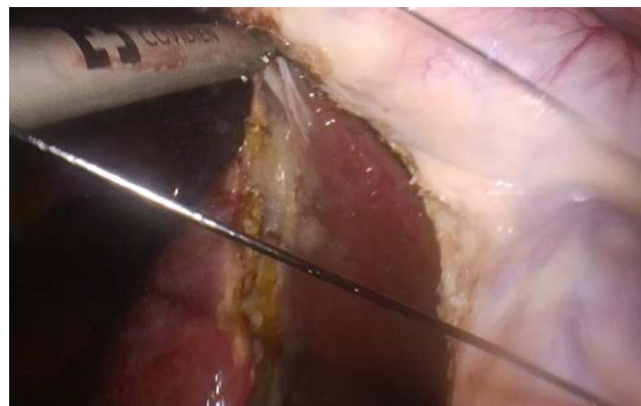


Figure 4. Dissection of the gallbladder off the cystic plate with an ultrasonic scalpel. Tension is maintained on the sutures through the fundus and body to facilitate dissection.

be burdensome. While not a new technique, the single-incision, marionette technique helps circumvent the problems related to this anatomic variation. The surgeon is allowed to dissect with the dominant hand, using instrument-free retraction, which simplifies the procedure. In our experience with the marionette technique, operative times are not significantly longer than those for standard cholecystectomy, and we are able to reliably obtain a critical view of safety. The retraction sutures are placed in a figure-of-eight configuration to minimize trauma to the gallbladder wall. This method results in minimal intraperitoneal bile spillage from the needle holes. There is adequate medial and lateral mobility, making dissection with a single working port feasible. If retraction is not optimal when using the marionette technique, the sutures can simply be removed and replaced with ease. In case reports regarding use of single-port, multichannel apparatuses to perform cholecystectomy in the setting of situs inversus totalis, instruments are often bunched together and compete against each other.^{4,12,13} The marionette technique overcomes this problem with instrument-free retraction requiring only a camera and a single additional instrument for dissection. With appropriate suture placement, there is ample traction placed on the gallbladder to allow single instrument dissection. The described approach also eliminates the cost of a single multichannel device. We opted to perform the operation in patients placed supine with the primary surgeon on the patient's right, but it could equally be approached from the lithotomy position.

The diagnosis of symptomatic cholelithiasis or acute cholecystitis in the setting of situs inversus totalis necessitates identification of the anatomic condition before surgery.

This method allows the surgeon to adjust the approach before surgery. Although the single-incision marionette technique for cholecystectomy entails a learning curve, once mastered, it provides ergonomic advantages and simplifies port placement. In addition, if the case cannot be completed in the described fashion, the option for conversion to a traditional mirrored 4-port approach is preserved. In the case described above, the single-incision approach allowed for safe completion of cholecystectomy, using the operating surgeon's dominant hand in an ergonomic fashion without the need for crossing instruments.

CONCLUSION

Cholecystectomy with the single-incision marionette technique in the setting of situs inversus totalis circumvents many of the ergonomic and technical challenges posed by the mirroring of traditional 4-port placement and multi-channel single-port approaches described elsewhere.

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