Single-Incision Laparoscopic Surgery—Hype or Reality: A Historical Control Study

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Abstract

Introduction: Single-incision laparoscopic surgery (SILS) is a “new” method to perform “old” operations. Though SILS has been referred to by many names, for the sake of this paper, any procedure done laparoscopically through one incision (regardless of the number of ports or working channels) will be considered a SILS procedure. This brief review will discuss the history of SILS, current applications, and potential pitfalls.

Methods: To explore the outcomes of SILS cholecystectomy in a community setting, we conducted a historical control study comparing, through retrospective review, 50 laparoscopic cholecystectomies to 50 SILS cholecystectomies, all performed by one of the authors (DT).

Results: Of the 50 patients selected, 12 patients had cholangiograms performed at the same time. The mean operative time for all cases was 50.4 minutes (range 31 minutes to 108 minutes). For the noncholangiogram group, the mean operative time was 48 minutes whereas it was 57.7 minutes for patients requiring a cholangiogram. Mean estimated blood loss was 28 mL. There was a 20% “conversion” rate (n = 10): 4 with an additional trocar, 5 with a 4-port technique, 1 with an open procedure.

Discussion: We conclude that, although SILS is a relatively new procedure for general surgery, we feel it is here to stay. Although the only documented benefit is cosmetic, SILS is equivalent to conventional laparoscopy in all other respects.

Introduction

Single-incision laparoscopic surgery (SILS) was first described in the gynecology literature in 1969; tubal ligation being the first procedure routinely performed through a single incision at the umbilicus. The first published report in general surgery appeared in 1992 with appendectomies. Currently, the debate continues of whether SILS has anything more to offer to the patient, to the surgeon, or to the health care industry compared with the conventional laparoscopic approach. As SILS’ media coverage rises along with its popularity amongst surgeons, the importance of this debate gains more significance.

In this article, we will discuss the history of SILS, the current applications of SILS and a literature review. Additionally we will discuss a single surgeon’s experience with 50 SILS cholecystectomies and draw conclusions about the viability, advantage and appropriateness of SILS compared with standard laparoscopic techniques.

The Evolution of Single-Incision Laparoscopic Surgery

The advent of SILS was in the field of gynecology. wheeless reported on the first 4000 cases of SILS tubal ligation in 1969. The procedure was done using an offset eyepiece and a 5-mm working port to introduce instruments to perform the procedure. They reported that healing was “so satisfactory that no scar was grossly visible.” Since then, SILS tubal ligation has become the standard of care for elective female sterilization. The first application of SILS in general surgery was a SILS appendectomy by Pelosi in 1992 in 25 patients. That same year, D’Alessio described a technique for appendectomy in pediatric patients in which a special port was used at the umbilicus to allow the surgeon to bring the appendix out through the umbilicus to perform an extracorporeal appendectomy. In this study, of the 166 patients enrolled, 19% required additional trocars to assist in the operation, and 4% required conversion to an open operation. When the operation was able to be completed with a single port, the mean operative time was 35 minutes with a 7-day return to normal activity, compared with 10 days for those that required additional trocars. The technique showed promise.

The Evolution of Single-Incision Laparoscopic Surgery for Cholecystectomy

The first reports of SILS cholecystectomy came in 1997 in a letter to the editor in the British Journal of Surgery by Navarra. In 30 patients two 10-mm ports were placed side-by-side with a small skin bridge between them. The surgeon placed multiple transabdominal sutures through the gallbladder to manipulate it. Once the gallbladder was able to be removed the small skin bridge was transected and the gallbladder was removed via this common incision. This was a technical

Various terms cited in the literature for single-incision laparoscopic surgery

- Single Port Surgery
- Embryonic Natural Orifice Transumbilical Endoscopic Surgery (E-Notes)
- Laparo-Endoscopic Single Site Surgery (LESS)
- Single-Port Access (SPA)
- Single-Access Surgery (SAS)
- Single Site Surgery (S3)
- Trans Umbilical Endoscopic Surgery (TUES)
- Natural Orifice Trans-Umbilical Surgery (NOTUS)
- Single-Access Video Endoscopic Surgery (SAVE)
- Single-incision, multiport laparoscopy (SIMPL)
- Single-incision laparoscopic surgery (SILS)
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Current Literature Review

Current literature is composed primarily of the experiences of various surgeons using the SILS technique. These are mainly case reports or case series. Nearly every operation imaginable has been reported using SILS techniques (see Sidebar: Summary of general surgery operations performed using single-incision laparoscopic surgery techniques). Similar to the controversy surrounding laparoscopic appendectomy versus open appendectomy, there is little data comparing SILS procedures to their traditional laparoscopic counterparts. Indeed there is no evidence that SILS is any better than current standard laparoscopic procedures other than the obvious cosmetic results. Some worries about SILS surgery include the possible increase in pain because of larger fascial incisions needed to place the large ports into the abdomen and the increased risk of umbilical hernia formation. There are very few randomized studies comparing SILS cholecystectomy to the conventional 4-port technique (we could only find two). Navarra performed a randomized study of traditional laparoscopic cholecystectomy to their single-incision technique as described above. They found longer operative times with the SILS procedure and a higher rate of umbilical herniation. It should be noted, however, that in this study the fascial defect required to remove the gallbladder was 2.5 cm, because of the use of two 10-mm ports (a 5-mm clip applier was not available during the study period). Early results from a current study, which is designed to compare SILS and conventional cholecystectomy, have shown no differences in operative time, postoperative pain, and blood loss. The only advantage seen has been in cosmesis. In this study 68% of patients would have opted for a SILS cholecystectomy if they had to have the operation done again. It should be noted that this is a preliminary study that has only enrolled 25 of the 200 patients needed to complete the study. A recent study presented at the Society of American Gastrointestinal and Endoscopic Surgeons found no difference in total operating room cost, charges to the patient, and hospital charges when comparing SILS cholecystectomy to standard cholecystectomy.

Further randomized studies are needed to determine if SILS is any better than conventional laparoscopic surgery. This review of literature shows that there is a paucity of quality data comparing SILS to its counterpart. The studies we have do not reveal any significant advantage to SILS over standard laparoscopic techniques thus far, except with respect to cosmesis.

Methods

Patient Inclusion Criteria

We conducted a historical control study comparing, through retrospective review, 50 laparoscopic cholecystectomies to 50 SILS cholecystectomies, all performed by one of the authors (DL).

Fifty patients from March 2009 through February 2010 were selected to undergo SILS cholecystectomy. Initially patients were excluded if their body mass index (BMI) was >40 or they had acute cholecystitis, however, once more experience was obtained this was liberalized to every patient requiring cholecystectomy. There were 43 women and 7 men with...
Operative Technique

Patients were placed in a supine position with their arms abducted. After induction of general anesthesia, an 11-mm curvilinear supra-umbilical incision was made and a cut down onto the umbilical stalk. A veress needle was inserted into the abdomen at the base of the umbilicus and pneumoperitoneum was established. A 5-mm port was placed into the left lateral aspect of this common incision and the patient was positioned into reverse Trendelenburg, left side down. The abdomen was surveyed and, if the gallbladder was visualized, then a SILS cholecystectomy was attempted. Another 5-mm port was placed in the right lateral aspect of the 11-mm incision (Figure 1). A transabdominal suture was placed through the fundus of the gallbladder to suspend it to the anterior abdominal wall. This was achieved with an O-silk suture on a Keith-needle passing it through the right lateral abdomen at the midclavicular line just below the costal margin and subsequently brought back out near the point of entry (Figure 2). A second O-silk suture was then brought through the abdominal wall in the subxiphoid area with two passes through the infundibulum of the gallbladder. This suture was then brought out through the right lateral abdominal wall. The assistant then “marionettes” the infundibulum to allow dissection of the posterior aspect of Calot’s triangle (Figures 3 and 4). The “critical view” was then obtained. If a cholangiogram was performed this was done by placing a 14-gauge angiocatheter through the abdominal wall and a cholangiocatheter was introduced into an incision made in the cystic duct. Once the surgeon was satisfied that the cystic duct and artery were identified, the structures were clipped with a 5-mm clip applier. If the cystic duct was too large for the 5-mm clips then the right-sided 5-mm port was replaced with an 11-mm port and a 10-mm clip applier was used. We found that when the use of an 11-mm port was needed, the mobility of the surgeon becomes very limited because the 5-mm and 11-mm port are in such close proximity. Once the cystic duct and artery were divided, the gallbladder was taken off the gallbladder bed using electrocautery. The suture used to suspend the gallbladder to the anterior abdominal wall was then removed; the gallbladder was centered and the “marionetting” sutures were then cut at the skin level. Both ends of the “marionetting” sutures were then grasped intracorporeally and the gallbladder was brought out through the 11-mm incision. The fascial incision was closed in a usual fashion with absorbable suture.

Results

Of the 50 patients selected, 12 patients had cholangiograms performed at the same time. The mean operative time for all cases was 50.4 minutes (range 31 minutes to 108 minutes). For the noncholangiogram group the mean operative time was 48 minutes whereas it was 57.7 minutes for patients requiring a cholangiogram. Mean estimated blood loss was 28 mL. There was a 20% “conversion” rate (n = 10) in the study group, with “conversion” considered placement of at least one additional trocar. In 4 of these patients an additional trocar was placed to put an endoloop around the cystic duct stump, because their cystic duct was too large for even a 10-mm clip. Five patients were converted to a 4-port technique (3 for adhesions and 2 for acute cholecystitis, making dissection too difficult). In one patient the anatomy was too difficult to discern with the SILS technique so the operation was converted to a traditional 4-port technique. During this dissection the cystic artery began bleeding and the suction and pneumoperitoneum simultaneously failed necessitating conversion to an open procedure.

Discussion

SILS is emerging as a new method of performing laparoscopic operations. General surgeons with laparoscopic skills are now performing many simple operations (ie, cholecystectomy and appendectomy) using the current technology. Surgeons with more advanced laparoscopic skills can perform more advanced procedures (ie, splenectomy and adrenalectomy) with the current tools available; however, it is recommended that they use simpler procedures.
**Operative Pitfalls and Pearls**

Currently SILS procedures require working inline with the camera using the same incision with either multiple ports placed through the common incision or a single specialized port with multiple access ports. Current technology available includes specialized trocars, instruments, and cameras that prevent crowding of instruments and that maintain adequate pneumoperitoneum. Many of these technologies do not require any special training but do require a change in the way one operates.

SILS requires working inline with the camera making movements difficult to perform because of instrument crowding. This can be circumvented by using articulating instruments of which there are numerous manufacturers. Additionally, ports and instruments of different lengths can be used to make the distance between the surgeons hands greater allowing greater mobility. As mentioned previously using all 5-mm ports is preferable because using anything larger limits the mobility of the trocar movements. As shown in the technique described above, transabdominal sutures can be used to manipulate the organ of interest decreasing the need for additional trocars.

Visualization during SILS procedures is obscured by the inline nature of traditional scopes. Using a flexible scope or angled scope can allow a surgeon to see around difficult corners. Additionally a bariatric length scope can help keep the scope out of the way of the surgeon's working hands.

Leakage of pneumoperitoneum can be problematic using SILS procedures. This is true if you are using traditional ports placed through the common incision (as described above) or using some of the manufactured ports that contain multiple ports within the single large port. This is especially true if the surgeon is torquing the instruments to perform the procedure. Placing a piece of gauze with surgilube around the port can help prevent leakage. Additionally trocars can slip out easily and suturing them to the skin can help prevent this from occurring.

In our experience with SILS for cholecystectomies, the two most important factors for the future may be patient selection criteria and recognizing the limitations of SILS.

**Conclusion**

Thus far, the only documented benefit of SILS procedures is cosmetic, although it is equivalent to conventional laparoscopy in all other respects. We conclude that the most important factor for success with SILS is likely in judicious patient selection criteria.

From the literature review and our surgeon’s personal experience, we believe that SILS is a reality that is here to stay, especially as experience with SILS grows, and the learning curve shortens. We look forward to future studies on the learning curve associated with the procedure, SILS in the hands of advanced laparoscopic surgeons versus general surgeons, and long-term follow-up studies.

**Disclosure Statement**

The author(s) have no conflicts of interest to disclose.

**References**


**Operative Skill**

Actual operative skill cannot be gained by observation, any more than skill in playing the violin can be had by hearing and seeing a virtuoso performing on that instrument.

— Allen O Whipple, MD, 1881-1963, American surgeon known for the Whipple procedure and for Whipple’s triad