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Single incision cholecystectomy using a clipless technique with LigaSure in a resource limited environment: The Bahamas experience

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ABSTRACT

BACKGROUND: Scarless/single-incision laparoscopic cholecystectomy (SILC) is a new procedure. It affords a superior cosmetic outcome when compared to conventional laparoscopic cholecystectomy. We examine the application of this technique using LigaSure via a clipless method. The present study looks at the experience of a single surgeon using this method with initial evaluation of the safety, feasibility, affordability, and benefits of this procedure.

METHODS: Twenty-eight patients underwent transumbilical SILC at Doctors Hospital from January to December, 2014. The cohort included both emergency and elective patients. There was no difference in the preoperative work-up as indicated. To perform the operation, a 2–2.5-cm linear incision was made through the umbilicus and the single port platform utilized. A 10 mm 30-degree laparoscope, a 5 mm LigaSure and straight instruments were used to perform the laparoscopic cholecystectomy procedure.

RESULTS: All patients except two were operated on successfully. Conversion was considered the placement of an additional epigastric/Right upper quadrant (RUQ) port. The conversion rate to standard LC was 7%. No patient was converted to open cholecystectomy. In the 28 successfully completed patients, the median duration of the operation was 38.5 min and estimated operative blood loss was 24 ml. Patients were commenced on liquid diet immediately on being fully conscious and after return to the ward with an estimated time of 6 h. The mean postoperative hospital stay was 1.4 days. Follow-up visits were conducted for all patients at 2-weeks intervals and continued for 6 weeks after surgery where possible. Two patients developed wound infections. All patients were satisfied with the good cosmetic effect of the surgery. The total satisfaction rate was 100%.

CONCLUSIONS: SILC is a safe and feasible technique for operating with scarless outcomes and reducing perioperative discomfort at the same time. The GelPOINTTM is a safe and feasible platform to be used. The procedure can be accomplished using regular instruments and laparoscope. Curved instruments and a bariatric length laparoscope may make the procedure easier and result in greater time saving. The addition of LigaSure™ decreases the complexity of the operation, decreases operative time and blood loss. The technique is economical in a resource-limited environment.

1. Introduction

The world's first laparoscopic cholecystectomy was preformed in 1985 using a galloscope by Muhe [1]. Kaiser and Corman documented the introduction of the digital camera which allowed Phillipe Mouret to perform the first video-assisted laparoscopic cholecystectomy in 1987 [2,4]. The introduction of laparoscopic cholecystectomy was met with much resistance when it first appeared in America in 1989. Many surgeons condemned it. Cameron and Gadacz highlighted the increasing population demand for cholecystectomy to be preformed laparoscopically. The procedure was greeted with skepticism because at the time it challenged open cholecystectomy which was one of the safest and most effective operative procedures [3]. Cosmesis was the pivotal factor that allowed conventional laparoscopic cholecystectomy to surpass open cholecystectomy as the gold standard for the treatment of symptomatic cholelithiasis in the 20th century [3]. At that time, they were no morbidity or mortality statistics to guide its implementation. As technological advancements were made, the paradigm shifted towards minimally invasive surgery. One of the emerging concepts is single-port or single-incision laparoscopic surgery (SILS). Once again, the gold standard is undergoing metamorphosis in the face of technological innovation. These techniques are based on the principle of having all working ports

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enter the abdomen through a single incision. It utilizes the concept of inline viewing, which evolved following the development of natural orifice transluminal endoscopic surgery (NOTES). Conventional laparoscopy advocates triangulation around a central optical instrument and thus SILS is thought to be contrary to this. Newer port systems (SILS™, GelPOINT™, TriPORT™) allow a combination of inline viewing and triangulation to accomplish the surgery. To the best of our knowledge, we report the first initial clinical experiences of performing **S**ingle Incision Laparoscopic Energy device Cystic duct Transection (SILECT) cholecystectomy in the Bahamas. We attempt to describe its safety and feasibility in a resource-limited environment. Doctors Hospital is the only private hospital for the city of Nassau and the other surrounding islands in the Bahamas. Just over 100 conventional laparoscopic cholecystectomies are performed annually with acceptable complication rates.

2. Patients and methods

Between January and December, 2014, 32 patients underwent SILECT cholecystectomy. The umbilicus was the point of access into abdomen in all patients. A single surgeon performed all of the operations consecutively. Informed written consent was obtained prior to surgery. The inclusion criteria included symptomatic cholelithiasis in male or female patients older than 18 years and an American Society of Anesthesiology (ASA) score of 1–3. Patients with a previous history of gallstone complications (e.g., acute cholecystitis, cholangitis, pancreatitis, or choledocholithiasis) were included. However patients with previous upper abdominal surgery, known cirrhosis of the liver, and an ASA score of 4 or higher were excluded. All patients underwent preoperative ultrasonography or CT scan and baseline liver functions were determined. Data was collected using the Meditech electronic record keeping system and an questionnaire at discharge that included age, sex, weight (kg), height (cm), operative technique, operative time (min), complications, postoperative hospital stay (days), and mortality. Patient satisfaction of the surgical scar was also assessed.

2.1. Operative techniques for SILECT cholecystectomy

Patients were placed in a supine position with arms placed to the sides. The surgeon was on the patient's left and the assistant to the right of the patient. A television monitor and the insufflator system Karl Storz HD were placed to the right shoulder of the patient. A 2.0–2.5 cm vertical trans-umbilical skin incision was made and directed down into the peritoneum (Fig. 1). Vicyrl 2/0 stay sutures were placed at the fascial end of incision to facilitate ease of port introduction. A special single incision port (GelPOINT™ port) was placed through the incision using retraction on stay sutures (Fig. 2). The GelPOINT™ advanced access platform enables a single incision approach by facilitating triangulation of standard instrumentation through a single incision.

The GelPOINT™ platform accommodates varying abdominal walls and incision sizes, provides continuous access and ensures improved articulation of 5–12 mm instruments. The Alexis wound protector/retractor offers atraumatic retraction and protection, maintains moisture at the incision site, while providing convenient extracorporeal resection and specimen retrieval (Figs. 3 and 4).

After pneumoperitoneum was established using 15 mm Hg, a 10/12 mm trocar and 3 × 5-mm trocars were then inserted through the GelPOINT™ in a rectangular fashion. The platform was positioned to place the 10/12 mm port at the 9 o'clock with other ports at 12, 3, and 6 o'clock, respectively. We used a standard length 10-mm 30° laparoscope placed in the 9 o'clock position. No bariatric length or curved instruments were used. A straight grasper was used at the infundibulum for lateral retraction and 12 o'clock was used as the working port. Dissection of Calot's triangle was carried out using a standard Maryland's dissector. Division of the cystic duct and artery were then performed using LigaSure™. The jaws were placed at a safe distance from the common bile duct to avoid injury to it. The cystic duct was coagulated then the LigaSure™ reapplied distally and tissues divided. The cystic artery was also isolated and divided using LigaSure™. There was no need for a specimen bag retrieval of the gallbladder. The gallbladder was simply removed via the GelPOINT™ systems after disengagement of the cap. The Alexis wound protector isolated the wound edge. If bile

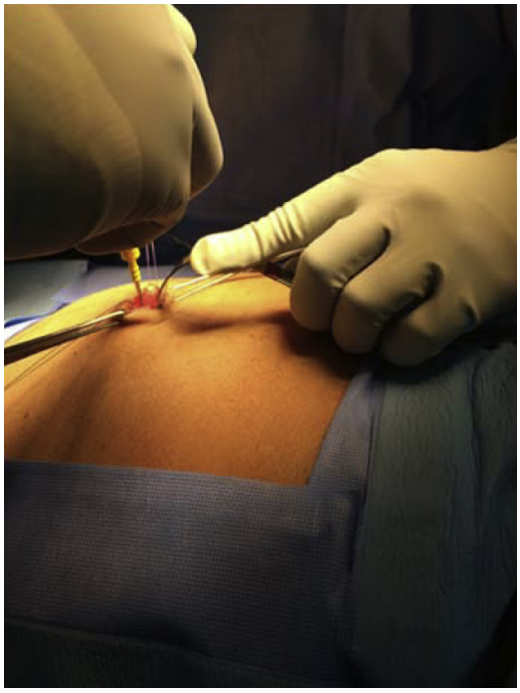

Fig. 1. Transumbilical incision.

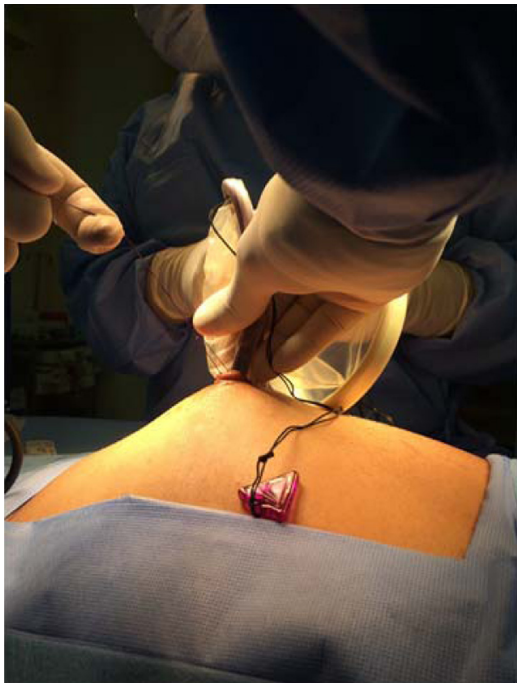

Fig. 2. Insertion of the SILS.

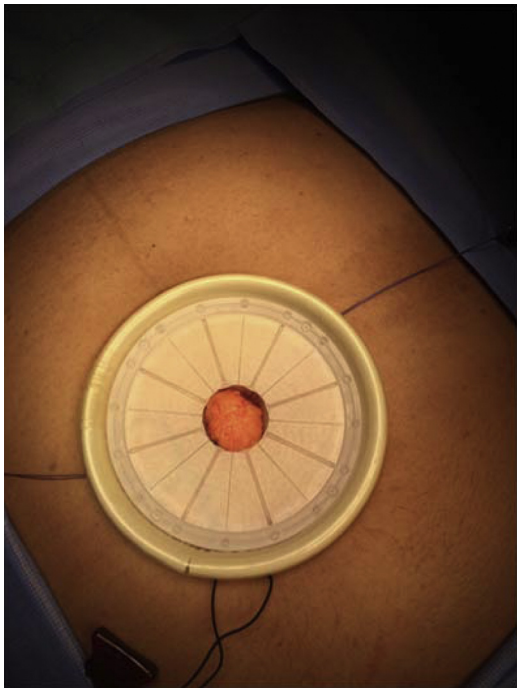

Fig. 3. Alexis O-ring inserted.

Fig. 4. The GelPOINT^{TM} permits the introduction of three 5-mm and one 12-mm trocars.

spillage occurred or turbid peritoneal fluid noted, the abdominal cavity was irrigated. Uncapping of platform deflated the abdomen. Alexis O-ring was subsequently removed.

After the operations were completed, the GelPOINT^{TM} (Applied Medical, Rancho Santa Margarita, CA, USA) port was removed and the umbilical fascia was closed using Vicryl O J needle (Johnson & Johnson, USA). The umbilical skin was closed using 4-0 monocryl (Johnson & Johnson, USA) (Fig. 5).

Fig. 5. Umbilical wound immediately after surgery.

3. Results

The characteristics of the patients and the operative and outcome data are detailed in Table 1. A conventional grasper could reach the gallbladder from the umbilical position for all patients. Two patients were "converted" with placement of an epigastric port due to difficulty of dissection of Calot's triangle in the presence of acute inflammation. Three patients where excluded because of ASA of 4. One of these patients was also in the conversion group. One patient had a combined cholecystectomy and incisional hernia repair and was excluded. However, these procedures were completed successfully. No open cholecystectomies were done. Of 28 patients, 17 (61%) were female, the mean age was 43.5 years (range: 24–80 years) and the mean body mass index (BMI) was 28.6 kg/m^2 (range: 21.6–44.1 kg/m^2). The mean operative time was 38.5 min (range: 33–120 min). Blood loss was acceptable in all cases. There were 2 cases of iatrogenic gallbladder perforation and 1 drain was used. The length of the postoperative stay was 1.4 days (range: 1–5 days). All patients were placed on a standard pain regimen and thus pain medication requirements were not accessed. None of the patients however reported pain that interfered with normal or work activities during follow up. There were no bile leaks evident intraoperative or postoperatively. Two patients developed a wound infection postoperatively which were managed conservatively with antibiotics. At the 2nd-week follow-up examination, all of the patients were satisfied with the resultant scar. Only 3 procedures were noted to be elective. One patient represented with recurrent right upper quadrant, no jaundice clinically but with deranged liver function tests consistent with biliary tree obstruction. A MRI revealed a retained stone and emergent ERCP was preformed. This patient had an uneventful recovery period (Fig. 6).

4. Discussion

Single-incision laparoscopic cholecystectomy (SILC) is an evolving concept that has sent a tidal wave through the field of minimally invasive surgery. It utilizes the concept of inline viewing and a single incision that accommodates all of the working instruments. This

Table 1
Summary of patient demographic, operative, and outcome data ($n = 28$).

	Total	1st 10 procedures	After 10 procedures
Mean age	43.5(24–80)	43.2(29–80)	41.7(24–66)
Mean BMI (kg/m^2)	28.6	30.6	29.0
Mean operative time (min)	38.5	63	37.9
Blood loss	minimal	minimal	minimal
Mean length of postoperative stay	1.4	3.3	1.3
Complications		-Wound infection [2]	
(n)		-Retained stone in 1 patient	
Pathology (%)		Acute/Chronic cholecystitis 100%	
Cosmesis score (/10)		All patients satisfied with wound	
Emergency/Elective		25/3	

BMI – body mass index; SD – standard deviation.

procedure is technically more complex and time consuming. The GelPOINT^{TM} system is one of the few single port platforms currently in use. It however, does not seem to matter which platform is used [39,45]. Navarra et al. first described a series of 30 SILC in 1997 that utilized two 10-mm ports and three trans-abdominal stay sutures to aid in gallbladder retraction. At the end of the procedure, the two umbilical fascial incisions were connected to facilitate the removal of the gallbladder [5]. Romanelli and Earle published their experience on the use of transumbilical SILC [7]. There was little reporting on this technique prior to this. As technology revolutionized the healthcare industry, there has been a renewed vigor in SILC. Several authors have reported feasibility and safety of this technique [8–11,13–22].

The use of the SILS technique demands increased scrutiny and adherence to the principles of safety that have been established for the laparoscopic procedure. The major concern regarding this technique is the risk of common bile duct injury. Early experiences with SILC were not associated with higher rates of common bile duct injuries. Single incision laparoscopic cholecystectomy in the emergency setting for acute cholecystitis had no greater incidence of bile duct injury compared with elective cholecystectomy [6,13–20,41–45]. Regarding overall safety, there were no significant differences in complications between SILC and traditional LC [41–44]. The addition of LigaSure did not change the complication rates in our study in comparison with other accounts [6,35–38,41–45]. Early conversion should not be viewed as a failure or complication. Attention to detail should be maintained at all times. The critical view is of the upmost importance. If it cannot be visualized then the use of an extraumbilical port or conversion to a 3 or 4-port operation should be performed.

Fig. 6. No visible scar at 6-weeks postsurgery.

The closure of the cystic duct using LigaSure^{TM} is feasible and effective in SILS cholecystectomy [24]. The LigaSure^{TM} was originally designed for vessels up to 7 mm and found to be just as effective as other sealing devices like Harmonic Scalpel, surgical clips and conventional hemostasis [25,26]. Its uses were later expanded to include parenchymal dissection/transection [27–34]. It thus achieves an effective sealing of the duct and artery with minimal blood loss. We suggest using LigaSure^{TM} for cystic duct diameter up to 5 mm to ensure complete sealing along its entire length of transection. This is especially important in the acute setting where cystic duct wall might be edematous and inflamed. With larger duct diameters we suggest an alternate method of duct closure. To prevent thermal collateral damage, it is imperative to keep a safe distance from other intra-abdominal structures when using thermal energy devices. Theoretically one could expect that insufficient cystic duct stump closure resulting in biliary leakage would occur using the LigaSure^{TM} device; however, this did not occur in any of the cases in this series [24,35,36]. The average blood loss in our series was 24 mls. This is consistent with other series that illustrates the use of energy devices and reduces blood loss significantly [25–34]. The use of the LigaSure^{TM} is an attempt to simplify SILC by reducing the degree of motion required thus reducing clashing of instruments with the assistant during the procedure. There was reduction of the operative time and easy handling of the LigaSure^{TM} device compared with ligation of the cystic duct by hand. This is beneficial and was confirmed by our results. Similar outcomes are seen is larger studies with the harmonic scalpel where shorter operative times, less bile spillage secondary to gallbladder perforation, less postoperative pain, and lower conversion rates were observed [35–37]. Thus the combination of single port surgery with energy device transection of the cystic duct and artery is the likely the next stage of evolution of SILC.

The average operating time was 38.5 min. When we compare the first 10 cases with later procedural times, we found that we went from an average operating time of 63 min to 37.9 min. Reviews of operative experience with this procedure have recommended that performance of at least ten cases is required for a fellowship-trained laparoscopic surgeon to become proficient at SILC [23]. Our experience suggests that surgeons may become proficient after 10 cases with the operating time being significantly altered. However, in certain patients the operative time may be prolonged due to anatomical difficulties. Larger series will be able to delineate the learning curve in terms of operative time.

To achieve improved triangulation some authors advocate the use of articulating instruments [9,16,17,19,20,23]. Our initial

experiences indicate that conventional laparoscopic instruments are feasible for use in SILECT cholecystectomy. Some of the difficulties experienced during the procedure included clashing between the instruments and the optic cable of the laparoscope, sub-optimal retraction of the gallbladder, and smoke entrapment in the abdominal cavity. We believe most importantly a bariatric length scope would correct this issue. This may be enhanced with a posteriorly connected light cable instead of in the lateral position. This would facilitate full rotation of the 30° laparoscope without interference with the operative instruments. The use of the single port platform did not impede the ability to visualize important structures in any way. The GelPOINT™ port comes with a separate venting channel so that smoke can be evacuated or a smoke-filtering system can be connected. Furthermore, the use of instruments with a low profile, streamlined hand pieces that reduce external crowding could make the surgery less stressful for the surgeon.

SILECT cholecystectomy represents advancement in the field of minimally invasive surgery. There is no debate that it is cosmetically superior to traditional LC [40]. However, it remains to be determined whether this approach would benefit patients, other than for cosmetic purposes, in comparison with conventional laparoscopic cholecystectomy. Hospital stay was an average of 1.4 days, which improved with later cases. Hospital stay was extended in patients with difficult dissection, or to facilitate patients' return to their cruiseships or relating to travel. The learning curve and patient demographics were also important with respect to prolonged hospitalization. The hospital asks all patients to fill out a feedback questionnaire at discharge. The information from this was combined with verbal confirmation at follow up visits. They were asked about their overall patient satisfaction as well as their surgical incision. No patients were dissatisfied with their wound outcomes. We did not examine postoperative pain but previous studies have shown that there is no difference in analgesia requirements between conventional laparoscopic and SILECT cholecystectomy [6,41,43,44]. We had a wound infection rate of 7%. Due to the length of our study we did not look at other complications like stricture formation and port site hernias. However, previous studies report no difference in overall wound complication rates [6,41–45]. Secondly with the decreased manipulation at the operative site with the use of the LigaSure™ device, these rates should be low. No bile duct injuries were noted consistent with the literature [6,41,43]. The use of LigaSure™ is thought to be superior in the patient with chronic cholecystitis. It was thought that these devices are better at differentiating the planes between the gallbladder and liver unlike electrocautery in the presence of post-inflammatory tissue [12]. Additional prospective randomized controlled trials are needed to examine this concept.

Emphasis should be made on the benefits of the team approach. We advocated as much as possible for the same surgical assistant and anesthesiologist to be used as much as possible. Having individuals who are knowledgeable with the procedure allows for greater efficiency and decreased errors.

Single-port laparoscopic surgery is a technically challenging and expensive surgical approach [44]. With limited resources in the Caribbean, the argument can be made that adopting new surgical technologies comes at a cost to the patient and the surgeon. This capita may be better spent in other sectors. Thus, financial concerns have been advocated against this approach. Some authors have demonstrated no financial advantages between techniques while maintaining acceptable outcomes and complications [45]. At our institution, the modifiable costs are due to the disposables used. This includes the port system, LigaSure™ hand piece and extraction bag. At our institution, disposables for a traditional laparoscopic cholecystectomy cost $2292.95 while the SILECT cholecystectomy using LigaSure™ cost $2446.85. That is a cost difference of $153.90. An additional expense to consider is the initial purchase of the energy generator. More cost savings could be achieved with the use of reusable port system and the use of straight standard instruments [42]. From our review of the literature, we have seen no other accounts of combining LigaSure™ and single port for laparoscopic cholecystectomy. It appears to be a novel idea with the potential for significant benefit.

5. Conclusions

SILS represents the next step in minimally invasive surgery. The SILECT technique appears to be a novel approach. We found our technique to be safe, feasible, affordable, and beneficial in the treatment of cholecystitis. It is possible that the public demand for this surgical approach will force an explosion in its use. Conceptual development through human experiences and the introduction of new dedicated instruments may be the key to unlocking its potential. As for the present, we believe SILC should be performed by surgeons with significant experience in advanced laparoscopy.

Conflicts of interest

None.

Funding

None.

Ethical approval

This was not a research study. It was a retrospective analysis. No ethical approval was obtained.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

Ross Downes designed, wrote, analyzed, and revised the manuscript. Charles Diggiss, James Iferenta, and James Iferenta revised the manuscript.

Guarantor

Ross Downes.

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