

Laparoendoscopic Single Site (LESS) Cholecystectomy

Steven E. Hodgett · Jonathan M. Hernandez ·
Connor A. Morton · Sharona B. Ross ·
Michael Albrink · Alexander S. Rosemurgy

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Abstract

Introduction The journey from conventional “open” operations to truly “minimally invasive” operations naturally includes progression from operations involving multiple trocars and multiple incisions to operations involving access through the umbilicus alone. Laparoscopic operations through the umbilicus alone, laparoendoscopic single site surgery (LESS), offer improved cosmesis and hopes for less pain and improved recovery. This study was undertaken to evaluate our initial experience with LESS cholecystectomy and to compare our initial experience to concurrent outcomes with more conventional multiport, multi-incision laparoscopic cholecystectomy.

Methods All patients referred for cholecystectomy over a 6-month period were offered LESS. Outcomes, including blood loss, operative time, complications, and length of stay were recorded. Outcomes with our first LESS cholecystectomies were compared to an uncontrolled group of concurrent patients undergoing multiport, multi-incision laparoscopic cholecystectomy at the same hospital by the same surgeon.

Results Twenty-nine patients of median age 50 years undergoing LESS cholecystectomy from November 2007 until May 2008 were compared to 29* patients, median age 48 years, undergoing standard multiport, multiple-incision laparoscopic cholecystectomy over the same time period. Median operative time for patients undergoing LESS cholecystectomy was 72 min and was not different from that of patients undergoing multiport, multi-incision laparoscopic cholecystectomy ($p=0.81$). Median length of hospital stay was 1.0 day for patients undergoing LESS cholecystectomy and was not different from patients undergoing standard laparoscopic cholecystectomy ($p=0.46$). Operative estimated blood loss was less than 100 cc for all patients. No patients undergoing attempted LESS cholecystectomy had conversions to “open” operations; two patients had an additional trocar(s) placed distant from the umbilicus to aid in exposure. Three patients undergoing LESS cholecystectomy had complications: two were troubled by pain control and another had urinary retention.

Conclusions LESS cholecystectomy is a safe and effective alternative to standard laparoscopic cholecystectomy. It can be undertaken without the expense of added operative time and provides patients with minimal, if any, apparent scarring. We believe LESS cholecystectomy will be driven by consumer demand, and therefore, laparoscopic surgeons will need to become proficient with LESS procedures.

Keywords Laparoendoscopic single site (LESS) Surgery ·
Cholecystectomy · Minimally invasive · Umbilicus ·
Laparoscopic cholecystectomy

Introduction

The first cholecystectomy was undertaken in 1882 by Langenbuch through a subcostal incision. His technique became the standard of care, remaining essentially unchanged for over a century. In 1987, Phillipe Mouret was credited with the first laparoscopic cholecystectomy using video technology, marking the beginnings of the minimally invasive revolution in General Surgery. Laparoscopic cholecystectomy is currently the standard of care for

S. E. Hodgett · J. M. Hernandez · C. A. Morton · S. B. Ross ·
M. Albrink · A. S. Rosemurgy (✉)
Department of Surgery, University of South Florida,
Tampa General Hospital,
P.O. Box 1289, Tampa, FL 33601, USA
e-mail: arosemur@health.usf.edu

gallbladder removal, with the open technique being largely reserved for failure of laparoscopic resection.¹ Today, we stand on the brink of a technological explosion that may drive surgery from small incisions to incisionless.^{2–8}

Natural orifice transluminal endoscopic surgery (NOTES) may represent the final frontier for the minimally invasive revolution—surgery without incisions.^{2,9–15} However, laparoendoscopic single site (LESS) cholecystectomy can be implemented now. LESS approaches “no scar” surgery and may not be associated with any significant learning curve beyond standard laparoscopic cholecystectomy. Furthermore, LESS offers the potential advantages of decreased postoperative pain and shortened, if any, postoperative hospitalization.

Our institution began focusing on LESS within the last year and subsequently developed a technique for laparoendoscopic single site cholecystectomy. We herein report our technique and results with the first 29 patients undergoing LESS cholecystectomy. Our hypothesis in implementing LESS cholecystectomy is that it would offer similar operative time, length of stay, and complication profile with improved cosmesis and less postoperative pain in comparison to traditional multiport, multi-incision laparoscopic cholecystectomy.

Methods

From November 2007 until May 2008, 29 patients referred with gallbladder pathology requiring cholecystectomy were operated upon with the general intent of undertaking LESS. One surgeon (MA) participated in all operations. Operative time, defined as the time from incision to time of closure, blood loss, complications, and length of stay were recorded. Outcomes of 20 patients undergoing multiport, multi-incision laparoscopic cholecystectomy during the same time period, by the same surgeon, were also recorded. In order to compare an equal number of patients, the last nine standard laparoscopic cholecystectomies undertaken prior to the time of first LESS cholecystectomy were included in the analysis. The results of patients undergoing LESS cholecystectomy or standard laparoscopic cholecystectomy were compared utilizing the Mann–Whitney *U* test. Data are presented as median, mean±SD.

Operative Technique

Patients were placed in supine position with the operating surgeon on the patients’ left and the assistant on the patients’ right. A 10-mm longitudinal incision is made through the umbilicus and the natural umbilical defect is used to enter the peritoneum. A 5-mm blunt port is inserted into the peritoneum and the abdomen is insufflated. Air

leaks at port sites must be avoided. A 0°, 5-mm laparoscope is inserted into the port to assure adequate pneumoperitoneum. A second 5-mm working port (with a sharp trocar) is placed in the same incision superiorly to the camera port through a second fascial insertion. This technique diminishes the amount of air leak to a negligible level. Attention is then turned to the gallbladder.

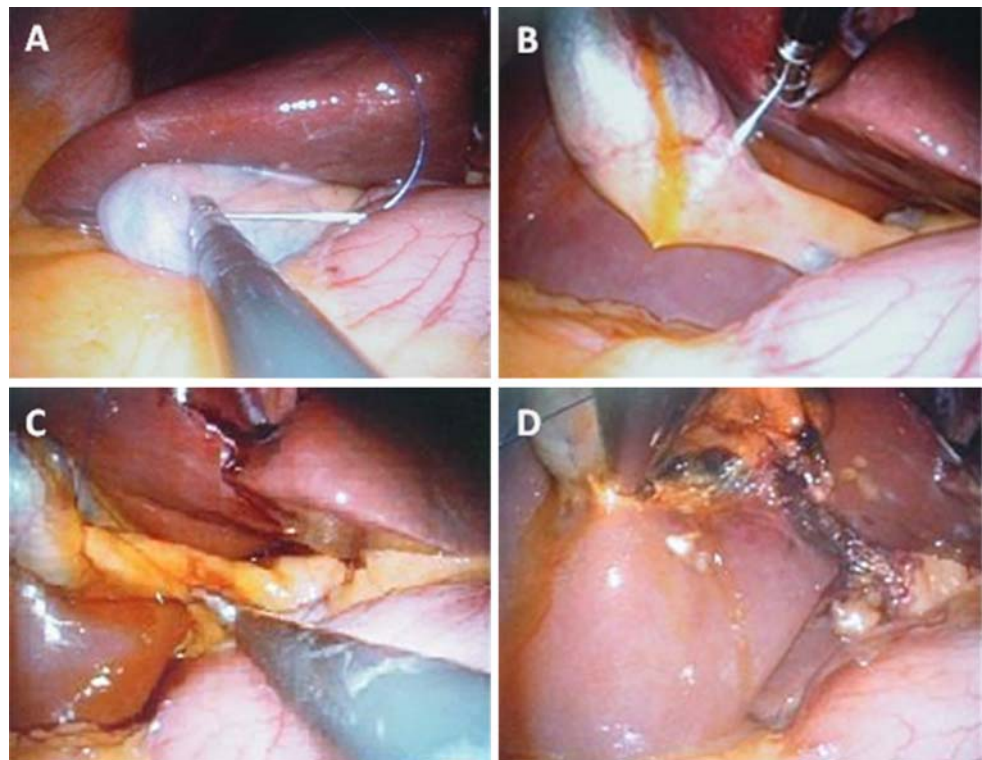
Any adhesions to the fundus of the gallbladder are dissected free as the fundus is made visible. A 2–0 polypropylene suture on a Keith needle is inserted through the abdominal wall subcostally at approximately the mid-clavicular line. This needle is then grasped intracorporally and placed through the fundus of the gallbladder. The needle is then returned through the abdominal wall near the original insertion. With retraction, the fundus of the gallbladder is lifted to the anterior abdominal wall, exposing the infundibulum of the gallbladder as well as the triangle of Callot (Fig. 1). A second suture is then inserted subxiphoid through the skin, grasped, and then placed through the infundibulum in a medial to lateral direction. This suture is then placed, quite laterally on the patient’s right, through the abdominal wall. A 5-mm clip applier is then inserted through the working port, and clips are applied to the medial and lateral aspects of the infundibulum at the insertion and exit of the latter suture. This permits a “puppeteering” of the infundibulum to allow excellent exposure of Callot’s triangle and the liver–gallbladder interface. Attention is then turned to the dissection of the cystic duct. This may be facilitated by the use of articulating laparoscopic dissectors. The cystic duct and artery are dissected free, clipped, and divided.

The gallbladder is then dissected free off the liver bed with hook cautery. After the gallbladder is free, it is grasped with a locking grasper and withdrawn through the umbilicus as both ports are removed. The umbilical port is dilated and, if needed, the two fascial incisions are joined and the gallbladder drained to facilitate removal. The umbilical incision is closed with fascial and skin sutures.

Results

Twenty-nine patients underwent LESS cholecystectomy from November 2007 through May 2008 (Table 1). Median age of patients undergoing LESS cholecystectomy was 51 years. Twenty-nine patients underwent standard laparoscopic cholecystectomy (three- or four-port cholecystectomy through three or four incisions, including the umbilicus). The median age of patients undergoing standard cholecystectomy was 46 years. Median body mass index (BMI) for all patients was 28 kg/m². No patients had acute cholecystitis; 22 patients undergoing LESS cholecystectomy and 21 patients undergoing multiport, multi-incision

Figure 1 A Keith needle is placed through the fundus of the gallbladder to provide initial exposure (a). A second Keith needle is placed near the gallbladder infundibulum to facilitate exposure of the cystic duct and artery (b). Suture retraction of both the fundus and infundibulum provide excellent exposure for dissection (c). After identification and clipping of the cystic duct and artery, the gallbladder is dissected from the liver using electrocautery (d).



laparoscopic cholecystectomy had chronic cholecystitis. Operative time for patients undergoing LESS cholecystectomy was 72 min (74 min \pm 17.3) vs. 66 min (71 min \pm 16.3) for those undergoing standard laparoscopic cholecystectomy ($p=0.46$). All patients had less than 100 cc of estimated blood loss. No patients required conversion to an “open” operation. Two patients undergoing LESS cholecystectomy required placement of additional trocar(s) away from the umbilicus in order to facilitate exposure. These patients were considered to have undergone LESS cholecystectomy for the purposes of the comparison. No major postoperative complications occurred in any patients. Two patients undergoing LESS cholecystectomy required extended postoperative stays for pain control. One patient undergoing LESS cholecystectomy required catheter insertion for

urinary retention. Length of stay for patients undergoing LESS cholecystectomy was 1 day (1 day \pm 0.61) vs. 1 day (1 day \pm 0.51) for those patients undergoing standard laparoscopic cholecystectomy ($p=0.81$). No biliary injuries or complications occurred in any patients.

Discussion

LESS, driven by consumer demand and fueled by technological explosion, is the next step along the path to incisionless procedures. LESS allows the incision to be hidden in the umbilicus. Unlike NOTES, which faces obvious hurdles in safety,¹⁵ single incision transumbilical laparoscopy, e.g., LESS cholecystectomy, is ready for

Table 1 A Comparison of 29 LESS Cholecystectomies vs. 29 Multiport, Multi-incision Laparoscopic Cholecystectomies

	Single-incision laparoscopic cholecystectomy	Multiple-incision laparoscopic cholecystectomy	p value
Number of patients	29	29	N/A
Gender	6 males/23 females	9 males/19 females	NS
Age	51 years (50 years \pm 16.2)	46 years (48 years \pm 16.7)	NS
BMI	28 kg/m ² (28 kg/m ² \pm 5.5)	28 kg/m ² (29 kg/m ² \pm 7.0)	NS
Length of operation	72 min (74 min \pm 17.3)	66 min (71 min \pm 16.3)	NS
Blood loss	Minimal in 100%	Minimal in 100%	NS
Pathology	Chronic cholecystitis (76%)	Chronic cholecystitis (72%)	NS
Complications	Pain control (2) Urinary incontinence (1)	None	NS
Length of stay	1 day (1 day \pm 0.61)	1 day (1 day \pm 0.51)	NS

widespread implementation. We have outlined a safe technique for LESS cholecystectomy, which can be undertaken safely and with similar operative time. Exposure is nearly equivalent to standard laparoscopic cholecystectomy, and any inadequacies can be remedied with the addition of a 3- to 5-mm trocar away from the umbilicus. This report documents the largest LESS experience to date and serves as the prelude to a randomized prospective trial comparing LESS cholecystectomy with standard laparoscopic cholecystectomy.

The BMI of patients undergoing LESS cholecystectomy were similar to patients undergoing multiport, multi-incision laparoscopic cholecystectomy in this report. As a group, these patients are representative of the average patients presenting with complaints of biliary pathology to general surgeons across America. In other words, patients undergoing LESS cholecystectomy in this report did not represent a highly selected group of patients based upon anticipated technical ease, with the exception of patients with acute cholecystitis. All patients seen in clinic during the 6-month period specified were offered LESS cholecystectomy. After a detailed explanation of the procedure, 20 patients refused in favor of a standard laparoscopic cholecystectomy. The reason for this refusal varied from patient to patient but was felt by the surgeon obtaining consent to be related to the nascent procedure about which definitive conclusions regarding safety and complication rates could not be given. It was not and is not our practice to coerce patients after any hesitation or indecisiveness.

Additional 5-mm trocars were placed in two patients undergoing LESS cholecystectomy. An additional trocar was placed in one patient because of a bleeding cystic artery. Retrospectively, this was felt to be unnecessary by the operating surgeon but demonstrates the importance of a conservative approach during the learning curve for any procedure. In a second patient, an additional trocar was placed away from the umbilicus because of failure to adequately delineate the anatomy of Callot's triangle. This patient also had a second additional trocar placed away from the umbilicus to assure avoidance of injury to the common bile duct.¹⁶ We did not consider placing a third trocar through the umbilicus, although this technique has been utilized at our institution for LESS Nissen funduplications and LESS Heller myotomies (data not yet reported). In our experience, a third trocar through the umbilicus is technically more restrictive for the operating surgeon. Furthermore, with difficult exposure, we feel that the addition of trocar in a standard (i.e., non-umbilical) location is safest and more expedient, especially with this new technique.

Two patients undergoing LESS cholecystectomy requested to stay an additional night in the hospital for pain control. Both patients were discharged on postoperative

day number two. Interestingly, both patients complained of subcostal pain despite only an umbilical incision. Although no conclusions can be drawn from two patients, the potential for better pain control with a single incision certainly will require formal evaluation to substantiate this claim.

Scattered reports of different techniques for LESS cholecystectomy have been reported in the literature and have utilized several acronyms including SILS (single-incision laparoscopic surgery) and SPA (single-port access).^{3–6,8} The technique we have developed utilizes a single umbilical incision without the expense of increased operative time. There is essentially no learning curve to this approach; operative times were consistently similar from the time of the very first LESS cholecystectomy to the 29th LESS cholecystectomy. Only techniques necessary for standard laparoscopic cholecystectomy are required to undertake and complete LESS cholecystectomy. We believe that the ease of the operation is largely facilitated by the exposure provided by suture retraction. Furthermore, we do not feel that the use of suture retraction away from the umbilicus detracts from this single site procedure any more so than percutaneous local anesthetic “needle-stick” injection at the end of the case.

We recommend LESS cholecystectomy for patients with uncomplicated gallbladder pathology and biliary anatomy not distorted by inflammation. This is a safe alternative to standard laparoscopic cholecystectomy and can be done with comparable operative times. Currently, provisions are underway at our institution to evaluate this technique in a randomized controlled trial to document, not only safety and feasibility but also patient satisfaction, postoperative pain, and cosmesis.

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