

Advantages of Minimal Incision Laparoscopic Cholecystectomy

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ABSTRACT: **Background:** Modifications to conventional laparoscopic cholecystectomy (CLC) are aimed at decreasing abdominal wall trauma and improving cosmetic outcome. Although single-incision laparoscopic surgery (SILS) provides excellent cosmetic results, the procedure is technically challenging and expensive compared to the conventional laparoscopic approach.

Objectives: To describe a novel, hybrid technique combining SILS and conventional laparoscopy using minimal abdominal wall incisions.

Methods: Fifty patients diagnosed with symptomatic cholelithiasis were operated using two reusable 5 mm trocars inserted through a single 15 mm umbilical incision and a single 2–3 mm epigastric port. This technique was dubbed “minimal incision laparoscopic cholecystectomy” (MILC).

Results: MILC was completed in 49 patients (98%). In five patients an additional 3 mm trocar was used and in 2 patients the epigastric trocar was switched to a 5 mm trocar. The procedure was converted to CLC in one patient. Mean operative time was 29 minutes (range 18–60) and the average postoperative hospital stay was 22 hours (range 6–50). There were no postoperative complications and the cosmetic results were rated excellent by the patients.

Conclusions: MILC is an intuitive, easy-to-learn and reproducible technique and requires small changes from CLC. As such, MILC may be an attractive alternative, avoiding the cost and complexity drawbacks associated with SILS.

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KEY WORDS: minimal incision laparoscopic cholecystectomy (MILC), single-incision laparoscopic surgery (SILS), gallbladder, cholecystectomy

newer techniques and modifications were suggested in an attempt to further reduce the pain, rate of surgical site infection, and scarring associated with multiple port sites [3–8]. Of these techniques, single-incision laparoscopic surgery has become an increasingly popular approach to CLC. Proponents of this approach claim that SILS provides several advantages over CLC, including decreased trauma to the abdominal wall and improved cosmetic outcome [9]. However, SILS has not been widely accepted for several reasons. Firstly, the introduction of surgical instruments and camera through the same entry point carries inherent difficulty in achieving triangulation and sufficient exposure of the surgical field. This leads to several opportunities for instrument clashes and obstruction of camera view. The parallel movement of SILS instruments allows mostly single-axis dissection and manipulation which limits the ability to obtain the “critical view” of the triangle of Calot, and thereby potentially hampers procedure safety. Secondly, the procedure is difficult to standardize due to the diversity of dedicated surgical instruments with corresponding multiple techniques, requiring a steep learning curve [10,11]. Thirdly, most dedicated access ports and articulating tools are costly and add substantial expense to the procedure. As cost containment is becoming an important issue, added costs to a well-accepted procedure with no substantial benefit addition impedes SILS acceptance as standard of care. Another challenge in SILS is organ retraction. Retracting an organ in order to obtain a clear view of the critical dissection area is usually done with a static grasper through a separate port. Providing retraction without introduction of an additional port is challenging. The use of sutures, magnets and needles has been reported, but all were found to have significant drawbacks [12]. Recently, two novel stand-alone retracting devices which reproducibly provide sound retraction (EndoGrab™ and EndoLift™, Virtual Ports, Misgav, Israel) were introduced [11]. These devices are deployed in the abdominal cavity using a designated introducer. After they are anchored to the internal abdominal wall and obtain adequate retraction they are disconnected from the introducer and free the trocar for other instruments.

Shortly after its introduction by Mühe in 1985, laparoscopic cholecystectomy has become the gold standard treatment for symptomatic cholelithiasis [1,2]. CLC is commonly performed using two 10 mm and two 5 mm trocar ports. Recently,



Figure 1. Surgical technique – external view. Two 5 mm low profile reusable trocars are introduced via a single 15 mm skin incision at the umbilicus. A 3 mm port is placed at the epigastrium. The surgeon is at the patient's left, the assistant on the patient's right

We have designed a laparoscopic procedure, coined minimal incision laparoscopic cholecystectomy. The procedure intends to provide the potential benefits of SILS, yet maintain the simplicity and safety of CLC. As such, MILC may result in similar cosmetic results and pain scores as SILS while simultaneously maintaining proper laparoscopic principles at reduced costs.

PATIENTS AND METHODS

Between September 2010 and June 2012, 50 consecutive patients with symptomatic cholelithiasis were treated with MILC. Obese patients (body mass index > 35 kg/m²), patients with acute cholecystitis, and patients with history of median laparotomy were excluded from the study. Patients were selected for MILC when a trans-umbilical incision was judged to be anatomically feasible by the surgeons.

OPERATIVE TECHNIQUE

Preoperative preparation was performed according to common surgical practice, with patients under general anesthesia in supine anti-Trendelenburg position with slight left rotation. The surgeon was positioned on the left side of the patient with the assistant on the opposite side. The monitor was placed above the right shoulder of the patient [Figure 1].

The procedure started with a 15 mm incision in the umbilicus [Figure 1]. The incision was performed according to the individual shape and size of the umbilicus, aimed to achieve the best possible cosmetic result. A Veress needle was intro-



Figure 2. Surgical technique – internal view. The gallbladder is retracted supero-laterally by the EndoGrab™ device, facilitating dissection of the structures at the Calot triangle

duced and the abdomen insufflated with CO₂ to a pressure of 12 mmHg. After pneumo-peritoneum was achieved, a reusable low profile 5 mm trocar was introduced (Yellow Port, Surgical Innovation, Littleton, CO, USA). A 5 mm 30° laparoscope (Karl Storz GmbH & Co. KG, Germany) was inserted and the abdomen explored. Next, a second low profile trocar was inserted through the same umbilical incision. We found that retracting the skin and placing the two trocars on a transverse axis as far as possible from each other made the procedure easier to perform. An additional 3 mm trocar (Karl Storz GmbH) was introduced in the epigastrium [Figure 1]. The gallbladder was lifted with a 3 mm grasper (Karl Storz GmbH) and anchored to the internal abdominal wall using an EndoGrab™ (Virtual Ports, Misgav, Israel) [Figure 2]. A reusable 5 mm articulating grasper (Snowden-Pencer, Carefusion, Waukegan, IL, USA) was applied through the right umbilical port to retract Hartmann's pouch laterally, thus exposing the triangle of Calot. This provided a direct line of vision towards the gallbladder with the surgeon's left hand retracting Hartmann's pouch and right hand performing the dissection in the TOC using a 3 mm dissector or hook (Karl Storz GmbH), thus mimicking the ergonomics and viewing angles of conventional laparoscopic cholecystectomy. After the cystic duct and artery were identified and dissected, they were clipped using a 5 mm clip applicator (Covidien, Mansfield, MA, USA) introduced through the umbilical port and divided with scissors. The gallbladder was dissected off the liver bed using the same instruments. After the gallbladder dissection was completed, it was grabbed at the cystic duct with an Endo-Loop™ (Ethicon Endo-Surgery, Cincinnati, OH, USA) and brought close to the umbilical port. The abdomen was then checked for bleeding and the epigastric port was removed under vision. The two umbilical ports were removed and the two entry ports joined to form a 15 mm transverse fascial incision allow-

MILC = minimal incision laparoscopic cholecystectomy

TOC = triangle of Calot

ing extraction of the gallbladder. The fascia was closed with an absorbable suture, and the skin incision with two intradermal sutures. The epigastric stab wound was taped. Following surgery the patients were allowed to drink and eat as tolerated, and were discharged as soon as their discomfort level allowed.

The data collected included patients' clinical characteristics, operative time, length of hospital stay, deviation from the described procedure (addition of port sites), and need to convert to alternative methods. Adverse events were recorded. Outpatient follow-up was performed after 1–2 weeks and again after 3 months. At their final follow-up, patients were asked to rate the cosmetic results as poor, fair, good, or excellent.

RESULTS

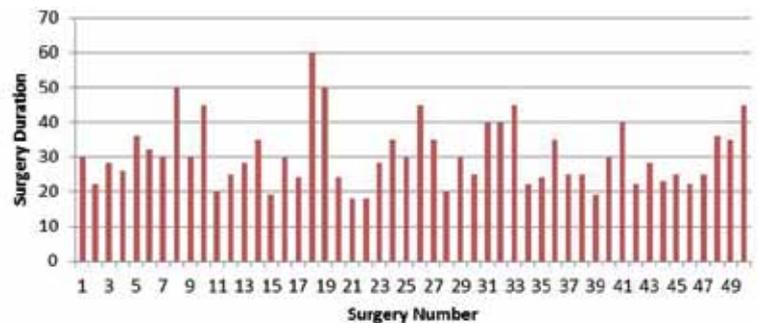
Fifty patients (47 females) were enrolled in this study. The median age of patients was 36.5 years (range 17–62 years). The median operative time, from first incision to completion of skin closure, was 29 minutes (range 18–60 minutes). Operative times were not influenced by case number progression [Figure 3], implying that there was not a significant learning curve involved. It should be noted, however, that all surgeons participating in this study were well-trained laparoscopic surgeons. In eight cases (16%) an additional 3–5 mm trocar was required to complete the operation. In this group of patients the mean operative time was longer compared to procedures performed without the need for an additional port (42.5 compared to 27 minutes, respectively), but this difference was not statistically significant ($P = 0.1$). Conversion to traditional laparoscopic cholecystectomy occurred in one case (2%) due to troublesome bleeding that necessitated a 5 mm suction device. All operations were completed with negligible blood loss and no intraabdominal injuries. No postoperative complications were encountered in this small group, namely, wound infection or bile leak.

The average hospital stay was 22 hours (range 6–50 hours) and depended on the discomfort level of the patients. Follow-up was performed 1–2 weeks following surgery and again at 3 months. One patient complained of sustained upper abdominal pain 1 week after the operation. Blood tests and abdominal ultrasound were normal, and the pain spontaneously subsided within 30 days postoperatively. At the 3 month office visit the patients were asked to rate their satisfaction with the cosmetic result. All patients who had a completed MILC were highly satisfied and rated the results as excellent.

DISCUSSION

CLC is the gold standard operation for symptomatic cholelithiasis [3,5,7,13]. The advantages of CLC over open cholecystectomy have been extensively reported and include

Figure 3. Operative time learning curve. The time of operation was plotted against consecutive operations. No significant changes were found between the initial and final operations



preservation of abdominal wall integrity, lower wound-related complications (infection and hernia), lower pulmonary complications, diminished analgesic requirements, decreased operative trauma, faster recovery, and improved cosmetic outcomes [8,14]. Different technical modifications have been suggested, including the reduction of working port number and the use of mini-instruments. This may be accomplished by the introduction of smaller-caliber laparoscopic instruments, improved optics and better light sources. Downsizing the port incision and reducing the number of port incisions were shown to reduce the magnitude of postoperative pain, decrease discomfort, and improve cosmetic results with minimal scarring [6,15-17]. Trans-umbilical endoscopic surgery and SILS are two techniques that employ these modifications [18]. Both procedures introduce three ports placed in a co-axial arrangement, leading to loss of triangulation, conflict between instruments, and compromised gallbladder retraction. The use of these instruments requires the adaptation of new technical capabilities with the right hand operating the left-sided instrument, while the left hand operates the right-sided instrument. This results in a steep learning curve [19]. All these techniques are challenging and result in longer operative times.

In order to facilitate this type of surgery, the medical device industry is constantly introducing new tools to resolve these problems. However, this generally increases the cost of the procedures [22]. Our preliminary experience with MILC suggests that this novel technique may provide a safe and effective alternative that combines the advantages of four-port CLC with the minimally invasive surgical approach. Indeed, we found several advantages with this technique. First, since the operative principles are intuitive and resemble CLC, no learning curve was required [Figure 3]. The surgeon and assistant are situated far enough from each other to avoid arm and instrument collision or crossing, thereby allowing a broad range of motion. Thus, the simplicity of this technique contributes to shorter operative times and a minimal learning curve. The mean operative time for MILC was 29 minutes,



Figure 4. Excellent cosmetic results

significantly shorter than that reported for SILS: 118 minutes in a review of 29 studies [19]. Whereas no learning curve was required for MILC, studies have shown that a steep learning curve is required for SILS in order to reduce surgery time from 100–150 minutes to 50–100 minutes [11]. Second, we found that the conversion and complication rates were very low with this procedure. There was one (2%) conversion to CLC and no complications compared to the reported 5% conversion rate and approximately 5% complication rate for SILS [19]. Finally, the equipment used is mostly standard and intended for multiple uses, thereby maintaining a cost similar to that of CLC. The only disposable instruments are a 5 mm clip applier and the EndoGrab™, with a combined average cost of a single disposable trocar.

In summary, MILC seems safe, easy to perform, utilizes mostly multiple-use traditional equipment, and provides excellent cosmetic results [Figure 4]. The technique is intuitive and ergonomically mimics CLC.

“The gods too are fond of a joke”

Aristotle (384-322 BCE), Greek philosopher

“A man should never be ashamed to own he has been in the wrong, which is but saying, in other words, that he is wiser today than he was yesterday”

Alexander Pope (1688-1744), English poet, best known for his satirical verse and for his translation of Homer

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