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Single-incision laparoscopic cholecystectomy: is it more than a challenge?

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Abstract
Background Single-incision laparoscopic surgery (SILS) is a promising technique with regard to reducing postoperative pain, decreasing complications, and improving cosmesis.
Methods Between September 2008 and April 2009, 20 patients underwent cholecystectomy via SILS. The umblicus was the access point of entry to the abdomen for all the patients.
Results Of the 20 cholecystectomies, 19 were performed with SILS. Failure of trocar insertion was the reason for conversion with the first patient. No complications or mortalities were associated with the technique. The mean operating time was 94 min.
Conclusion The use of SILS for cholecystectomy is safe and feasible with reasonable operation times.

Keywords Cholecystectomy · Single-incision laparoscopic surgery

Currently, laparoscopic cholecystectomy (LC) is indisputably regarded as the gold standard for the treatment of symptomatic gallbladder stone disease, even in the case of acute cholecystitis [1, 2]. In recent years, natural orifice transluminal endoscopic surgery (NOTES) has been offered as the next generation of minimally invasive surgery with no scars [3, 4]. However, serious drawbacks specifically belonging to this technique such as access, safety of closure, infection, lack of appropriate instrumentation, and difficulty in orientation have discouraged the use of NOTES procedures [5].

Because of the inconvenience associated with NOTES, single-incision laparoscopic surgery (SILS) [6] has gained greater interest and popularity in the surgical community. Several reports of this novel technique have been published. Almost all of these reports are from academic centers and documented by authors with esteemed expertise in advanced laparoscopic procedures. Nevertheless, in describing their own techniques, these authors have introduced differing terminologies, resulting in a confusing nomenclature. Together with SILS, the terms transumblical endoscopic surgery (TUES) [7], laparoendoscopic single-site surgery (LESS) [8], natural orifice transumblical surgery (NOTUS) [9], and single laparoscopic incision transabdominal surgery (SLIT) [10] are used to denote laparoscopic surgical procedures performed by a single incision with some variations.

Whatever the terminology, all the reports separately emphasize the feasibility and safety of the described techniques. In this study, we report our initial experience with cholecystectomy via SILS with a series of 20 patients.

Patients and methods

Between September 2008 and April 2009, 20 patients underwent cholecystectomy via SILS. All the patients had a previous diagnosis of symptomatic gallbladder stone disease with no acute attacks of inflammation. The patients' histories and clinical assessments were verified by ultrasonography. Also, the patients had no contraindications for conventional LC. They were informed about the novel technique, and written consent was provided by each patient.

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Operative technique

The operative technique was fundamentally similar to that described by Tacchino et al. [6] with some modifications. Unlike their described approach, we did not consider it a requirement to empty the gallbladder. In contrast, we considered it more facile to recognize and subsequently dissect the borders of a full gallbladder than to empty one. Another difference was that only one straight-needle suture placed on the fundus of the gallbladder was sufficient in our series to expose the triangle of Calot instead of two sutures. Additionally; while pinning, we found it wise to obey the rules of chest tube insertion to avoid bleeding or a hematoma on the abdominal wall due to a disruption of the intercostal vessels. For favorable results, the location of the suspending suture usually must be in the thoracoabdominal region.

Besides these two small differences, we performed cholecystectomy via SILS according to the description of Tacchino et al. [6]. The abdominal cavity was insufflated with carbon dioxide via a Versastep Veress needle (Versa-Step, 5 mm; Covidien, USA) until a pressure of 12 mmHg was reached. Three 5-mm trocars were placed separately on the abdominal fascia through one 10- to 15-mm intraumblical skin incision. One 30° scope and two articulating instruments (Roticulator Endo Grasp and Roticulator Endo Dissect, 5 mm; Covidien) were used for the procedure.

The patient was in the anti-Trandelenburg left-rotated position as for a conventional LC. Both the surgeon and the camera assistant were on the left side of the operating table oriented toward the monitor on the opposite side. Due to the articulation of the instruments, the grasper and the dissector were handled in a reverse manner for dissection of the structures, as shown in Fig. 1. The gallbladder was dissected in a retrograde manner. At this point, for approximation to the fundus of the gallbladder, we suggest that the suspending suture be relaxed by 1 to 2 cm to help disclose the dissection plane.

Fig. 1 Dissection of the triangle of Calot with articulating instruments

Fig. 2 Umblical incision after 7 days

After the dissection, one of the trocars was replaced by a 10-mm trocar, and the gallbladder was removed inside a bag (Endo Catch Gold, 10 mm; Covidien). After hemostatic control, the trocar sites on the fascia and the skin incision were closed with absorbable sutures (Fig. 2).

Results

The characteristics of the patients and the data belonging to the operations are detailed in Table 1. The mean age of the patients was 44.9 years (range, 18–82 years), and the mean body mass index (BMI) was 26.5 (range, 22–34). Of the 20 patients, 19 underwent surgery with SILS. Conversion to conventional LC was required only for the first patient because of a failure in trocar insertion. The second and third trocars were too close, and an incompetent fascial bridge between the trocars caused uncontrollable gas leakage from the trocar sites. Inadequate pneumoperitoneum did not allow us to perform cholecystectomy via SILS, and we were compelled to insert an additional trocar away from the umblicus. The mean operative time for the cholecystectomies using SILS was 94 min.

The postoperative courses of all patients were uneventful. All were allowed to feed orally the night after the operation, and all were discharged from the hospital the next day. They were contacted on postoperative day 7. None complained about the operation, and there were no complications involving the intraumblical incision.

Table 1 Patient characteristics and operative data

	Age	Sex	ASA score	BMI	Technique	Operation time (min)
1.	30	F	1	29	Conversion to LC	115
2.	54	F	2	24	SILS	110
3.	45	F	2	28	SILS	125
4.	18	F	1	23	SILS	130
5.	44	F	2	25	SILS	90
6.	65	F	2	26	SILS	105
7.	53	F	2	29	SILS	95
8.	56	F	2	27	SILS	100
9.	38	F	2	33	SILS	90
10.	44	F	2	34	SILS	115
11.	28	F	1	22	SILS	90
12.	27	F	1	22	SILS	85
13.	31	F	1	25	SILS	100
14.	28	F	1	24	SILS	70
15.	45	F	2	27	SILS	85
16.	82	F	2	26	SILS	95
17.	59	F	2	28	SILS	100
18.	52	F	2	29	SILS	90
19.	48	M	2	29	SILS	80
20.	51	M	2	25	SILS	105

ASA American Society of Anesthesiology, *BMI* body mass index, *LC* laparoscopic cholecystectomy, *SILS* single-incision laparoscopic cholecystectomy

Discussion

In this study, we concluded that cholecystectomy via SILS with transumblical access is a feasible, safe, and reproducible technique. The most important feature of cholecystectomy via SILS that discriminates it from NOTES is the feasibility of the technique with existing instruments. Also, the orientation and safety landmarks suggested for conventional laparoscopic cholecystectomy are not different for this technique [11].

However, these points should not engender an underestimation of the potential danger. It is well known that early experiences with LC are associated with higher rates of bile duct injuries [12]. Nevertheless, including LC in residency training programs has dramatically decreased those injuries [13]. Currently, in contrast to cholecystectomy, the majority of the residency training programs do not include advanced laparoscopic procedures, and many surgeons are not familiar with the articulating instruments. Additionally; not only the surgeon but also the camera assistant must be familiar with reverse handling of the grasper and dissector. Therefore, the learning curve will be related directly to the experience and proclivity of the surgeon and his or her team.

Moreover, patient-related factors definitely affect the success rates, particularly in the learning period. It was previously reported that the incidence of bile duct injury is three times higher with LC used for cases of acute cholecystitis than with elective cholecystectomy [11]. Indeed, these considerations were the main reasons why the cohort in this study was composed of patients without any signs of inflammation. Also, the patients were selected from those without any coexistent diseases or higher BMIs. These selection criteria provided us facility in the learning period with reasonable operation times.

As seen in Table 1, the operation times decreased considerably after the first four cases and were comparable with those for LC. Eventually, our preliminary experiences supported the previous studies, suggesting the feasibility of cholecystectomy using SILS.

As a novel technique, cholecystectomy via SILS has introduced some advantages of its own. The prominent expectations for the short and long terms are lower rates for pain, infection, and herniation. However, no prospective study has shown the superiority of SILS with regard to postoperative pain despite the existence of such an opinion. We currently are executing a prospective study concerning this issue and believe that many similar studies will be published very soon.

In contrast, incidences of trocar-site infection and herniation are well documented. After LC, the rate for infection is reported to be 2% compared with 5.2% for herniation [14, 15]. Considering the prevalence of LC worldwide, these numbers should not be ignored. Reasonably lessening the number of trocars will lead to a decrease in the complication rates. Nevertheless, both complications commonly locate at the umblicus [14, 15]. Therefore, insertion of more than one trocar at this site may show surprising results in prospective studies.

To date, it is reassuring that such a hazard has not been reported with preliminary experiences in cholecystectomy via SILS. In our series, we also did not face wound problems.

In conclusion; the development of minimally invasive surgery has given us cholecystectomy via SILS with no visible scars. As long as evidence accumulates concerning the safety of this feasible technique, cholecystectomy via SILS will pioneer more complex procedures, as in the early era of conventional laparoscopy.

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