

Single-incision laparoscopic cholecystectomy: from four wounds to one

Jeff SW Wong 王韶宏
 YS Cheung 張宇新
 KW Chan 陳建榮
 Charing CN Chong 莊清寧
 KF Lee 李傑輝
 John Wong 黃創
 Paul BS Lai 賴寶山



A video of single-incision laparoscopic cholecystectomy is available at <www.hkmj.org>.

Key words

Cholecystectomy, laparoscopic; Cholelithiasis; Treatment outcome

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Division of Hepatobiliary and Pancreatic Surgery, Department of Surgery, Prince of Wales Hospital, The Chinese University of Hong Kong, Shatin, Hong Kong

JSW Wong, FRCSEd (Gen)

YS Cheung, FRCSEd (Gen)

CCN Chong, FRCSEd (Gen)

KF Lee, FRCSEd (Gen)

J Wong, FRCSEd (Gen)

PBS Lai, FRCSEd (Gen), MD

Department of Surgery, Alice Ho Miu Ling Nethersole Hospital, Tai Po, Hong Kong

KW Chan, FRCSEd (Gen)

Correspondence to: Prof PBS Lai
 Email: paullai@surgery.cuhk.edu.hk

Objective To review the initial results and surgical outcomes of single-incision laparoscopic cholecystectomy.

Design Prospective case series.

Setting A university teaching hospital and a regional hospital in Hong Kong.

Patients All patients undergoing single-incision laparoscopic cholecystectomy from August 2009 to March 2011.

Results Fifty patients underwent single-incision laparoscopic cholecystectomy during the study period. The indications for surgery included symptomatic gallstones (n=43) and gallbladder polyps (n=7). The mean operating time was 78 (standard deviation, 24) minutes. Forty-five of the patients successfully underwent single-incision laparoscopic cholecystectomy, giving a success rate of 90%. In the remaining five patients, additional working ports were constructed to obtain better exposure and dissection around Calot's triangle. On comparing the results of the initial 25 cases to the subsequent 25 cases, in the latter group the operating time was significantly shorter (86 vs 71 minutes; P=0.02), and the success rate was higher (80% vs 100%; P=0.05). During the median follow-up period of 6.8 months, four patients had complications, which included: postoperative urinary retention (n=2), one each with a haematoma and an incisional hernia. No patient endured bile duct injury, postoperative bile leakage, or haemorrhage in our series.

Conclusion Single-incision laparoscopic cholecystectomy is feasible and safe for treatment of uncomplicated gallbladder diseases. There was a reduction in the operating time and increase in success rate with accumulation of experience. Nevertheless, surgeons should be cautious about the potential risks of this new technique.

New knowledge added by this study

- Single-incision laparoscopic cholecystectomy (SILC) is feasible and safe for patients with uncomplicated gallbladder diseases.
- With the accumulation of operative experiences in SILC, surgeons can reduce operating times and conversion rates.

Implications for clinical practice or policy

- SILC is an alternative procedural option to four-port laparoscopic cholecystectomy for patients with uncomplicated gallbladder disease.

Introduction

Surgery of the gallbladder has evolved tremendously over the last century. Nowadays, laparoscopic cholecystectomy is the gold standard for gallbladder removal and the most common laparoscopic procedure worldwide. Many studies have shown its benefits over open cholecystectomy in terms of less postoperative pain, faster recovery, and shorter hospital stays. Recent research has focused on whether further reduction of skin incisions could result in better postoperative outcomes. Against this background, single-incision laparoscopic surgery (SILS) has recently emerged as another approach for cholecystectomy. The feasibility of single-incision laparoscopic cholecystectomy (SILC) has been reported widely in the literature.¹⁻⁴ With a reduced number of skin incisions, theoretically there may be less postoperative pain, a better cosmetic outcome, and higher patient satisfaction than conventional laparoscopic cholecystectomy. We would therefore like to share our experience and outcomes on our first 50 cases of SILC.

單切口腹腔鏡膽囊切除術： 從傳統的四孔法發展至單孔手術

- 目的** 回顧單切口腹腔鏡膽囊切除術的初步成效及術後結果。
- 設計** 前瞻性病例系列研究。
- 安排** 香港一所大學教學醫院及一所分區醫院。
- 患者** 2009年8月至2011年3月期間所有接受單切口腹腔鏡膽囊切除術的病人。
- 結果** 共50名病人在研究期間接受了單切口腹腔鏡膽囊切除術；當中7名病人患有膽囊息肉，另外43名病人患有膽結石。手術平均時間為78分鐘（標準差24分鐘）。其中45名患者成功完成了單切口腹腔鏡膽囊切除術，成功率為90%。其餘5名患者需要另外加設腹腔鏡管道來改善膽囊三角的視野，以達至成功的切除。將前25個病例與後25個病例作比較，後者的手術時間明顯較短（86比71分鐘； $P=0.02$ ），成功率亦較高（80%比100%； $P=0.05$ ）。中位數為6.8個月的術後跟進期間，出現了4宗併發症，其中包括兩宗術後尿瀦留，一宗傷口積血以及一宗切口疝氣。所有病人均沒有出現膽管受損、膽汁滲漏或術後出血等嚴重併發症。
- 結論** 對於一般膽囊疾病，單切口腹腔鏡膽囊切除術是一種可行及安全的方法。隨着經驗的累積，手術時間可得到縮短，成功率也有所提升。當然醫生亦要注意此新技術的潛在風險。

Methods

In what we considered a pilot study, from August 2009 to March 2011, we performed SILC on 50 patients who suffered from symptomatic gallstones and gallbladder polyps. Patients were excluded if

they were older than 70 years; had American Society of Anesthesiologists (ASA) scores of higher than 2; a previous history of cholecystitis, cholangitis or pancreatitis; or radiological finding of chronic cholecystitis or suspected gallbladder carcinoma. All procedures were performed or supervised by a single specialist in hepatobiliary surgery. Operations were carried out at the Prince of Wales Hospital and the Alice Ho Miu Ling Nethersole Hospital in Hong Kong. The latter hospital provides short-stay surgery services within the same cluster. Most of the patients stayed in the ward for overnight observation after surgery. The primary outcomes were operating time, the success rate, the complication rate, and duration of hospital stay. In addition, we compared outcomes of the first 25 cases to the subsequent 25 cases, in order to detect any differences after accumulation of operative experience. The duration of the operation was defined as the time interval between the initial skin incision and skin closure.

Operative technique

All surgical procedures were performed in the reverse Trendelenburg position with the table tilted downward to the patient's left. The operating surgeon and assistant were standing at the left side of the patient. A 2-cm skin incision was made in the para-umbilical region. A single 10-mm trocar was inserted by open technique and a diagnostic laparoscopy was performed with a 5-mm laparoscope (5-mm 30-degree EndoEYE video laparoscope; Olympus, Tokyo, Japan). Another two 5-mm ports were introduced in a subcutaneous space slightly above the 10-mm port, one on the left and one on the right, leaving a small bridge of fascia between each port site to avoid leakage of pneumoperitoneum. In most of the cases, a straight-needle suture (2/0 polypropylene) was passed transabdominally into the right subcostal region and placed at the seromuscular layer of gallbladder fundus for suspension of the gallbladder from the abdominal wall. Hartmann's pouch was retracted with Endograsper rotulators (Covidien, Norwalk, CT, US) for exposure of Calot's triangle. Dissection was performed with an ultrasonic device (SonoSurg, Olympus, Tokyo, Japan) and standard laparoscopic instruments. Calot's triangle was dissected in the usual manner to obtain a critical view. After identification of both the cystic artery and cystic duct, they were clipped with 10-mm metal clips and 10-mm polydioxanone clips, respectively. The gallbladder was dissected away from liver with an ultrasonic or diathermy device. Then the gallbladder was retrieved within specimen retrieval bag (Endo-pouch, Unimax Medical Systems Inc, Taiwan), after removal of the suspending stitch from the abdominal wall. The umbilical fascia was closed with an absorbable suture. Intra-operative and postoperative photos are shown in Figures 1 and 2, respectively.

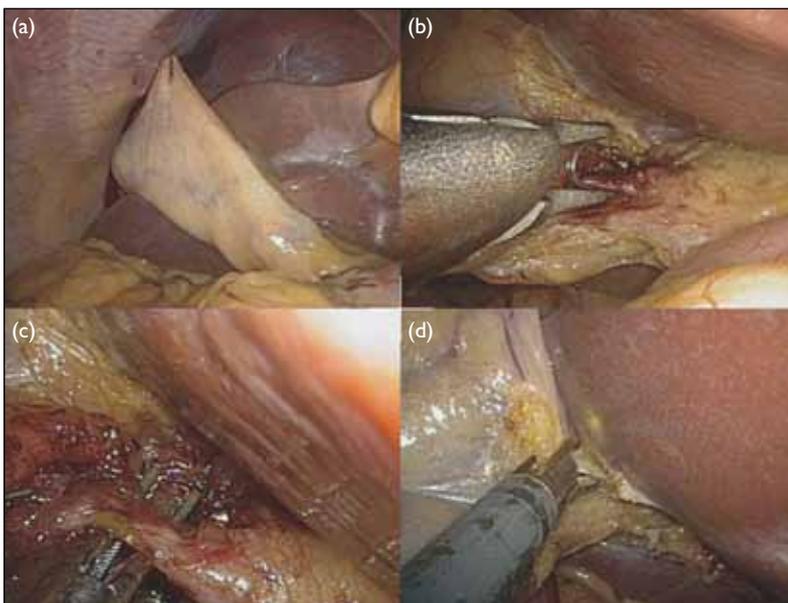


FIG 1. Intra-operative photos during single-incision laparoscopic cholecystectomy (a) Suturing of gallbladder fundus to anterior abdominal wall. (b) Clipping of the cystic artery. (c) Dissection of the cystic duct. (d) Dissection of gallbladder from liver bed

Statistical analysis

Outcome data were collected prospectively. Data were expressed as mean (standard deviation [SD]) or median (range). Continuous variables were compared using Student's *t* test or the Mann-Whitney *U* test as appropriate. Categorical variables were compared by the χ^2 test or Fisher's exact test, as appropriate. A statistically significant result was defined as $P < 0.05$. All statistical calculations were performed using the Statistical Package for the Social Sciences (Windows version 15.0; SPSS Inc, Chicago [IL], US).

Results

During the study period, 50 patients underwent SILC. Their mean (SD) age was 54 (10) years, and there were 15 males and 35 females. The mean (SD) body mass index was 23 (3) kg/m² and the median ASA score was 2 (range, 1-2). In 43 patients, the indication for cholecystectomy was symptomatic gallstones, and in 7 it was gallbladder polyps. Regarding operative outcomes, the mean (SD) operating time was 78 (24) minutes, and 45 patients successfully underwent SILC (success rate, 90%). The remaining five patients had additional working ports constructed or conversion to standard four-port laparoscopic procedures. The reasons for conversion were suboptimal view of Calot's triangle in two patients and dense adhesions around Calot's triangle in the other three patients. The median postoperative hospital stay was 1 day (range, 0-3 days). Immediate postoperative complications included two cases of postoperative urinary retention. During a median follow-up period of 6.8 months (range, 0.3-18.5 months), two more complications were observed, namely wound haematoma and incisional hernia. On comparing the first 25 patients with the subsequent 25, the latter had significantly shorter mean operating times (mean [SD]: 86 [23] vs 71 [21] minutes; $P = 0.02$), and higher success rates (80% vs 100%; $P = 0.05$), although this difference did not reach statistical significance (Table).

Discussion

Laparoscopic cholecystectomy is now the gold standard for treatment of benign gallbladder disease. In order to reduce postoperative pain and improve the cosmetic outcome, different technical modifications of laparoscopic cholecystectomy have been described. These include reducing the number of working ports,⁵ and the use of mini-laparoscopic instruments.⁶ The development of SILS is an even less invasive approach. The obvious benefit of SILC over conventional laparoscopic cholecystectomy is better cosmetic outcome. However, whether SILC causes less pain and better clinical outcomes is still under investigation.⁷⁻⁹ Nevertheless, the initial results



FIG 2. Postoperative photos of the umbilical wound

TABLE. Comparison of the first 25 cases and subsequent 25 cases of single-incision laparoscopic cholecystectomy

	First 25 cases*	Next 25 cases*	P value
Age (years)	55 ± 9	53 ± 11	0.52
Sex (M:F)	7:18	8:17	0.76
Body mass index (kg/m ²)	23 ± 3	22 ± 2	0.22
American Society of Anesthesiologists score	2 (1-2)	2 (1-2)	0.14
Operating time (mins)	86 ± 23	71 ± 21	0.02
Success rate	20/25 (80%)	25/25 (100%)	0.05
Postoperative hospital stay (days)	1 (1-3)	1 (0-2)	0.99
Pathology			1.00
Chronic cholecystitis	22	23	
Others†	3	2	

* Results are shown in mean ± standard deviation, No. (%) of patients, or median (range)

† Other pathologies included gallbladder adenoma, adenomyoma, and mucocele

from our centre showed that SILC for the treatment of uncomplicated gallbladder disease was safe and feasible.

Various operative techniques for SILC have been reported. Transumbilical access can be performed with a different single-port apparatus¹⁰⁻¹³ or using a single-incision multiport laparoscopic technique^{3,14-16} (as in our series). Besides, different techniques for gallbladder retraction have been reported and entail the use of transabdominal suture,^{3,17,18} transabdominal hooks,¹⁵ or a standard laparoscopic grasper.^{10,16} Regarding the different surgical techniques, it is essential to obtain a critical view of Calot's triangle in order to avoid biliary injury. In our initial few cases, the gallbladder was retracted by a laparoscopic grasper and a transabdominal suture was not routinely applied, for which reason exposure of Calot's triangle was found to be suboptimal. Thereafter, we tried to apply a transabdominal suture to Hartmann's pouch to attain better exposure, but the result was still unsatisfactory. Under these circumstances, additional working ports were applied to obtain the critical view. Finally, we modified our technique with routine suturing of the gallbladder fundus to the anterior abdominal wall and retracted Hartmann's pouch with a flexible endograsper so as to obtain the critical view. The conversion rate

was greatly reduced after this adaptation. Besides, after the first 25 patients and the accumulation of operative experience, the operating time was also significantly reduced. The other main reason for the reduced operating time and conversion rate was the accumulation of experience by the surgical assistant. With experience, the surgical assistant learnt how to cooperate with the operating surgeon in maintaining the laparoscopic view without hindering the surgeon's movements. Nevertheless, we still encountered patients with adhesions around Calot's triangle for which longer operating times and additional working ports for dissection became necessary.

Despite the feasibility of SILC, its safety is a matter of concern. A recent systematic review of 1166 cases of SILC showed that the overall success and complication rates were 91% and 6%, respectively.¹⁹ Complications included bile duct injury (0.1%), postoperative bile leakage (0.4%), bile duct stricture (0.1%), haemorrhage (0.3%), incisional hernia (0.1%), and wound complications (2.1%). From our series, there were four complications; two of the patients developed postoperative urinary retention (in association with underlying prostatic enlargement) that settled after temporary urinary catheterization. One patient developed wound haematoma after

surgery, which was subsided spontaneously within a month visit. An incisional hernia was observed in one patient during the 6-month follow-up visit, and it transpired that this patient had the umbilical wound extended to extract the 2 cm-sized gallstone specimen. The patient then underwent a second operation to repair the incisional hernia. There were no instances of biliary injury, bile duct stricture, postoperative bile leakage or haemorrhage in our series. However, the limited follow-up period might not have been long enough to allow all complications to be observed. In summary, although there were no serious complications in our series, surgeons should be cautious of potential complications from this new procedure. In case of unclear anatomy or difficult dissection, additional working ports should be added without hesitation.

Conclusion

Single-incision laparoscopic cholecystectomy is feasible and safe for treatment of uncomplicated gallbladder disease. There were reductions in the operating time and increases in success rate with accumulation of experience. Nevertheless, surgeons should be cautious, and aware of the potential risks of this new technique.

References

- Carr A, Bhavaraju A, Goza J, Wilson R. Initial experience with single-incision laparoscopic cholecystectomy. *Am Surg* 2010;76:703-7.
- Curcillo PG 2nd, Wu AS, Podolsky ER, et al. Single-port-access (SPA) cholecystectomy: a multi-institutional report of the first 297 cases. *Surg Endosc* 2010;24:1854-60.
- Erbella J Jr, Bunch GM. Single-incision laparoscopic cholecystectomy: the first 100 outpatients. *Surg Endosc* 2010;24:1958-61.
- Hernandez JM, Morton CA, Ross S, Albrink M, Rosemurgy AS. Laparoendoscopic single site cholecystectomy: the first 100 patients. *Am Surg* 2009;75:681-6.
- Poon CM, Chan KW, Lee DW, et al. Two-port versus four-port laparoscopic cholecystectomy. *Surg Endosc* 2003;17:1624-7.
- Novitsky YW, Kercher KW, Czerniach DR, et al. Advantages of mini-laparoscopic vs conventional laparoscopic cholecystectomy: results of a prospective randomized trial. *Arch Surg* 2005;140:1178-83.
- Lee PC, Lo C, Lai PS, et al. Randomized clinical trial of single-incision laparoscopic cholecystectomy versus mini-laparoscopic cholecystectomy. *Br J Surg* 2010;97:1007-12.
- Tsimoyiannis EC, Tsimoyiannis KE, Pappas-Gogos G, et al. Different pain scores in single transumbilical incision laparoscopic cholecystectomy versus classic laparoscopic cholecystectomy: a randomized controlled trial. *Surg Endosc* 2010;24:1842-8.
- Marks J, Tacchino R, Roberts K, et al. Prospective randomized controlled trial of traditional laparoscopic cholecystectomy versus single-incision laparoscopic cholecystectomy: report of preliminary data. *Am J Surg* 2011;201:369-73.
- Merchant AM, Cook MW, White BC, Davis SS, Sweeney JF, Lin E. Transumbilical Gelport access technique for performing single incision laparoscopic surgery (SILS). *J Gastrointest Surg* 2009;13:159-62.
- Hong TH, You YK, Lee KH. Transumbilical single-port laparoscopic cholecystectomy: scarless cholecystectomy. *Surg Endosc* 2009;23:1393-7.
- Romanelli JR, Roshek TB 3rd, Lynn DC, Earle DB. Single-port laparoscopic cholecystectomy: initial experience. *Surg Endosc* 2010;24:1374-9.
- Ito M, Asano Y, Horiguchi A, et al. Cholecystectomy using single-incision laparoscopic surgery with a new SILS port. *J Hepatobiliary Pancreat Sci* 2010;17:688-91.
- Tacchino R, Greco F, Matera D. Single-incision laparoscopic cholecystectomy: surgery without a visible scar. *Surg Endosc* 2009;23:896-9.
- Cuesta MA, Berends F, Veenhof AA. The "invisible cholecystectomy": A transumbilical laparoscopic operation without a scar. *Surg Endosc* 2008;22:1211-3.
- Elsley JK, Feliciano DV. Initial experience with single-incision laparoscopic cholecystectomy. *J Am Coll Surg* 2010;210:620-6.
- Navarra G, Pozza E, Occhionorelli S, Carcoforo P, Donini I. One-wound laparoscopic cholecystectomy. *Br J Surg* 1997;84:695.
- Piskun G, Rajpal S. Transumbilical laparoscopic cholecystectomy utilizes no incisions outside the umbilicus. *J Laparoendosc Adv Surg Tech A* 1999;9:361-4.
- Antoniou SA, Pointner R, Grandrath FA. Single-incision laparoscopic cholecystectomy: a systematic review. *Surg Endosc* 2011;25:367-77.