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Laparoscopic cholecystectomy with two incisions: an improved, feasible and safe technique with superior cosmetic outcomes

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Abstract

Objective: Conventional laparoscopic cholecystectomy (CLC) is usually performed with four incisions. Minimally invasive surgery for gallbladder disease with less pain and smaller scars has become increasingly popular. This study reported a new, two-incision laparoscopic cholecystectomy (TILC) using conventional instruments.

Methods: In this prospective study, 43 patients were recruited to undergo TILC and were compared with 43 historical cases undergoing CLC. We evaluated operative time, postoperative pain, cosmesis and complications.

Results: There was no significant difference in gender, age, body mass index, bile duct damage, blood loss and postoperative hospital stay between the two groups. The mean operation time was longer with TILC than with CLC, but the difference was not statistically different. Postoperative pain scores were significantly lower with TILC than with CLC. The mean cosmetic satisfaction score was significantly higher with TILC than that with CLC. There was no significant difference in the incidence of complications between the two groups.

Conclusion: Our work demonstrates that TILC generates less postoperative pain and significantly improved cosmesis for patients. TILC is a safe and feasible alternative to CLC.

Keywords

Laparoscopic cholecystectomy, cosmesis, pain, two-incision, conventional laparoscopic cholecystectomy, gallbladder disease

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Introduction

Laparoscopic cholecystectomy (LC) is the treatment of choice for gallbladder disease.[1,2] With enhanced experience and more advanced instrumentation, new minimally invasive surgical procedures have been developed to further reduce postoperative pain, improve cosmesis and decrease recovery time.[3–5] Techniques such as natural orifice translumenal endoscopic surgery (NOTES)[6,7] and single-incision laparoscopic surgery (SILS)[8,9] have been reported. However, NOTES is still controversial as it requires a long and difficult operation process and a multidisciplinary team. There are also other problems, such as an unfamiliar visual approach and ethical principles.[10] SILC is more difficult to perform than conventional LC (CLC) because of the need for triangulation and specific instruments, and problems with arm collision and a steep learning curve, which greatly limit the use of SILC.[11,12] To improve cosmetic outcomes without increasing the surgical difficulty, two-incision laparoscopic cholecystectomy (TILC) is a better choice. Several surgical options for TILC have been reported.[13–16] However, some options require special instruments during the operation, such as a 2-mm endoscopic grasper and a 000 monofilament nylon suture with a straight needle, which increase the costs to patients. Other options involve difficulty exposing the surgical visual field caused by inappropriate incision position.

In this study, we report a modified TILC performed with conventional instruments, and we compared postoperative pain, cosmesis improvement and complications, such as bile duct damage, wound site inflammation and blood loss between modified TILC and CLC.

Patients and methods

This study was approved by the Ethical Committee of Taizhou Hospital of Zhejiang Province, China, in January 2018. Written informed consent was obtained from all patients for participation in the study and to undergo the procedures. A case series with 86 consecutive patients with indications for cholecystectomy were included in this prospective study. CLC and TILC were performed in patients who visited our hospital between January and April, and between May and September 2018. The inclusion criteria were as follows: indication for laparoscopic cholecystectomy (gallbladder polyps $\geq$1 cm or symptomatic cholecystolithiasis), age older than 18 years, American Society of Anesthesiology (ASA) grade $\leq$III and body mass index (BMI) $<45\,kg/m^2$. We excluded patients with uncontrolled medical illness or requiring extensive adhesiolysis owing to previous abdominal surgeries and those requiring exploration of the biliary tract or who refused the invitation to participate. Patients were enrolled regardless of whether the intervention was elective or emergent. Patients with an ASA > III were also excluded. We collected the following demographic and clinical data: age, gender, BMI, operative time, postoperative hospital stay, postoperative pain, cosmesis and complications. Postoperative pain was evaluated using a visual analogue scale (VAS) 6 hours and 24 hours postoperatively (VAS-6 and VAS-24, respectively).[17] The patients were asked to score their pain on a scale from 0 (no pain) to 10 (worst pain ever). Cosmetic outcome was assessed according to a Photo Series Questionnaire (PSQ) on a scale from 1 (worst satisfaction) to 10 (best satisfaction) on postoperative day 7[18] (Figure 1).

Operative technique

For TILC, patients were placed in the dorsal decubitus position under general anaesthesia, with the operators standing on the patient's left side. An arcuate incision of approximately 12 mm was made along the upper edge of the umbilicus, and

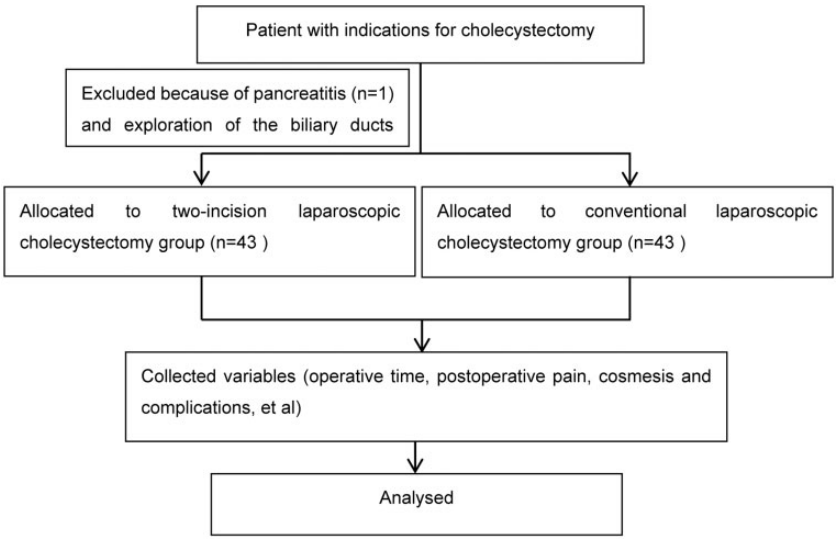

Figure 1. Flowchart of patient section in the laparoscopic cholecystectomy trial.

pneumoperitoneum was created using a Veress needle in the same manner as for CLC. A 5-mm port (P1) was placed in the incision, and a 5-mm 30° laparoscope was inserted through the port. Then, the patient's position was changed to the reverse Trendelenburg position to fully expose the gallbladder. Another incision was made on the right side below the xiphoid to allow the insertion of the second 5-mm port (P2). The third 5-mm port (P3) was placed at the corner in the right end of the umbilical incision beside P1 under direct vision by placing the laparoscope through P2. The 5-mm laparoscope was placed in P1, and a grasping clamp was fixed in P3 to hold and manipulate the gallbladder (Figure 2a). The dissection forceps, hook and clip applicator (5 mm) were used through P2 to perform cholecystectomy (Figure 2b and c). Finally, the laparoscope was shifted to P2, and both 5-mm ports in the umbilical incision were removed and replaced with a 10-mm port. The excised gallbladder was removed through the umbilical incision with an endo-bag (Figure 2d). All operations were performed by the same surgeon (Dr Zhenyu Li).

Statistical analysis

Statistical analysis was performed with SPSS 22.0 software (IBM Corp., Armonk, NY, USA). The Chi-square test or Fisher's exact test was used to compare the distribution of nominal variables between the two groups. Student's t test was used to determine the differences in normally-distributed continuous variables, and the Mann–Whitney test was used for asymmetrically-distributed variables. A sample size calculation was not performed. $P < 0.05$ was considered statistically significant.

Results

Forty-six patients underwent TILC, including eight emergent cases (acute cholecystitis)), and three patients were excluded from the study: one patient was diagnosed with pancreatitis, and another two patients required exploration of the biliary ducts. CLC was performed in 43 patients (including 10 emergent cases (acute cholecystitis)) as the controls. All patients were operated by the same surgeon, and there was no

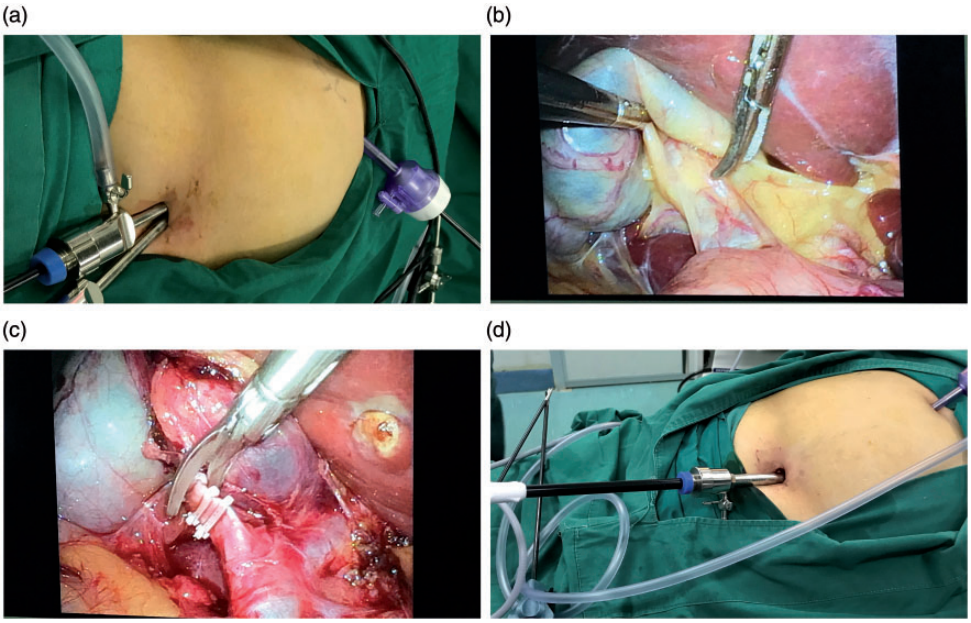

Figure 2. Procedure for two-incision laparoscopic cholecystectomy. a. Arrangement of the instruments in two-incision laparoscopic cholecystectomy (TILC). b. Calot's triangle and the gallbladder. c. Cystic duct clipping with the gallbladder in traction. d. Retrieving the gallbladder through the umbilical incision with an endobag.

Table 1. Patients' characteristics.

	Group		
Variable	TILC	CLC	*P* value
Gender, n (M/F)	18/25	17/26	0.826
Age (year)	48.44 ± 13.25	49.74 ± 11.75	0.631
BMI (kg/m^2)	23.90 ± 3.34	24.44 ± 4.18	0.508
Operation time (min)	49.19 ± 8.59	47.79 ± 9.15	0.468

TILC, two-incision laparoscopic cholecystectomy; CLC, conventional laparoscopic cholecystectomy; BMI, body mass index.

difference in the emergent to elective case ratio between the two groups ($p = 0.596$). The characteristics of the patients in the two groups are summarised in Table 1. No significant difference was observed for gender, age and BMI. The mean operation time was higher with TILC (49.19 ± 8.59 minutes) than with CLC (47.79 ± 9.15 minutes), but the difference was not statistically significant.

Complications are shown in Table 2. One patient was converted to open cholecystectomy in the CLC group. There was no bile duct damage or massive haemorrhage in any case, and the mean amount of intraoperative blood loss was similar in both groups. Although two patients developed wound site inflammation in the TILC group, they recovered after dressing changes, without further intervention. There was no

Table 2. Comparison of operative data and complications between TILC and CLC.

Variable	Group		*P* value
	TILC	CLC	
Blood loss (mL)	11.86 ± 5.35	12.67 ± 3.83	0.420
Bile duct damage	0	0	1
Conversion to open surgery	0	1	1.000
Wound site inflammation	2	0	0.494

TILC, two-incision laparoscopic cholecystectomy; CLC, conventional laparoscopic cholecystectomy.

Table 3. Comparison of postoperative data between TILC and CLC.

Variable	Group		*P* value
	TILC	CLC	
VAS-6	3.93 ± 0.91	4.16 ± 0.97	0.256
VAS-24	2.16 ± 0.92	2.65 ± 0.97	0.019
Cosmetic satisfaction	8.86 ± 0.86	7.93 ± 1.24	≤0.001
Postoperative days of hospital stay	1.26 ± 0.54	1.35 ± 0.65	0.472

TILC, two-incision laparoscopic cholecystectomy; CLC, conventional laparoscopic cholecystectomy; VAS-6, visual analogue scale score 6 hours postoperatively; VAS-24, visual analogue scale score 24 hours postoperatively.

significant difference in the incidence of complications between the two groups.

Although the VAS-6 scores in the two groups were not statistically different, the CLC group scored higher. The VAS-24 scores were significantly lower in the TILC group than in the CLC group (2.16 ± 0.92 vs 2.65 ± 0.97; $p = 0.051$). Regarding cosmetic satisfaction, the PSQ scores in the TILC group were significantly higher than those in the CLC group ($p \leq 0.001$; Table 3).

Discussion

The advantages of minimally invasive surgeries, such as SILC for gallbladder disease, are well recognised.[3,19,20] However, there are increased risks of pain, bile duct injury and port-site hernia formation, with a larger umbilical incision and prolonged operative time. These procedures also require special instruments.[21–24] In this report, we presented a new TILC procedure that can be performed with conventional instruments. All patients were operated based on a 5-mm laparoscope, which was placed in the umbilical incision and which provided a visual field and images exactly as for CLC. The positioning of one forceps in the umbilicus and another in the epigastrium allowed for optimal triangulation. Arm collision is the biggest challenge during TILC. In our experience, crossing two instruments in the same incision as an 'X' created only one rotational axis and generated less inter-instrument collision. In this way, surgeons can work in a manner very similar to CLC, ensuring that TILC is as safe as CLC.

The main benefits of TILC are improved cosmesis and reduced postoperative pain. The data from this study showed that the pain scores (VAS-24) were significantly lower with TILC than with CLC. The decreased incisional trauma and incision

number may account for the decreased postoperative pain. The cosmetic advantages of such 'scarless' operations are very important for patients. TILC showed higher cosmetic satisfaction scores because the number of incisions is lower, and the incision is anatomically concealed within the umbilical scar. The most important criteria to evaluate surgical outcomes are morbidity and complications, and no significant difference was observed in iatrogenic bile duct injury and bleeding between our groups, indicating that TILC is safe and effective.

In an early study,[13] classic four-port LC was compared with TILC. The study found that TILC was more effective in decreasing postoperative pain and providing improved cosmesis, which is similar to the results in this study. However, it is important to note that the TILC procedure in the previous study differed from ours. In the previous study, a 1-cm incision was made in the umbilicus to expose the subcutaneous fascia, and two 5 mm-ports were inserted. Then, another 1-cm incision was made just above the pubis in the lower abdomen, extending to the midline, and a 1-mm port was placed to insert a 10-mm laparoscope. Therefore, the two instruments in the umbilicus could not provide good triangulation, which greatly increased the difficulty of the operation.[13] The safety and feasibility of this approach were also reported, although the port locations differed from our study.[25] In addition, Lai *et al*.[15] confirmed that TILC is a safe alternative to CLC for paediatric gallbladder disease. However, the authors used a special instrument (2-mm endoscopic grasper) for TILC and found that obese patients might require additional ports.

Although our study found no significant difference in the clinical parameters, such as bile duct damage, blood loss and postoperative hospital stay, between the two groups, there are limitations in our study. The number of cases was small, and selection bias is possible. Additionally, we did not perform a sample size calculation, and the limited number of samples might have affected the statistical significance. The study was also conducted at single centre. Therefore, large, multi-centre studies are needed to validate our conclusions.

Conclusion

This study demonstrated that TILC is safe and feasible for gallbladder disease. TILC generated less postoperative pain and provided a remarkable improvement in cosmesis compared with CLC. This procedure can be performed with the same instruments as CLC without increasing the costs; thus, offering more options for patients and physicians to manage the disease.

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Author contributions

YX, AW and ZL designed the study. AW, QD, ZF and ZL analysed and interpreted the experimental data. QD, ZF and YX performed the statistical analysis. AW, QD, ZF and ZL were major contributors to writing the manuscript. All authors read and approved the final manuscript.

Declaration of conflicting interest

The Authors declare that there is no conflict of interest.

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