



Transumbilical single-port laparoscopic cholecystectomy using traditional laparoscopic instruments: a report of thirty-six cases

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Abstract: Objective: To evaluate the feasibility and safety of the operation of transumbilical single-port laparoscopic cholecystectomy (TSPLC) by traditional laparoscopic instruments and summarize the initial experience. Methods: Sixty subjects with cholelithiasis were divided into two groups. One group (36 cases) underwent TSPLC and the control group (24 cases) underwent traditional three-port laparoscopic cholecystectomy (LC). Postoperative complications were observed and operation time, hospital days, visual analogue scale (VAS) after 6 and 24 h of operation, and subject satisfaction score were measured. Results: TSPLC and traditional LC were performed successfully in the two groups. The operation time in the TSPLC group was significantly longer than that in the control group. There was no statistically significant difference in hospital stay and VAS between the TSPLC and control groups. The subject satisfaction score in the TSPLC group was 91.2, significantly higher than that in the control group ($P < 0.01$). All subjects recovered from the operation and no postoperative complication occurred during the period of two weeks after operation. Conclusions: TSPLC is a feasible and safe method for cholecystectomy, although it may be more time-consuming. However, it is welcomed by patients who are more concerned with cosmetic outcomes. Future studies are needed to confirm its disadvantages and contraindications.

Key words: Laparoscopic cholecystectomy, Single-incision laparoscopic cholecystectomy, Minimally invasive surgery, Traditional laparoscopic instruments

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1 Introduction

Since the first case of laparoscopic cholecystectomy (LC) was reported by Mouret (1996), a French gynecologist in 1987, LC has become the preferred form of cholecystectomy. In the 21st century, with the development of minimally invasive surgeries and their acceptance by many patients interested in the cosmetic outcomes, single-port laparoscopic technique (Tacchino *et al.*, 2009) and natural orifice transluminal endoscopic surgery (NOTES) (Pearl and Ponsky, 2008) are advancing rapidly on the basis of traditional endoscopic technique. Transumbilical single-port laparoscopic cholecystectomy (TSPLC) has been accepted by many surgeons and patients (Raman *et al.*, 2008).

The first case of TSPLC was reported in 1997 by Navarra *et al.* (1997). In the early years, TSPLC developed slowly because of technical and instrumental limitations. In recent years, it has developed rapidly, and has been performed by more and more surgeons. We have performed the operation since 2008. In this article, we report our initial experience of TSPLC performed entirely by common laparoscopic instruments, and we have evaluated the safety and feasibility of the operation.

2 Materials and methods

2.1 Subjects

Between December 2008 and October 2010, 60 patients with symptomatic cholelithiasis were hospitalized. The 60 subjects were divided into two

groups according to patient desires after particular preoperative education of TSPLC and traditional LC. Thirty six subjects decided to undergo TSPLC and were classified to the TSPLC group, the others (24), undergoing traditional LC, were classified to the control group. All subjects were selected strictly and had no other disease history such as heart disease, pneumonia, gastroenteritis, or hepatitis. Operative history of upper abdominal operation, body mass index (BMI) >30 kg/m², acute cholecystitis, suspicion of malignancy, and the presence of a cystic duct stone were considered contraindications to TSPLC (Hirano *et al.*, 2010). Potential subjects with contraindications were also excluded from the study.

The average ages of the TSPLC and control groups were 46.5 and 48.3 years, respectively. There were 17 females in the TSPLC group and 10 females in the control group. No statistically significant difference in age or sex was found between the two groups.

Careful preoperative examinations, such as abdominal ultrasonography, blood tests, and electrocardiogram, were performed to exclude contraindications. Before each operation, the subjects were fully informed about risks of operation and provided informed consent.

Postoperative complications were observed (e.g., bleeding, biliary leak, bile duct injury, port site infection, port hernia, and spilled gallstones). Operation time, hospital days, visual analogue scale (VAS; 0–10 scores) (Boonstra *et al.*, 2008) after 6 and 24 h of operation, and subject satisfaction score (0–100) (Tomlinson and Ko, 2006) were also measured in the perioperative period. All operations were performed by the same surgical team. All subjects were observed and recorded by another research team.

2.2 Statistical analysis

Data analysis was performed by software of SPSS 10.0. All data were expressed as mean±standard deviation (SD) and comparisons between groups were made by analysis of variance (ANOVA). *P* value <0.05 was considered for statistical significance.

2.3 Operation procedure

In this study, all operations were accomplished by common laparoscopic instruments listed in Table 1.

Table 1 Instruments of TSPLC

Instrument	Company (country)
Trocar (10 and 5 mm)	STORZ (Germany)
Electric coagulating hook	STORZ (Germany)
Suction apparatus	STORZ (Germany)
Absorbable clip	STORZ (Germany)
Laparoscope (10 and 5 mm)	STORZ (Germany)
Laparoscopic scissors	WOLF (Germany)
Elastic separating pliers	WOLF (Germany)
Clip applicator	WOLF (Germany)
Tongs type grab	WOLF (Germany)

The subjects were placed on the operating table in supine position and legs apart. One surgeon, located between subject's legs, and the assistant stood on the right side of the subject. A 2.0–2.5 cm periumbilical incision was made for port access, and then CO₂ pneumoperitoneum with pressure between 12 to 14 mmHg (1 mmHg=0.133 kPa) was set up by open Hasson's method. A 10-mm laparoscope was inserted into the abdominal cavity through the 10-mm trocar (for the last eight subjects, we use 5-mm laparoscope and 5-mm trocar). Additional 5- and 10-mm trocars were inserted into the same incision, but separated at the peritoneum, to avoid CO₂ gas leak (Fig. 1). The 10-mm trocar was the major manipulating port. Retrograde LC was performed as per three-port LC. The cystic duct and artery were all identified before the cystic duct was clipped, to avoid bile duct injury (Fig. 2). Careful hemostasis was necessary after the gallbladder was separated from the cholecystic bed. Finally, the gallbladder specimen was removed through the transumbilical incision.

3 Results

TSPLC was successfully performed in all 36 subjects with cholelithiasis and no case was transferred to three-port LC. The other 24 patients also successfully underwent three-port LC. The operation time in the TSPLC group was significantly longer than that in the control group (56.0 min vs. 36.7 min, *P*<0.01; Table 2). In the last 10 subjects of the TSPLC group, however, the mean operation time was 37.4 min (Table 3), this having decreased obviously

from the initial cases (Fig. 3). There was no statistically significant difference in hospital stay or VAS between the TSPLC and control groups (Table 2). The subject satisfaction score in the TSPLC group was 91.2, significantly higher than that in the control group ($P<0.01$; Table 2). In the TSPLC group, hospital stay, VAS, and satisfaction score showed no statistically difference between the first 26 cases and the last 10 cases (Table 3). All patients recovered from the operation and no postoperative complication occurred within two weeks after operation.



Fig. 1 Triangulate arrangement of trocars in TSPLC



Fig. 2 Intraoperative views of TSPLC

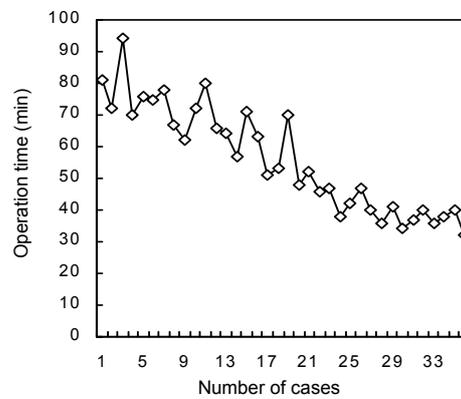


Fig. 3 Operation time decrease with increasing of TSPLC cases

Table 2 Operation results in the TSPLC and control groups

Group	Operation time (min)	Hospital day (d)	VAS score (1-10)		Subject satisfaction score (1-100)
			6 h	24 h	
TSPLC (n=36)	56.0±16.70	2.6±0.42	5.1±2.21	2.3±0.68	91.2±6.90
Control (n=24)	36.7±6.00	2.4±0.51	4.4±1.92	2.1±0.51	88.5±5.30
<i>F</i>	430	1.26	3.37	0.94	16.80
<i>P</i>	0	0.27	0.07	0.34	0

Table 3 Operation results of first 26 cases and last 10 cases in the TSPLC group

Case	Operation time (min)	Hospital day (d)	VAS score (1-10)		Subject satisfaction score (1-100)
			6 h	24 h	
First 26 cases	63.2±14.10	2.6±0.50	5.4±2.21	2.3±0.72	91.3±6.83
Last 10 cases	37.4±2.95	2.6±0.52	4.5±1.80	2.3±0.48	90.9±7.31
<i>F</i>	414	0.01	2.66	0.01	0.20
<i>P</i>	0	0.84	0.11	0.92	0.68

4 Discussion

Since the first case of TSPLC was reported in 1997, many surgeons have attempted to perform single-incision laparoscopic operation. In the early years, only a few reports were issued in journals (Navarra *et al.*, 1997) and most surgeons did not think such a “difficult” operation, other than providing scar reduction, would be beneficial for patients. In recent years, after scarless endoscopic thyroidectomy was widely performed in many medical centers, the concept of a minimally invasive esthetic operation had been accepted by many surgeons, because it was welcomed by many patients (Snissarenko *et al.*, 2009). More surgeons found that TSPLC was not as difficult as before with the development of laparoscopic technology and instrument upgrades (Romanelli *et al.*, 2008; 2010). Today, natural orifice transluminal endoscopic cholecystectomy, such as endoscopic cholecystectomy through gastric and vaginal access, has been successfully performed in some hospitals (Pearl and Ponsky, 2008). TSPLC has no visible scar on the body (Bucher *et al.*, 2009).

In the early period of TSPLC use, laparoscopic surgeons were mainly confronted with the difficulty of how to abate interactions between working apparatuses when they were operating through three trocars in the same incision (Navarra *et al.*, 1997; Rivas *et al.*, 2010). Three methods could be adopted to solve the problem: (1) Hanging the cholecystic bottom to the right subcostal abdominal wall by one to three percutaneous sutures could provide adequate working room and the assistant trocar can be moved from the transumbilical incision (Philipp *et al.*, 2009); (2) Using a Triport trocar or self-made apparatus, such as sterile gloves (Romanelli *et al.*, 2008); (3) Using articulating instruments (Podolsky *et al.*, 2009), such as flexible-tip laparoscope (Elazary *et al.*, 2009) and articulating grasper. This reduces operative difficulty, but increases operation fees. In our study, all three trocars were inserted through a 2.0–2.5 cm incision and entered into abdominal cavity at different sites of peritoneum to avoid CO₂ gas leak. Perfect positions of the three trocars would abate interactions between the apparatuses. A triangular placement of three trocars is the most consistent arrangement such that laparoscope locates at the apex and two working ports

locate at two hemline endpoints of the triangle. The remaining interaction was overcome by the surgeon's adroit skill. Thirty-six cases of TSPLC were successfully performed without transference to three-port LC, and it was feasible in practice. As experience increases, operation time becomes as short as that of traditional LC.

In this study, 36 cases of TSPLC were successfully performed without postoperative complication such as incisional hernia or wound infection. TSPLC showed the same safety as traditional LC. The TSPLC group achieved a high VAS score after a 6-h operation compared to the control group, perhaps because of the longer operation time and larger umbilicus incision. Following 24 h from the operation, the VAS score showed no statistically significant difference. The subject satisfaction score in the TSPLC group was higher than that in the control group, which indicated that TSPLC was attractive to most patients, especially to young women.

Although all TSPLCs were successfully performed, further research is still needed to solve many operative difficulties. In TSPLC, all three trocars entered into the abdominal cavity from the same incision, and it was difficult to work from two directions as in traditional LC. Hanging the gallbladder's bottom to the right subcostal abdominal wall was helpful to expose the neck of the gallbladder (Ponsky, 2009). The mobile range of the laparoscopic apparatus was also restricted by other trocars and the operating field was extremely narrow. Thus, concurrent manipulations were very important and necessary to work effectively and to avoid having the apparatus suddenly disappear from view. The surgeon requires considerable experience with laparoscopic operations to overcome these difficulties.

5 Conclusions

TSPLC with common laparoscopic instruments was feasible and safe. It may need more time to complete the operation in the early period. However, it is welcomed by the patients who have concerns about cosmetic effects of surgery. TSPLC is an ideal alternative to traditional LC. Of course, future studies are needed to confirm its disadvantages and contraindications.

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