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Results of laparoscopic subtotal cholecystectomy by laparoscopic linear stapler in difficult cases with severe cholecystitis

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Laparoscopic subtotal cholecystectomy (LSC) has been recognized as a safe and feasible alternative surgical procedure for a difficult laparoscopic cholecystectomy (LC) with severe inflammation in Calot's triangle. We compared the surgical outcomes of cholecystectomy for acute cholecystitis between standard LC and LSC using laparoscopic linear stapler. 172 patients were diagnosed as acute cholecystitis, among them, 16 patients who underwent LSC and other 156 patients who underwent standard LC were enrolled in this study. The severity grading of acute cholecystitis in LSC group was significantly higher than LC group. Operation time was longer in the LSC group than LC group. LSC had significantly more intraoperative blood loss compared to LC. However, there was no significant difference in the postoperative complications between two groups. LSC using laparoscopic linear stapler contributes surgeons avoid common bile duct injury in difficult LC.

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Introduction

The most feared and serious complications of laparoscopic cholecystectomy (LC) remains common bile duct injury. The incidence of common bile duct injury after LC is 0.5-1.5 % (1-3). The critical view of safety is accepted as a standard technique for safe and accurate LC with the prevention of common bile duct injury (3). However, chronic severe inflammation, dense adhesion in Calot's triangle and gangrenous gallbladder may disturb the identification of the critical view of safety. Laparoscopic subtotal cholecystectomy (LSC) has been reported as a safe and feasible alternative surgical procedure in such a difficult LC that has a potential risk of common bile duct injury (4-6). In the present study, we compared the surgical outcomes of cholecystectomy for acute cholecystitis between LC and LSC. We also assessed the safety and feasibility of LSC by laparoscopic linear stapler in difficult cases with severe cholecystitis.

Patients and Methods

Patients

This retrospective analysis was undertaken in the patients with LC or LSC for acute cholecystitis in the National Hospital Organization Nagasaki Medical Center between January 2015 and December 2018. The severity grading of acute cholecystitis was based on TG18 (7). In this period, 172 patients were diagnosed as acute cholecystitis, among them, 16 patients who underwent LSC and other 156 patients who underwent standard LC were enrolled in this study. Our standard management for the patients with grade I acute cholecystitis is elective LC following antibiotics therapy, whereas percutaneous transhepatic gallbladder drainage (PTGBD) is indicated for the patients with grade II or grade III acute cholecystitis, or the patients with grade I acute cholecystitis who are unresponsive to conservative treatments. Those patients with PTGBD undergo elective and scheduled LC. Ultrasonogra-

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phy (US) , computed tomography scan (CT), and magnetic resonance cholangiopancreaticography (MRCP) were performed for all patients in the present study. Informed consent was obtained from all patients, and the study protocol (# 29060) was approved by the Ethics Committee of National Hospital Organization Nagasaki Medical Center.

Operative technique

All LC and LSC were performed by fixed members including expert biliary surgeons. LC was performed using four-trocar technique under general anesthesia. The patients were placed in the supine position. The PTGBD catheter was removed just before operation. The first 12-mm laparoscopic trocar was inserted at the umbilicus using an open technique, and pneumoperitoneum was set at 8 mm Hg. The maximum intraabdominal pressure was 12 mm Hg. Three additional trocars were inserted: two 5-mm trocars levels with the right subcostal area, one 12-mm trocar level with the subxiphoid. First, we dissected the junction between the neck of the gallbladder and the cystic duct at the inferior margin of the gallbladder. After dissection of the triangle of Calot, the cystic duct and the cystic artery were exposed and we confirmed the critical view of safety. The cystic artery and the cystic artery were clipped and then divided with laparoscopic scissors. The gallbladder was dissected from the liver bed using a regular hook electrocautery device. When it was extremely difficult to expose and dissect the triangle of Calot or the neck of the gallbladder due to severe inflammation, LSC was performed. The gallbladder was divided downward from the gallbladder fundus to the neck. And then, we opened the gallbladder wall at the fundus. All gallstones were removed through the incision at the fundus and the orifice from the neck to the cystic duct was confirmed for prevention of the bile duct injury. The gallbladder was transected by a laparoscopic linear stapler (Powered ECHELON FLEX® GST system, ETHICON, Inc., Sommerville, NJ, USA) at the gallbladder neck (Fig 1). A disposable retrieval bag was inserted directly, and the gallbladder and the gallstones were then extracted. No intraperitoneal drainage tube was placed.

Data collection and statistical analysis

The preoperative clinical status was examined by age, gender, comorbidity, American Society of Anesthesiologists (ASA) classification, laboratory findings such as leukocyte count and CRP, radiological findings such as wall thickness of the gallbladder on CT imaging. The wall thickness of gallbladder was measured using the maximum thickness on a transverse image of a CT scan. Numerical data were shown as the median and range, and evaluated using Mann-Whitney *U*-test. Statistical analysis was carried out using SSPS version 23 (SSPS, Chicago, IL). $P < 0.05$ was considered statistically significant.

Results

Clinical characteristics on admission

During the study period, 172 consecutive patients admitted due to acute cholecystitis. Among them, 16 patients (9%) underwent LSC. Clinical characteristics were shown in Table 1. The median age of the patients who underwent LC and LSC were 62.5 and 63.5 years. Age, sex, and comorbidity

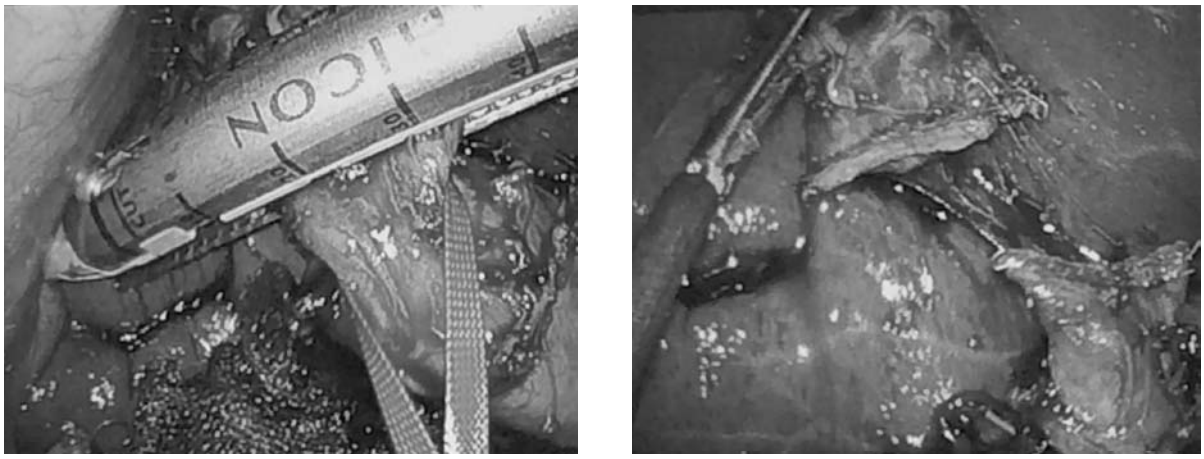

Figure 1. Subtotal reconstituting cholecystectomy using laparoscopic linear stapler. The gallbladder was transected by a laparoscopic linear stapler at the gallbladder neck

Table 1. Preoperative characteristics of patients undergoing LC and LSC.

Characteristics	LC (n=156)	LSC (n=16)	P value
Age [years] (median, range)	62.5 (23-98)	63.5 (39-84)	0.214
Gender			0.434
male	78	6	
femal	78	10	
Comorbidity			0.730
Cardiovascular disease	21	2	
Diabetes mellitus	15	1	
Pulmonary disease	12	1	
Chronic liver disease	4	1	
Tokyo Guidelines 2018			< 0.001
grade I (mild)	91	0	
grade II (moderate)	60	14	
grade III (severe)	5	2	
WBC on admission [count/mL] (median, range)	7,950 (2,900-28,000)	14,750 (8.900-21,500)	< 0.001
CRP on admission [mg/dl] (median, range)	0.99 (0.14-32.44)	22.40 (9.40-33.56)	< 0.001
Gallbladder wall thickness using CT [mm] (median, range)	3 (1-12)	7.5 (2-10)	< 0.001

LC, laparoscopic cholecystectomy; LSC, laparoscopic subtotal cholecystectomy.

Table 2. Perioperative characteristics of patients

Characteristic	LC (n=156)	LSC (n=16)	P value
Preoperative PTGBD	28	9	< 0.001
ASA score			0.045
I	60	2	
II	95	14	
III	1	0	
Operation time [min] (median, range)	104 (47-278)	165.5 (89-243)	< 0.001
Intraoperative blood loss [g] (median, range)	5 (0-1010)	22.5 (0-225)	< 0.001
Postoperative complication			0.390
Bile leakage	1	1	
Postoperative bleeding	1	0	
Surgical site infection	2	0	
Postoperative hospital stay [days] (median, range)	4 (2-27)	6.5 (4-25)	< 0.001

PTGBD, percutaneous transhepatic gallbladder drainage.

did not differ significantly between two groups. The severity grading of acute cholecystitis of patients who underwent LC and LSC were grade I in 91 and 0 patients, grade II in 60 and 14 patients, and grade III in 5 and 2 patients, respectively. The severity grading of acute cholecystitis in LSC group was significantly higher than LC group ($P < 0.001$). Preoperative WBC were 7,950 and 14,750 ($P < 0.001$), and CRP were 0.99 and 22.40 ($P < 0.001$). Median gallbladder wall thickness on CT imaging were 3 and 7.5 mm ($P < 0.001$), respectively.

Perioperative characteristics of patients

Perioperative characteristics of patients were shown in Table 2. Preoperative PTGBD was performed in 28 patients (18%) in the LC group, 9 patients (56%) in the LSC group. The number of patients who underwent preoperative PTGBD was significantly larger in the LSC group ($P < 0.001$). ASA score of patients who underwent LC and LSC were grade I in 60 and 2 patients, grade II in 95 and 14 patients, and grade III in 1 and 0 patients, respectively. The number of patients with ASA score grade II or III was significantly

larger in the LSC group (P = 0.045). Although there was no routine intraoperative cholangiography in our strategy for LC or LSC, one case of LSC was performed intraoperative cholangiography using endoscopic nasobiliary drainage (ENBD) tube which was inserted in the common bile duct preoperatively. Operation time was longer in the LSC group (median 165.5 versus 104 min) (P < 0.001). LSC had significantly more intraoperative blood loss compared to LC (P < 0.001). However, there was no significant difference in the postoperative complications between two groups. In the LC group, 1 patient had minor bile leakage, 1 patient had postoperative bleeding, and 2 patients had surgical site infection. In the LSC group, 1 patient had minor bile leakage. These 2 patients who had bile leakage in the two groups promptly resolved after transpapillary approach. There was no mortality in the both groups. The postoperative hospital stay in the LSC group was significantly longer than LC group (median 4 versus 6.5 days) (P < 0.001).

Discussion

LSC is recommended to avoid the intraoperative bile duct injury when severe inflammation and fibrous change of Calot's triangle is observed in cases of acute cholecystitis (4-6). LSC is secure surgical procedure for cases of technically difficult laparoscopic total cholecystectomy because no dissection is performed near the common bile duct. Subtotal cholecystectomy is divided into two categories, fenestrating and reconstituting subtotal cholecystectomy, according to the method of processing at neck of the gallbladder (8). In the present study, our choice for the subtotal cholecystectomy was reconstituting method in all cases. LSC group was associated with a higher grade of the acute cholecystitis according to the Tokyo Guidelines 2018 than LC group. In addition, LSC group showed more inflammation by the blood test and CT imaging compared to LC group. However, there was no significant difference in the incidence of the postoperative complication between LC and LSC group. Therefore, we consider that LSC by laparoscopic linear stapler is a feasible alternative procedure for a difficult LC with severe inflammation and fibrous change within Calot's triangle where there is risk of bile duct injury. When using laparoscopic linear staple for LSC, it is necessary to be careful to the injury of the common bile duct caused by the blind automatic suture (9). For the preventing common bile duct injury, we have reported that the biliary navigation surgery using ENBD tube is useful for difficult LC (10). The ENBD tube in the common bile duct can provide a repeated intraoperative cholangiography for the identifying of the exact anatomical location of the biliary tract. Our series demonstrated a high incidence (56%) of the requirement for preoperative PTGBD in LSC group. Preoperative PTGBD can be a predictor of the LSC. In addition, the severity grading of acute cholecystitis using Tokyo Guidelines 2018, inflammation of blood test, and gallbladder wall thickness were useful for predictors of the LSC. We recommended a biliary navigation surgery using ENBD tube for acute cholecystitis patients who had such predictors of the LSC.

LSC has two important issues. First problem is retained gallstones in the remnant gallbladder and/or common bile duct. Meta-analysis described that retained gallstones occurred in 38 patients (3.1%) in the postoperative period (11). This problem can be solved with endoscopic treatment using endoscopic retrograde cholangiography or complete cholecystectomy. Second problem is incidental gallbladder cancer. Incidental gallbladder cancers were found in 0.3-0.5% of patients who underwent LC (12, 13). It is difficult to accurately distinguish between gallbladder cancer and inflammatory wall thickness. Therefore, if there is any possibility of gallbladder cancer preoperatively, we should complete total cholecystectomy. In addition, we should take care to prevent bile spillage during cholecystectomy at any time.

In conclusion, we do not recommend the choice of LSC as a routine surgical strategy for difficult LC. However, we demonstrated that LSC using laparoscopic linear stapler was a safe and feasible alternative to standard LC for the severe cholecystitis when it was impossible to exposure an accurate view of Calot's triangle due to severe inflammation and fibrous change during LC. LSC using laparoscopic linear stapler contributes surgeons avoid common bile duct injury in difficult LC.

Acknowledgment

The authors have no conflicts of interest to disclose.

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