



## Comparison of laparoscopic cholecystectomy combined with intraoperative endoscopic sphincterotomy and laparoscopic exploration of the common bile duct for cholecystocholedocholithiasis

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Received: 27 January 2005/Accepted: 16 June 2005/Online publication: 4 January 2006

### Abstract

**Background:** Laparoscopic cholecystectomy (LC) combined with intraoperative endoscopic sphincterotomy (IOEST) was compared with laparoscopic exploration of the common bile duct (LCBDE) for cholecystocholedocholithiasis in an attempt to find the best mini-invasive treatment for the cholelithiasis and choledocholithiasis.

**Methods:** For this study, 234 patients with cholelithiasis and choledocholithiasis diagnosed by preoperative B-ultrasonography and intraoperative cholangiogram were divided at random into an LC-LCBDE group (141 cases) and an LC-IOEST group (93 cases). The surgical times, surgical success rates, number of stone extractions, postoperative complications, retained common bile duct stones, postoperative lengths of stay, and hospital charges were compared prospectively.

**Results:** There were no differences between the two groups in terms of surgical time, surgical success rate, number of stone extractions, postoperative complications, retained common bile duct stones, postoperative length of stay, and hospital charge.

**Conclusion:** Both LC-IOEST and LC-LCBDE were shown to be safe, effective, minimally invasive treatments for cholecystocholedocholithiasis.

**Key words:** Cholecystectomy — Common bile duct exploration — Endoscopic sphincterotomy — Extrahepatic duct stone — Laparoscope

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It is reported that laparoscopic cholecystectomy (LC) could be carried out for 95% of cholelithiasis cases in

the hospitals with the laparoscopic devices available, whereas 70% to 90% of extrahepatic duct stones could be treated by a mini-invasive procedure using three kinds of endoscopes: (laparoscope, pancreatocholedochoscope and choledochoscope) [7]. Currently, it still is controversial how these three mini-invasive procedures should be combined to achieve the best result due to the lack of research involving large series [4, 9, 18]. We prospectively compared laparoscopic exploration of the common bile duct (LC-LCBDE) and laparoscopic cholecystectomy combined with intraoperative endoscopic sphincterotomy (LC-IOEST) and report the results.

### Materials and methods

#### General conditions

From January 2002 to December 2003, 234 cases of cholelithiasis with extrahepatic duct stones diagnosed by history, physical examination, ultrasonography, magnetic resonance cholangiopancreatography (MRCP), or cholangiogram through cystic duct cannulation were treated. They were randomized into a LC-LCBDE group (141 cases) and a LC-IOEST group (93 cases) according to their identifying numbers. All the patients were informed about both the procedure and the technology, and all signed informed consent forms. The ultrasonographic findings were positive in 174 cases. Three cases had positive MRCP findings, and 57 cases had positive intraoperative cholangiogram (IOC) findings without a preoperative diagnosis of extrahepatic duct stones [3].

The postoperative diagnosis was acute cholecystitis, cholelithiasis, and extrahepatic duct stone leading to acute obstructive suppurative cholangitis in 18 cases, and cholelithiasis with extrahepatic duct stone in 216 cases. Among the latter, there were 16 cases involving acute gallbladder pancreatitis and 48 cases involving jaundice. The LC-LCBDE group comprised 28 males and 65 females ranging from 15 to 82 years of age (mean, 48 years). There was no significant difference between the two groups in terms of age or preoperative history of primary hypertension and coronary heart disease.

**Table 1.** Comparison of surgical data between the two groups<sup>a</sup>

Group	Surgical time (min)	Stones ( <i>n</i> )	Surgical success rate (%)	Stone size (mm)
LC-LCBDE ( <i>n</i> = 141)	133.83 ± 58.24	2.52 ± 1.62	89.36	4–40
LC-IOEST ( <i>n</i> = 93)	140.32 ± 56.55	2.26 ± 1.55	91.4	5–15
<i>t/x</i> <sup>2</sup>	0.46	0.41	0.08	

LC-LCBDE, laparoscopic exploration of the common bile duct; LC-IOEST, laparoscopic cholecystectomy combined with intraoperative endoscopic sphincterotomy

<sup>a</sup> All *p* values are greater than 0.05

### Operative techniques

#### LC-IOEST technique [3, 5]

Laparoscopic cholecystectomy was performed using four trocars. We performed catheterization of the cystic duct and IOC using C-arm x-ray. If IOC yielded positive result, IOEST was performed by gastroenterologists with the equipment in the operating room. The patient was returned to the supine position. Pneumoperitoneum was canceled, and the nasogastric tube was removed. A pancreatocholangioscope (JF140 or JF100, Olympus) was inserted into the duodenal descending segment through the mouth. We performed retrograde endoscopic cholangiopancreatography (ERCP) before endoscopic sphincterotomy (EST). Small stones 5 to 8 mm in size could be cleared into the duodenum by saline irrigation using the cholangiographic catheter. Stones of 8 to 15 mm in size could be removed by basket or balloon catheter. Stones of larger than 15 mm were removed with a mechanical lithotripter (replacement wire basket, MAJ-247; Olympus) during intraoperative endoscopic sphincterotomy (IOEST). After biliary tract irrigation a second cholangiogram was performed to ensure that no stones had been retained. After the pancreatocholangioscope was removed, we created pneumoperitoneum and inserted a nasogastric tube to continue the LC.

#### LC-LCBDE technique

Laparoscopic cholecystectomy was performed using four trocars. The cystic duct as well as anterior and posterior walls of the common bile duct (CBD) were dissected. The distal cystic duct was clipped. Cannulation of the cholangiogram catheter proceeded from the small incision in proximal cystic duct through the trocar on the right mid-clavicular line below the ribs. The catheter was fixed by clip. The trocar was removed, then inserted again for placement of the catheter attached to the outside of the trocar. If extrahepatic duct stone was detected by preoperative ultrasonography, we lifted the anterior wall of the CBD bile duct using the dissection clamp. A small incision is made, and the electric hook was used for hemostasis. After we had covered the Foley catheter or the irrigation catheter with a segment of a silicon tube, it was inserted into the CBD. The stone was flushed out or extracted after repeated saline irrigation of CBD. A cholangioscope was considered if stone removal failed. If we suspected CBD stone by clinical history or preoperative ultrasonography without demonstrated stones, cholangiogram through the cystic duct was performed [3, 9]. We opened the CBD in the case of positive cholangiography results. For sludge or a stone smaller than 10 mm in the CBD, irrigation through the catheter in cystic duct or introduction of a 3-mm cholangioscope into cystic duct was used in an attempt to clear the duct. If these procedures failed, opening of CBD was suggested.

A 5- or 3-mm cholangioscope was inserted into CBD through the 10-mm trocar in subxyphoid region. A multiple instrument guide (MIG) gave the 3-mm cholangioscope access to the CBD. The cholangioscope was connected with a monitor, and the stones were extracted by basket after we had checked the biliary tract upward and downward.

Primary closure of the CBD using 3-0 Vicryl or T-tube placement was performed after stone removal. We inserted the T-tube in 96 cases and used primary closure in 45 cases. After closure, a second cholangiogram through the cystic duct or T-tube was performed to rule out the retained stones and to ensure an unobstructed distal CBD. A J-P tube was maintained in the subhepatic space, then removed after 48 h.

Antibiotics were administered once preoperatively, then postoperatively for 1 or 3 days. No antibiotics were administered during the operation. On the second day, a semiliquid diet was given. Follow-up assessment using ultrasonography was carried out for 3 to 27 months, with MRCP or ERCP used when indicated.

### Results

The surgical times, surgical success rates, stone numbers and sizes, retained stone incidences, complications, postoperative hospital lengths stay, and hospital charges were compared between the two groups.

#### Comparison of surgical results

There was no statistically significance difference in surgical time, surgical success rate, or stone number (sludge was excluded) between the two groups (Table 1). The surgical success rate for the LC-LCBDE group was 89.36% (126/141), with 15 cases converted to open surgery, 3 cases of which required IOEST because of stone removal failure, involving 1 basket intrapment, 7 CBD stone incarcerations, and 4 severe adhesions in Calot's triangle.

The LC-IOEST success rate was 91.40% (85/93), with 8 cases converted to open surgery. The conversion include five cases of papilla knife insertion failure because of CBD stone impaction, two cases of severe adhesion in Calot's triangle, and one case of papilla deformity. The diameter of the stone removed was 40 mm in the LC-LCBDE group and 15 mm in the LC-IOEST group.

#### Comparison of postoperative data

There were no significant differences in postoperative retained stones, complications, postoperative lengths of hospital stay, or hospital charges between the two groups (Table 2). Three cases of retained stone were found in the LC-LCBDE group and one case in the LC-IOEST group. All the retained stones were removed by postoperative EST. Seven cases involved complications, including four cases of asymptomatic serum amylase elevation (>1,000 I U/l), one case of pneumonia, one case of jaundice that did not improve (hepatitis B virus infection was suspected), and one case of bile leakage. Pleural effusion improved after conservative therapy.

**Table 2.** Comparison of postoperative data between the two groups<sup>a</sup>

Group	Retained stones (%)	Complications (%)	Hospital charge (RMB) <sup>b</sup>	Postop hospital stay
LC-LCBDE	2.38	5.55	13559.20 ± 3452.10	4.66 ± 3.07
LC-IOEST	1.17	9.41	17279.96 ± 4097.43	4.25 ± 3.46
t/x <sup>2</sup>	0.68	0.64	0.01	0.40

RMB, LC-LCBDE, laparoscopic exploration of the common bile duct; LC-IOEST, laparoscopic cholecystectomy combined with intraoperative endoscopic sphincterotomy

<sup>a</sup> All *p* values are greater than 0.05

<sup>b</sup> Exchange rate for hospital charge is 8.27

Eight cases in the LC-IOEST group involved complications, including five cases of asymptomatic serum amylase elevation, one case of bile leakage cured by ultrasonography-guided drainage, one case of pneumonia, and one case of pancreatic pseudocyst with a preoperative diagnosis of acute biliary pancreatitis. One patient experienced recurrent jaundice with a diagnosis of acute obstructive suppurative cholangitis. The ERCP showed a 1 × 1-cm mass in the papilla and the pathologic report was adenocarcinoma. Thus, the patient was misdiagnosed because of suppurative and necrotic secretion coverage. He underwent the Whipple procedure.

The longest postoperative length of hospital stay was 32 days in the LC-LCBDE group and 27 days in the LC-IOEST group. In the one cases, there was no jaundice improvement, and HBV infection was suspected. The other case involved a postoperative complication of pneumonia and pancreatic pseudocyst. No deaths occurred.

## Discussion

Because of applications involving EST, LC, and LCBDE, reports give increasing attention to mini-invasive treatment of peri-LC extrahepatic duct stones, and it has become the focus in recent mini-invasive biliary surgery. The following procedures are available:

- No treatment for asymptomatic CBD stone while waiting for its natural clearance. For symptomatic cases after LC, EST is suggested [1].
- Cannulation through the cystic duct to the CBD and duodenum for cholangiogram during LC or stone removal by EST [2, 14].
- Stone removal by LCBDE [2, 9, 14, 15, 18].
- Pre-LC EST [9, 14, 15].
- EST during LC [3–5, 9, 14–16, 18].
- Post-LC EST [2, 9, 15, 18].

We reviewed the merits and faults of these procedures in literature and found the following:

- It is not acceptable to suggest no treatment for asymptomatic CBD stone in Chinese patients.
- It is time consuming to remove stones by cholangioscopy during LC
- A longer learning curve is required for LCBDE because of laparoscopic suture in T-tube placement.

- Routine ERCP in pre-LC EST result in suffering and increased charge to patients. If elective ERCP is performed, 50% to 60% extrahepatic duct stone cases will show false-negative results. There still is a possibility of LC conversion to open procedure even if EST succeeds [3–5].
- A second operation should be performed in post-LC EST failure cases.
- EST during LC is better than pre- and post-LC EST, but needs more expertise and experience.
- EST may cause Oddi's sphincter dysfunction and still is controversial whether it leads to stone recurrence and biliary carcinoma caused by permanent duodenal and pancreatic fluid reflux [2, 12, 13, 15].

With regard to the clinical effectiveness, as well as social and economy benefits, LC-IOEST and LC-LCBDE are the most ideal of the mini-invasive procedures. They are more and more prevalent [6, 8, 17]. We compared these two procedures and found no differences between them in terms of the surgical time, the number extracted of stones, the retained CBD stones, postoperative length of stay, and the hospital charge. For the LC-IOEST group, the rates were 89.38% surgical success and 91.4% complications, and the corresponding rates were 5.55% and 9.41% in the LC-LCBDE group. No deaths occurred.

Tranter and Thompson [15] reported the following rates: 79% to 98% (mean, 92%) for LC-EST success 75% to 96% (mean, 91%) for stone clearance, 0% to 6% (mean, 1%) for mortality, and 3% to 16% (mean, 13%) for complications.

For the LC-LCBDE group, the success rate was 80% to 99% (mean, 96%); the stone clearance rate was 81% to 100% (mean, 95%); the mortality rate was 0% to 5% (mean, 1%) and the complication rate was 2% to 17% (mean, 8%). Stone recurrence and biliary carcinoma were complications 10 years later, reaching rates of 16% and 2%, respectively. There still is a lack of large-sample controlled research.

To avoid the late complications, LCBDE is the procedure of choice when the operations are in competent hands. Sugiyama and Atomi [12] reported that EST caused transient bile and pancreatic fluid reflux, which disappeared 1 year later. The 10-year follow-up assessment did not show increasing of anaphase complications such as biliary carcinoma, cholangitis, or stone recurrence.

We concluded that stones larger than 20 mm are not suitable for stone removal by EST [10]. Excessive

cutting of the sphincter may increase complications because cystic duct dilation and normal structure are required for LCBDE through it. In our study of 26 CBD cases, stones smaller than 10 mm were treated using this procedure. For a CBD diameter larger than 10 mm, first-stage closure of the CBD after stone removal not only avoided the T-tube, but also eliminated the possibility of bile leakage caused by T-tube removal in LCBDE. In our study, 75 patients underwent such a procedure, and no bile leakage or biliary tract stricture was reported.

In conclusion, the two reported procedures can be used for treating cholelithiasis with common bile duct stones. To decrease stone recurrence and biliary carcinoma incidence, which may be seen more often with EST, LC-LCBDE is the better choice, especially for young patients. Our current choice is LCBDE without a T-tube, or with a T-tube, through the cystic duct.

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