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Endoscopic-Laparoscopic Cholecystolithotomy in Treatment of Cholecystolithiasis Compared With Traditional Laparoscopic Cholecystectomy

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Abstract: The study aimed to compare the application values of endoscopic-laparoscopic cholecystolithotomy (ELC) and laparoscopic cholecystectomy (LC) for patients with cholecystolithiasis. It did a retrospective analysis of 107 patients with cholecystolithiasis who underwent ELC and 144 patients with cholecystolithiasis who underwent LC. There is no significant difference in operating time and expenses when comparing ELC with LC ($P > 0.05$). ELC showed significantly less blood loss during operation compared with LC ($P < 0.01$). Shortened exhaust time ($P < 0.05$) and hospital stay ($P < 0.01$) were present in patients who underwent ELC. Moreover, ELC showed decreased occurrence rate of dyspepsia and diarrhea in comparison with LC ($P < 0.01$). The stone recurrence rate of ELC was 16.67%. ELC decreased the recurrence of stone in common bile duct in comparison with LC. The contractile function of gallbladder was close to normal ($P < 0.05$), and the thickness of gallbladder wall significantly decreased ($P < 0.001$). Patients who underwent ELC showed less digestive symptom, good recovery, and low stone recurrence compared with those who underwent LC.

Key Words: endoscopic-laparoscopic cholecystolithotomy, laparoscopic cholecystectomy, complications, stone recurrence

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Cholecystectomy has been used for treating cholecystolithiasis for over 100 years.[1] Laparoscopic cholecystectomy (LC) has been widely used in the treatment of cholecystolithiasis in the last 20 years in China. However, studies in recent years have reported complications after LC, including dyspepsia and diarrhea, upper abdominal discomfort, bile reflux gastritis, bile duct injury, an increased risk for colonic cancer, postcholecystectomy syndrome, and stone recurrence in the common bile duct.[2–4] Cholecystolithotomy was first described by Akiyama et al[5] and Kerlan et al.[6] With the recognition of the precise functions of the gallbladder, surgeons are now aware that the gallbladder cannot only concentrate and store bile but can also regulate the bile flow. Endoscopic-laparoscopic cholecystolithotomy (ELC), an operation for removal of gallstones and preservation of gallbladder, has become more and more common. ELC has become popular in China in recent years, but it is seldom reported in America and Europe. In our research, we retrospectively investigated and compared the application values of ELC and LC for patients with cholecystolithiasis.

MATERIALS AND METHODS

The data were selected from February 2009 to 2010 in Hepatobiliary and Enteric Surgery Center, Xiangya Hospital, Central South University. The diagnosis of gallstone was according to clinical manifestations, such as upper or right upper abdominal discomfort or pain, right shoulder-back radiating pain, and positive Murphy sign. Through ultrasonographic examination or computed tomography, gallbladder stones can be found. All patients had lived in Hunan province for >10 years. A group of 107 patients, including 47 men and 60 women, underwent ELC. The mean age of these patients was 34.13 ± 15.07 years. The mean body mass index was $25 \pm 4.51\,kg/m^2$. In total, 37 of them had a single gallstone and 70 had multiple gallstones. The mean diameter of these gallstones was 1.76 ± 0.82 cm. Another 144 patients, including 59 men and 85 women, underwent LC. The mean age was 51.16 ± 13.83 years. The mean body mass index was $27.13 \pm 3.34\,kg/m^2$. In total, 12 of them had a single gallstone and 132 had multiple gallstones. The mean diameter of these gallstones was 1.54 ± 0.93 cm (Table 1). This research was approved by the Xiangya Hospital Medical Ethics Committee, and all patients signed the consent forms.

The selection of patients who underwent ELC was according to the following criteria: (1) having asymptomatic cholecystolithiasis or mild cholecystolithiasis without intrahepatic and extrahepatic bile duct stone; (2) the contractile function of the gallbladder $>1/3$ of normal after a fatty meal (2 fried eggs); (3) thickness of the gallbladder wall <4 mm; (4) having an expedite cystic duct and common bile duct; (5) diameter of the gallstone <3 cm, and

TABLE 1. Characterization of Patients

	ELC	LC
Patients (n)	107	144
Sex (n)		
Male	47	59
Female	60	85
Mean age (y)	34.13 ± 15.07	51.16 ± 13.83
Body mass index (kg/m^2)	25 ± 4.51	27.13 ± 3.34
Single gallstone (n)	37	12
Multiple gallstones (n)	70	132
Mean diameter of gallstones (cm)	1.76 ± 0.82	1.54 ± 0.93

ELC indicates endoscopic-laparoscopic cholecystolithotomy; LC, laparoscopic cholecystectomy.

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TABLE 2. Perioperative Outcomes

	ELC (n = 84)	LC (n = 93)	*P*
Operating time (min)	56.3 ± 12.2	53.4 ± 10.9	0.88
Blood lost (mL)	14.2 ± 6.5	34.6 ± 13.3	< 0.0001
Exhaust time (h)	18.2 ± 5.31	57.1 ± 7.6	< 0.0001
Hospital stay (d)	2.12 ± 1.2	4.1 ± 1.7	< 0.05
Expenses (CNY)	7800 ± 1100	7600 ± 2400	0.74

ELC indicates endoscopic-laparoscopic cholecystolithotomy; LC, laparoscopic cholecystectomy.

number of gallstones ≤ 5; (6) patient request to preserve the gallbladder and strong refusal to undergo cholecystectomy. The contraindication were as follows: (1) malformed cystic duct; (2) gallbladder atrophy; (3) malignant biliary tumor; (4) obstruction of cystic duct or common bile duct; (5) biliary pancreatitis.

A surgical team consisting of 3 surgeons performed the ELC. Laparoscopic and cholecystoscope were used in all the procedures. General anesthesia was given, CO_2 pneumoperitoneum was settled between 12 and 15 mm Hg, patients were turned to antitrendelengburg position. The positions of ports were the same as those of traditional 3-ports LC (two 1 cm and one 0.5 cm port). An incision in the fundus of the gallbladder was made; the length of the incision was determined according to the size of the gallstones. A rigid cholecystoscope or soft choledochoscope was introduced into the gallbladder cavity. For distending the gallbladder and improving visualization, 0.9% saline was used to lavage the gallbladder through the choledochoscope. The gallstones were removed using stone baskets and suction. After all stones had been extracted, clear bile could be observed at the orifice of the cystic duct by choledochoscope, and ultrasonography confirmed the result again. Biopsy of the gallbladder mucosa was routine, so that malignant biliary tumor could be excluded. The incision in the fundus of the gallbladder was sutured using a 4-0 absorbable thread. Patients were suggested to take ursodeoxycholic acid or tauroursodeoxycholic acid for 3 to 6 months. LC was performed according to routine.

The follow-up period for all patients was in the range of 21 to 72 months. We investigated the clinical symptoms of the patients by phone or e-mail. Ultrasonography was performed every 3 months in the first year and every 6 months after the first year. We measured the thickness of gallbladder wall and calculated the emptying index of patients who underwent ELC in the second year after operation. Meanwhile, we chose 27 healthy people without gallbladder disease and 27 patients with gallstones for comparison. The emptying index can reflect the contractile function of gallbladder, emptying index = (volume of gallbladder before fatty meal − volume of gallbladder after fatty meal)/volume of gallbladder before meal × 100%.

The statistical package SPSS22.0 software was used for data analysis. The measurement data were indicated as ($\bar{x} \pm s$). The difference between the 2 groups was evaluated by t test, and the enumeration data in the groups were evaluated by χ^2 test and Fisher exact probability, $P < 0.05$ indicates a significant difference.

RESULTS

Among the 107 patients who underwent ELC, 91 (85%) had their biliary stones removed, and 16 patients were converted to LC because of obstruction of the cystic duct and presence of malignant biliary tumor. Of 91 patients 84 were followed up. Of 144 patients who underwent LC 93 were followed up. The reasons for failure of follow-up were change of contact information and noncooperation of patients.

There was no significant difference in the operating time between ELC (56.3 ± 12.2 min) and LC (53.4 ± 10.9 min) ($P = 0.88$). ELC (14.2 ± 6.5 mL) showed significant less blood loss during operation compared with LC (34.6 ± 13.3) ($P < 0.0001$). ELC showed decreased exhaust time ($P < 0.0001$) and shortened hospital stay ($P < 0.05$) in comparison with LC. The cost of ELC (¥7800 ± 1100) and LC (¥7600 ± 2400) demonstrated no significant difference ($P = 0.74$) (Table 2).

One case of bleeding after operation occurred in LC, but none in ELC, and no significant difference in bleeding was present ($P = 0.525$). Two cases of bile leakage occurred in LC, but none in ELC, and no significant difference was present ($P = 0.498$). Four cases of incision infection occurred in LC, none in ELC, and no significant difference was present ($P = 0.123$). Two cases of dyspepsia and diarrhea occurred in ELC, and 16 cases in LC. The incidence of dyspepsia and diarrhea in ELC is significantly decreased compared with LC ($\chi^2 = 9.055$, $P = 0.001$). In 9 cases postoperative upper abdominal discomfort occurred in ELC, because the patients of those cases had stone recurrence in gallbladder and common bile duct. In 14 cases postoperative upper abdominal discomfort occurred in LC, all the patients of those cases had stone recurrence in the common bile duct. The incidence of postoperative upper abdominal discomfort showed no significant difference in ELC compared with LC ($P = 0.391$). Five cases had stone

TABLE 3. Complications After Operation

	ELC (n = 84)	LC (n = 93)	χ^2 value	*P*
Dyspepsia and diarrhea	2/84	16/93	9.055	0.001
Upper abdominal discomfort	9/84	14/93	0.735	0.391
Bleeding after operation	0/84	1/93		0.525
Bile leakage	0/84	2/93		0.498
Incision infection	0/84	4/93		0.123
Stone recurrence	5/84* 9/84†	22/93‡	1.331	0.249

*Stone recurrence in gallbladder.
†Stone recurrence in gallbladder and common bile duct.
‡Stone recurrence in common bile duct.
ELC indicates endoscopic-laparoscopic cholecystolithotomy; LC, laparoscopic cholecystectomy.

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TABLE 4. The Contractile Function of Gallbladder

	n	Volume (mL)		Emptying Index
		Before Meal	After Meal	
Gallbladder after ELC	22	19.8 ± 9.58	7.87 ± 4.53	57.02 ± 10.79[a]
Gallbladder with stone	27	29.58 ± 16.36	16.14 ± 12.98	42.02 ± 19.97[b]
Normal gallbladder	27	20.31 ± 4.76	8.07 ± 2.79	56.66 ± 13.51[c]

a and b ($t = 2.51$, $P = 0.019$).
a and c ($t = 0.21$, $P = 0.741$).

recurrence in gallbladder and 9 cases had stone recurrence in gallbladder and common bile duct in ELC. There were 22 cases of stone recurrence in LC. There is no significant difference in total stone recurrence, but ELC reduced the stone recurrence in common bile duct in comparison with LC (Table 3).

Significant difference in the emptying index was observed between a gallbladder after ELC and a gallbladder with stone ($P = 0.019$). No significant difference was observed in the emptying index between a gallbladder after ELC and a normal gallbladder ($P = 0.741$) (Table 4). In addition, no significant difference presented in the thickness of the gallbladder wall of patients before and after ELC ($P < 0.001$). The contractile function of the gallbladder of the patients who underwent ELC improved significantly in comparison with that of patients with gallstones, and was close to normal (Table 5). Gallbladder inflammation decreased significantly too.

DISCUSSION

The incidence of gallstone was about 20%.[7,8] In China, the incidence of gallstone has increased in recent years with a greater consumption of a high-fat diet, and Hunan province is a high incidence area. There are some disadvantages with LC, and bile duct injury has been one of the most severe complications of it.[3,9] The reported occurrence rate of bile duct injury ranged from 0.4% to 4%.[10] It could prolong the hospital stay, and result in cholangitis and biliary cirrhosis. Hepatic failure could be the lethal complication after bile duct injury.[9] Postcholecystectomy syndrome has been another problem that disturbed the patients and the surgeons with an occurrence rate ranging from 5% to 40%.[4,11] Patients with postcholecystectomy syndrome usually complain of upper abdominal discomfort, dyspepsia,[4] and diarrhea,[12] including symptoms similar to those experienced by patients before LC. Aprea et al[13] reported that the incidence of bile reflux gastritis over a period of 6 months after LC was about 58%. In the first year after cholecystectomy, Goldacre et al[2] reported that the occurrence rate of small intestinal tumor, colonic neoplasms, and rectal carcinoma was 4.6%, 2.0%, and 1.7%, respectively. Another research showed that the bile excretion dysfunction was perhaps related to high trait anxiety.[14,15] Moreover, cholecystectomy cannot prevent recurrent choledocholithiasis.[16,17] The main findings of our study are as follows: (1) there was no significant difference in operating time and expenses between ELC and LC; (2) ELC showed significantly less blood loss during operation compared with LC; (3) patients who underwent ELC had shortened exhaust time and hospital stay; (4) ELC showed decreased recurrence of dyspepsia and diarrhea in comparison with LC. No duct injury occurred in ELC; (5) the stone recurrence rate of ELC was 16.67%, whereas the recurrence rate of stone in common bile duct was decreased in ELC compared with LC; (6) the contractile function of the gallbladder was close to normal, and the thickness of the gallbladder wall significantly decreased. The technique of gallbladder-preserving cholelithotomy was first described in 1985.[5,6] It was supposed to preserve the function of gallbladder, and avoid the complications of cholecystectomy. In the following decades, percutaneous cholecystolithotomy,[18] extracorporeal shock wave lithotripsy, and percutaneous cholecystostomy were developed as the alternative treatment for gallbladder stones. However, the stone recurrence rate could reach 30% to 40% in 5 to 10 years after the procedures during primary research, the advantages were marginal.[19,20] But recently, with the development of laparoscope and choledochoscope, the average stone recurrence rate decreased significantly.[21–24] Close observation and a wide view of the gallbladder mucosa can be made by a rigid cholecystoscope with an enlarged image. Rigid cholecystoscope makes it easy to find minute lesions and submucous stones. Because of the fixed body, a rigid cholecystoscope cannot find all stones in the cystic duct. The flexible head of soft choledochoscope can reach almost every part of gallbladder, even cystic duct, so it has been used to extract the stone in cystic duct more than rigid cholecystoscope. But its narrow view makes it more difficult to extract larger stone and submucous stone.[25] Hence, rigid cholecystoscope and soft choledochoscope have been often used alternately during ELC. According to a study, the average stone recurrence rate was only 3% during an average follow-up time of 4 years[26]; a long-term study of 15 years reported the stone recurrence rate to be only 10.11%.[24] The stone recurrence rate of our study was 16.67%. The following reasons could lead to this: (1) although we recommended all the patients to take ursodeoxycholic acid or tauroursodeoxycholic acid for 3 to 6 months, some of them with poor compliance did not take the medicine regularly. (2) Hunan province is a region with high gallstone prevalence in China; lifestyle and spicy diet habits contribute to the formation of gallstones.[27]

TABLE 5. Thickness of Gallbladder Wall

	n	Before ELC	After ELC	*P*
Thickness of gallbladder wall (mm)	84	3.52 ± 0.46	2.55 ± 0.66	< 0.001

ELC indicates endoscopic-laparoscopic cholecystolithotomy; LC, laparoscopic cholecystectomy.

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In conclusion, patients who underwent ELC showed fewer digestive symptoms, good recovery, and low stone recurrence compared with those who underwent LC. Patients with gallstones who wish to preserve their functional gallbladder and avoid the LC-related complications have an alternative option—ELC.

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