

# Micro-Incision of the Cystic Duct Confluence in Laparoscopic Common Bile Duct Exploration for Elderly Patients with Choledocholithiasis

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**Abstract** Common bile duct (CBD) stones are common in elderly patients. The laparoscopic transcystic approach with micro-incision of the cystic duct confluence in common bile duct exploration (LTM-CBDE) is a modified laparoscopic transcystic approach. Its safety and efficacy have not been studied in elderly patients with secondary choledocholithiasis. This study evaluates the safety and efficacy of LTM-CBDE in elderly ( $\geq 65$  years) patients with secondary choledocholithiasis and compares the results with those in younger patients. In this retrospective analysis, 128 patients underwent LTM-CBDE from March 2007 to December 2013. The patients were divided into two groups according to age: the elderly group consisted of 50 patients aged  $\geq 65$  years and the younger group consisted of 78 patients aged  $< 65$  years. The preoperative morbidity rate, American Society of Anesthesiologists (ASA) score, previous abdominal operations, operation time, postoperative hospital stay, open conversion rate, postoperative complication rate, residual stone rate, recurrence rate and mortality were compared in both groups. The preoperative morbidity (41 vs. 28) and ASA score ( $2.5 \pm 0.7$  vs.  $1.8 \pm 0.6$ ) were higher in the elderly group ( $P = 0.000$ , in both groups). No significant differences in previous abdominal operations, operation time, postoperative hospital stay, open conversion rate, postoperative complication rate, residual stone rate, recurrence rate and mortality ( $P > 0.05$ ) were found between the two groups from March 2007 to December 2013. LTM-CBDE is a safe and effective treatment procedure for elderly

patients with secondary choledocholithiasis. For suitable patients, we recommend LTM-CBDE as the treatment of choice.

**Keywords** The cystic duct confluence · Common bile duct exploration · Laparoscope · Common bile duct stones · Elderly patients

## Introduction

Common bile duct (CBD) stones are common in elderly patients. Treatment with traditional choledochotomy followed by T-tube drainage has been used for many years. However, T-tube placement renders postoperative management difficult and decreases quality of life. With the developments in endoscopic techniques, endoscopic retrograde cholangiopancreatography (ERCP) with endoscopic sphincterotomy (ES) has been widely used to manage elderly patients with secondary choledocholithiasis; however, it is still debatable whether ERCP with ES can be considered the treatment of choice for elderly patients with secondary choledocholithiasis. Laparoscopic primary closure without T-tube has been reported by many authors [1–4]. However, no report has compared the difference in outcomes with this treatment in between elderly and younger patients. It is questionable whether primary closure without the T-tube is applicable for elderly patients and does not increase the risk of bile leakage and bile duct stenosis.

In 1996, our team began to use the modified transcystic approach in open surgery for patients with secondary choledocholithiasis with good results. In this approach, the cystic duct was slit, and the CBD was incised open 2–3 mm at the confluence, followed by intrahepatic and extrahepatic bile duct exploration and the removal of stones with a choledochoscope. The incised cystic duct

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confluence was closed primarily without a T-tube. This method avoids excessive incision of the CBD and reduces trauma to the area as much as possible. This approach is a likely technique to effectively decrease the risk of bile leakage and bile duct stenosis by primary closure.

In 2004, our team used the modified transcystic approach in laparoscopic surgery, a laparoscopic transcystic approach with micro-incision of the cystic duct confluence in common bile duct exploration (LTM-CBDE), and obtained a good preliminary effect. Chen et al. [5] in a retrospective case-control trial reported the results of LTM-CBDE and LCBDE in two different groups of patients with secondary choledocholithiasis. They concluded that LTM-CBDE can avoid postoperative T-tube drainage, decrease complications, shorten hospital stay and improve patients' quality of life.

However, its safety and efficacy has not been reported in elderly patients with secondary choledocholithiasis. The aim of this study was to evaluate the safety and efficacy of LTM-CBDE in patients aged  $\geq 65$  years and compare the results with younger patients aged  $< 65$  years.

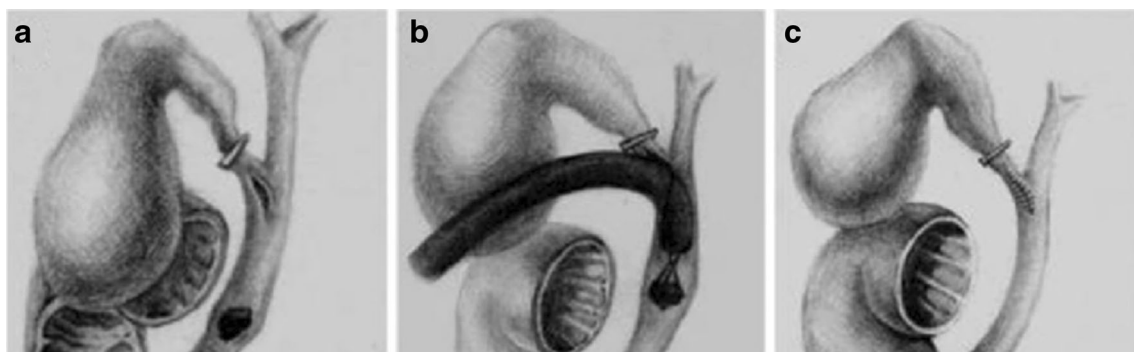
## Materials and Methods

From March 2007 to December 2013, 128 patients underwent LTM-CBDE at the Department of General Surgery, Beijing Hospital, Beijing, China. These patients were divided into two groups and a retrospective analysis was conducted. The patient population comprised 60 (46.9%) males and 68 (53.1%) females with a mean age of  $62.0 \pm 12.9$  years (range, 24–85 years). The groups were ascertained according to age. Group A comprised 50 patients aged  $\geq 65$  years (mean age,  $74.9 \pm 6.2$  years; range, 65–85 years). Group B comprised 78 patients aged  $< 65$  years (mean age,  $53.8 \pm 8.7$  years; range, 24–64 years). There were no significant differences in a male-to-female ratio, height, weight and follow-up duration.

All patients were diagnosed using abdominal computed tomography (CT), ERCP or magnetic resonance cholangiopancreatography (MRCP), and they were informed about their health conditions. Consent was given by each patient before the operation. Patients with the following conditions were excluded: (1) multiple or large stones in the CBD, (2) concurrent intrahepatic stones and stenosis of the biliary tract, (3) a diameter of CBD  $< 6$  mm, (4) abnormal anatomy in the cystic duct confluence, (5) malignant biliary tumours and (6) contraindications for laparoscopic surgery, such as severe intraperitoneal adhesions, hepatic cirrhosis and coagulation dysfunction, and poor cardiopulmonary function causing intolerance to pneumoperitoneum. In the others, LTM-CBDE was the first modality of treatment for those with secondary choledocholithiasis.

Operations were performed by the same surgical team. After general anaesthesia was administered to the patient, the four-port technique was used for LTM-CBDE: the first 10-mm trocar was supraumbilically inserted to the camera port with a CO<sub>2</sub> insufflation of 12 mmHg (1 mmHg = 0.133 kPa) and the other two 5-mm (right upper quadrant) and one 10-mm (subxiphoid) trocars were inserted under laparoscopic guidance (Karl Storz, Tuttlingen, Germany). Once the cystic duct was sufficiently exposed, it was slit and the CBD was incised approximately 2–3 mm (Fig. 1). A flexible choledochoscope was inserted through the cystic duct into the CBD. The stones were individually captured in a wire basket through the choledochoscope. The basket and stones were withdrawn together from the cystic duct confluence incision. If the CBD was completely clear and no evidence of remnant stones or bile duct stenosis was seen, the incision was primarily closed by suture without biliary drainage. Laparoscopic cholecystectomy was then performed in the standard antegrade fashion. An abdominal drainage tube was placed routinely to manage postoperative bile leakage.

With respect to patients' follow-up, physical examinations and laboratory tests were performed within the first month after surgery. After that, patients were followed up



**Fig. 1** The laparoscopic transcystic approach with micro-incision of the cystic duct confluence in common bile duct exploration (LTM-CBDE) surgical procedure. **a** After the cystic duct was exposed sufficiently, the

cystic duct was slit and the CBD was incised open 2–3 mm. **b** The stones were captured individually in a wire basket through the choledochoscope. **c** The incision of the cystic duct confluence was primarily closed by suture

at 3-month intervals for 1 year. Following this, they were followed up by physical examinations and laboratory tests at 6-month intervals. Abdominal ultrasound was performed at 6 months and 12 months after surgery. If these tests revealed unusual findings, such as CBD stones or bile duct stenosis, abdominal CT or magnetic resonance imaging was performed for a definitive diagnosis.

The preoperative morbidity rate, American Society of Anesthesiologists (ASA) score, previous abdominal operations, operation time, postoperative hospital stay, open conversion rate, postoperative complication rate, residual stone rate, recurrence rate and mortality were compared in both groups.

Statistical significance was analysed using the chi-square test and Student *t* test. A *P* value of <0.05 was considered statistically significant.

## Results

During the study period, 128 patients underwent LTM-CBDE for CBD stones in a Beijing hospital. The patient population comprised 60 (46.9%) males and 68 (53.1%) females with a mean age of  $62.0 \pm 12.9$  years (range, 24–85 years) (Table 1). Preoperative status is presented in Table 2. Group A had significantly higher comorbidities than group B ( $P = 0.000$ ). Cardiovascular diseases, diabetes mellitus and pulmonary diseases were significantly more frequent in group A ( $P < 0.05$ ). However, in the case of hepatic diseases and renal insufficiency, no significant differences were found between the groups ( $P = 0.321$  and  $0.134$ , respectively). The ASA score was also higher in group A ( $P = 0.000$ ). No significant differences were found between the groups regarding previous abdominal operation histories, involving either the upper ( $P = 0.134$ ) or lower ( $P = 0.249$ ) abdomen.

The mean operating time was  $155.7 \pm 70.4$  min in group A and  $139.5 \pm 61.0$  min in group B; however, the time difference was not significant ( $P = 0.170$ ) (Table 3). Regarding postoperative hospital stay, there was no significant difference between the groups ( $P = 0.226$ ). Primary

closure was successfully completed in all operations, and none required conversion to open surgery.

No significant difference was observed in the rate of postoperative complication between the groups ( $P = 0.132$ ) (Table 4). The overall incidence rate of complications was 18.0% in group A and 9.0% in group B. For complications related to the operation, there were no significant differences between the groups. Bile leakage was observed in three cases in group A and three cases in group B; however, there was no significant difference between the groups ( $P = 0.574$ ). Abdominal drains were removed within 24–48 h, if no bile leakage was observed. In three patients, the operated area was drained until bile leakage stopped. Two patients were managed by endoscopic nasobiliary drainage. And one patient was re-operated because of diffuse biliary peritonitis. Other complications were more common in group A than in group B. Heart failure, pneumonia and urinary retention were observed in both groups; however, no significant differences were found ( $P = 0.321$ ,  $0.210$  and  $0.749$ , respectively). No mortality or bile duct stenosis occurred during the hospital stay or at the postoperative follow-up in all patients. In the follow-up period, recurrent CBD stones were found in two patients of group A and two patients of group B, but the difference was not significant ( $P = 0.649$ ).

## Discussion

Occurrence of gallstones is common in elderly patients. Approximately 5.1–7.2% of patients undergoing cholecystectomy for gallstones have CBD stones [6, 7]. With advanced age, CBD stones occur more frequently [8]. Open cholecystectomy with CBD exploration was used to be the standard treatment with the lowest incidence of remnant stones, considerable morbidity (11–14%) and mortality (0.6–1%), especially in the elderly [9]. For elderly patients, mortality is much higher under the circumstances of emergency than elective operation [8, 10].

In the past few decades, two minimally invasive techniques, ERCP and laparoscopy, have been developed to manage such patients. Although ERCP with ES has been

**Table 1** Demographic data

Variable	Total	Group A	Group B	<i>P</i> value
No. of patients	128	50	78	
Male/Female	60/68	23/27	37/41	0.874
Mean age (year)	$62.0 \pm 12.9$	$74.9 \pm 6.2$	$53.8 \pm 8.7$	0.000
Age range (years)	24–85	65–85	24–64	
Height (cm)	$163.0 \pm 8.5$	$161.5 \pm 6.9$	$164.0 \pm 9.3$	0.105
Weight (kg)	$64.5 \pm 10.4$	$63.4 \pm 9.8$	$65.2 \pm 10.8$	0.342
Follow-up duration (months)	$18.1 \pm 13.2$	$16.8 \pm 12.5$	$18.9 \pm 13.6$	0.381

Values are presented as mean  $\pm$  SD or number

**Table 2** Preoperative status

Variable	Group A (n = 50)	Group B (n = 78)	P value
Preoperative comorbidities <sup>a</sup>	41 (82.0)	28 (35.9)	0.000
Cardiovascular disease	28	15	0.000
Diabetes mellitus	16	9	0.004
Hepatic disease	2	1	0.321
Pulmonary disease	16	5	0.000
Renal insufficiency	3	1	0.134
ASA score	2.5 ± 0.7	1.8 ± 0.6	0.000
Previous abdominal operation	10 (20.0)	7 (9.0)	0.073
Upper abdomen	3	1	0.134
Lower abdomen	7	6	0.249

Values are presented as number (%)

ASA American Society of Anesthesiologists

<sup>a</sup> Repeated counts on the same patient were excluded

regarded less invasive than surgery and a better option for elderly patients, subsequent adverse effects, such as pancreatitis, bleeding, perforation, recurrent retrograde cholangitis, recurrent stone formation and bile duct malignant degeneration, limit its effectiveness. Even for elderly patients, it is debatable whether ERCP with ES can be considered the treatment of choice for choledocholithiasis. LCBDE, although requiring advanced skills, brings the advantages of laparoscopic techniques to CBDE and preserves sphincter of Oddi to avoid those complications following ES. It is a safe and effective treatment modality for CBD stones for elderly patients [11, 12].

Usually, LCBDE is performed via the cystic duct or incision of CBD. The transcystic approach offers the same postoperative course as laparoscopic cholecystectomy, which is less invasive [13]. However, this approach may fail due to the small diameter of the cystic duct or presence of large and multiple stones. The angle of the cystic duct-CBD junction makes it difficult to examine the hepatic duct and CBD, particularly the hepatic duct due to its sharp angle. Elderly patients tend to have more number of stones that are larger in size. Thus, it is difficult to obtain a clearance of the bile duct with the transcystic approach alone [14]. This may explain why the transcholedochal approach was used in previous studies [11, 12]. Although the

transcholedochal approach solves these problems, it has some drawbacks. Increased trauma to the CBD increases the incidence of bile leakage and bile duct stenosis. Traditionally, the CBD is closed with T-tube drainage after choledochotomy and CBD stones removal. Successful primary closure without T-tube placement has been reported by many authors [1–4]. For elderly patients, we still consider the necessity of T-tube placement after CBD exploration. Because elderly patients are considered to be particularly prone to morbidity and mortality when they are surgically treated, a T-tube decreases spasm and oedema of sphincter after the exploration trauma [15, 16] that leads to increased biliary pressure. However, the T-tube-related complications should not be ignored, including CBD obstruction, bile leakage, persistent biliary fistulas, infection and dehydration and saline depletion. Accompanying discomfort and longer hospital stay is inevitable.

Compared with the transcystic and transcholedochal approaches, LTM-CBDE also has the advantage of the modified transcystic approach in open surgery. The incision not only overcomes the problems that the cystic duct is thin and the spiral valve acts as a barrier in exploration but also expands the entrance diameter of the CBD to >6 mm; this makes the insertion of the choledochoscope and removal of large multiple stones easier. Because the CBD incision

**Table 3** Operation results

Variable	Group A (n = 50)	Group B (n = 78)	P value
Operation time (min)	155.7 ± 70.4	139.5 ± 61.0	0.170
Postoperative hospital stay (day)	5.5 ± 1.3	5.2 ± 1.4	0.226
Remnant stone	0	0	
Recurrent stone	2	2	0.649
Open conversion	0	0	

Values are presented as mean ± SD or number

**Table 4** Complication and mortality

Variable	Group A (n = 50)	Group B (n = 78)	P value
Postoperative complications	9 (18.0)	7 (9.0)	0.132
Complications related to the operation	5 (10.0)	5 (6.4)	0.460
Bile leakage	3	3	0.547
Jaundice	1	0	0.210
Infection of incision	1	2	0.837
CBD stenosis	0	0	
Other complications	4 (8.0)	2 (2.6)	0.156
Heart failure	2	1	0.321
Pneumonia	1	0	0.210
Urinary retention	1	1	0.749
Mortality	0	0	

Values are presented as number (%)

CBD common bile duct

is <3 mm, the blood supply to the CBD remains unaffected; this can effectively reduce the occurrence of postoperative bile duct stenosis following primary closure. In this study, we further explored whether the technique was safe and effective for elderly patients. Although preoperative comorbidities in elderly patients were significantly higher than those in younger patients, no significant differences were observed in operation time, postoperative hospital stay and complications between both groups. It was noticed that all of the “mini” incisions were primarily closed, and T-tubes were not used in either groups with the modified transcystic approach. Our results suggest that the possibility of anterior CBD injury and postoperative stenosis could be avoided by this “mini” incision procedure.

Although LTM-CBDE for the treatment of secondary choledocholithiasis for elderly patients is safe and effective, it should be performed by experienced surgeons in minimum operating time possible and the choice of indications should be strictly controlled. For elderly patients with significant medical comorbidities or clinically unstable conditions, the operation modality should be carefully chosen. Whenever possible, LTM-CBDE should not be performed while the patient is in an acute inflammatory phase. Histories of abdominal operations are not contraindications; however, the surgeon should consider whether these may result in an overly long operation time. For patients in whom severe intraperitoneal adhesions are present or anatomy of the hepatic hilum is unclear, open operation should be considered as soon as possible. We tend to primarily close the CBD if no evidence of remnant stones or biliary stenosis exists. However, healing in elderly patients is poor, which makes them prone to bile leakage. Therefore, for elderly patients, the decision to place the T-tube must be considered. Nutritional support is necessary following operation, and active management of the comorbidities can reduce postoperative complications.

## Conclusions

Laparoscopic transcystic approach with micro-incision of the cystic duct confluence in common bile duct exploration is a safe and effective treatment procedure for elderly patients with secondary choledocholithiasis. For suitable patients, we recommend LTM-CBDE as the treatment of choice.

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## Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they have no conflict of interest.

**Human Rights** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. For this type of study, formal consent is not required. This article does not contain any studies with animals performed by any of the authors.

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