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Is Laparoscopic Common Bile Duct Exploration Safe for the Oldest Old Patients?

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Background: This study aimed to identify the risk factors for postoperative complications of laparoscopic common bile duct exploration (LCBDE) in the oldest old patients aged 80 years or older. **Methods:** From March 2001 to October 2020, 363 patients underwent LCBDE with stone removal. Based on their ages, they were divided into two groups, those younger than 80 years (n=240) and those 80 years old or older (n=123). We compared patient demographics, disease characteristics, surgical outcomes, and postoperative complications based on these groups. **Results:** The older group had a higher proportion of patients with a Charlson Comorbidity Index ≥5 (p<0.001) and the American Society of Anesthesiologist (ASA) physical status classification ≥3 (p<0.001). In addition, the older group had longer postoperative hospital stays than younger group (7.5±6.1 days vs. 6.2±3.9 days, p=0.013). However, there were no significant differences between groups according to the postoperative complications (13.8% vs. 20.3%, p=0.130). According to multivariate analysis, the risk factors for postoperative complications were Charlson Comorbidity Index ≥5 (odds ratio [OR]=2.307; 95% confidence interval [CI], 1.162–4.579; p=0.017) and operative time >2 hours (OR=3.204; 95% CI, 1.802–5.695; p<0.001). **Conclusion:** In patients with Charlson Comorbidity Index <5 and operation time <2 hours, LCDBE with stone removal can be considered safe for the oldest old patients.

Key Words: Laparoscopy, Choledocholithiasis, Aged, Postoperative complications, Multivariate analysis

INTRODUCTION

Common bile duct (CBD) stones occur in 10%–15% of patients with gallstone disease.[1] Up to approximately 4% of patients have symptoms related to CBD stones during the first year after cholecystectomy.[2] The appropriate treatment for CBD stones remains controversial.

Endoscopic retrograde cholangiopancreatography (ERCP) with endoscopic sphincterotomy (EST) plus laparoscopic cholecystectomy (LC) as a two-stage treatment is reportedly a safer treatment method than one-stage treatment.[3,4] Laparoscopic common bile duct exploration (LCBDE) with stone removal plus LC, a one-stage treatment, has been widely used in the treatment of bile duct stones since the 1980s with the development of laparoscopic surgery.[5] With the recent development of surgical devices and technology, many centers and surgeons have tried to practice LCBDE,[6,7] showing success in approximately 90% of patients. However, persistent and recurrent stones have been reported in 10% of patients.[7] Previous studies reported no significant differences in the success and complication rates between one- and two-stage treatments. However, one-stage treatment allows shorter hospital stays, requires fewer procedures, and is cost-effective.[8,9] Thus, the recent results of one-stage treatment are comparable or superior to those of two-stage treatment.

Life expectancy is gradually increasing with current trends in economic development and health promotion.[10] According to

data from the National Statistical Office of South Korea, the population aged 65 years or older increased from 5.9% of the total population in 1995 to 15.7% of the total population in 2020.[11] Life expectancy has also increased, reaching 82.3 years in 2016.[12] As a result, the number of older patients undergoing surgical procedures is increasing. These patients often have chronic diseases such as high blood pressure, diabetes, heart disease, or cerebral infarction; therefore, we anticipate additional postoperative risks compared to those in younger patients. Recent studies on surgery in older patients showed that risk stratification with comorbidity better predicts postoperative outcomes than age.[13] In contrast, Liu et al.[10] reported that patients > 70 years of age had a higher preoperative risk for CBD stones, although the results were comparable between one- and two-stage treatments. However, no studies have compared the outcomes of LCBDE in patients aged ≥ 80 years.

Therefore, this retrospective single-center study investigated LCBDE outcomes in the oldest old patients to identify the factors associated with increased complications.

MATERIALS AND METHODS

Patients

Overall, 363 patients with CBD stones underwent LCBDE at a single center between January 2003 and October 2020. CBD stones were diagnosed using abdominal ultrasonography, abdominal computed tomography, magnetic resonance cholangiopancreatography (MRCP), and ERCP. We enrolled patients who underwent LCBDE plus LC without attempting ERCP, attempted preoperative ERCP but failed, and underwent only LCBDE because they had previously undergone LC. We also excluded patients who underwent LCBDE in combination with other surgeries. If LCBDE was repeated for stone recurrence after LCBDE, only the first surgery was included in the study. We retrospectively reviewed the medical records for the following data: (1) clinical characteristics such as age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) score, medical history including surgeries, Charlson Comorbidity Index, diameter of CBD, number of CBD stones, bilirubin level, preoperative intensive care unit (ICU) management history, and cause of ERCP failure, (2) surgical outcomes including clearance of CBD stones, CBD stone recurrence, operation time, estimated blood loss, open conversion, and postoperative hospital stays, and (3) postoperative complications graded according to the Clavien-Dindo classification. We retrospectively investigated the postoperative complications using patient medical records, including bile leakage, wound infection, pancreatitis, dysuria, pneumonia, and urinary tract infection (UTI), and Clavien-Dindo classifications of grade III or higher were classified as major complications. This study was approved by the Institutional Review Board of Konyang University Hospital (No. 2021-03-007). The informed consent was waived. This study complied the ethical guidelines for authorship and pubhishing in the Annals of Geriatric Medicine and Research.[14]

LCBDE Technique

Surgery was performed as previously described.[15] The patients were placed in the supine position under general anesthesia. LCBDE was performed using a four-port method. A 12-mm port was used at the umbilicus for the camera, a 10-mm port was placed at the midclavicular line just above the nearest point from the CBD for the choledochoscope or fan retractor, and 5-mm ports were placed at the epigastric area and right anterior axillary line close to the right subcostal area. First, we performed cholecystectomy using a three-port method for the LC. We then performed a choledochotomy approximately 1 cm in length in the center of the anterior wall of the CBD using endo scissors. A flexible choledochoscope (Olympus, Tokyo, Japan) was inserted through this incision and any CBD stones were retrieved using saline irrigation, a wire basket (Olympus), and lithotripsy with a laser (Olympus). Subsequently, total stone removal was confirmed using a flexible choledochoscope from the distal CBD to the right and left hepatic ducts. The CBD incision was repaired by T-tube insertion, internal drainage, or primary suturing using polydioxanone 4-0 or 5-0 sutures (Ethicon Inc., Somerville, NJ, USA).

Statistical Analysis

Data are expressed as mean ± standard deviation. The patients were divided into two groups based on age: < 80 years (group A) and ≥ 80 years (group B). For statistical analyses, comparisons between groups were performed using Student t-tests for continuous data and chi-square or Fisher exact tests for categorical data. Logistic regression analysis was used to identify the factors associated with the risk of postoperative complications following LCBDE. Data were analyzed using PASW Statistics for Windows, version 18.0 (SPSS Inc., Chicago, IL, USA). Differences were considered statistically significant at $p < 0.05$.

RESULTS

Patient Demographics and Disease Characteristics

A total of 363 patients underwent LCBDE during the study period, including 240 patients < 80 years (group A; mean age 65.6 ± 12.8 years) and 123 patients ≥ 80 years of age (group B; mean age 83.9 ± 3.5 years).

We compared the demographic data and disease characteristics

Table 1. Comparison of patient demographics and disease characteristics between younger than 80 years old (A) and the 80 years old and older group (B)

Variable	Total (n = 363)	Group A (n = 240)	Group B (n = 123)	p-value
Age (y)	71.8 ± 13.7	65.6 ± 12.8	83.9 ± 3.5	< 0.001
Sex, female	186 (51.2)	118 (49.2)	68 (55.3)	0.318
BMI (kg/m^2)	22.6 ± 3.6	23.0 ± 3.6	21.7 ± 3.2	0.001
Charlson Comorbidity Index ≥ 5	70 (19.3)	17 (7.1)	53 (43.1)	< 0.001
ASA PS classification ≥ grade III	123 (33.9)	56 (23.3)	67 (54.5)	< 0.001
Previous abdominal surgery	109 (30.0)	67 (27.9)	42 (34.1)	0.228
Previous gastrectomy	61 (16.8)	35 (14.6)	26 (21.1)	0.138
CBD diameter (mm)	13.7 ± 5.3	13.5 ± 5.3	14.3 ± 5.1	0.134
Number of stone				0.031
Single	141 (38.8)	103 (42.9)	38 (30.9)	
Multiple	222 (61.2)	137 (57.1)	85 (69.1)	
Maximum stone size (mm)	12.3 ± 6.5	12.2 ± 6.3	14.2 ± 6.9	0.749
Initial total bilirubin (mg/dL)	2.9 ± 3.1	3.1 ± 3.4	2.5 ± 2.3	0.044
Past history				
Hypertension	157 (43.3)	96 (40.0)	61 (49.6)	0.093
DM	69 (19.0)	50 (20.8)	19 (15.4)	0.259
COPD	38 (10.5)	23 (9.6)	15 (12.2)	0.471
MI	29 (8.0)	13 (5.4)	16 (13.0)	0.014
CRF	5 (1.4)	1 (0.4)	4 (3.3)	0.047
CVA	38 (10.5)	25 (10.4)	13 (10.6)	1.000
Dementia	14 (3.9)	8 (3.3)	6 (4.9)	0.566
Liver disease	10 (2.8)	7 (2.9)	2 (1.6)	0.724
Preop ICU management	10 (2.8)	6 (2.5)	4 (3.3)	0.739

Values are presented as mean ± standard deviation or number (%).
BMI, body mass index; ASA PS, American Society of Anesthesiologists physical status; CBD, common bile duct; DM, diabetes mellitus; COPD, chronic obstructive pulmonary disease; MI, myocadiac infarction; CRF, chronic renal disease; CVA, cerebrovascular accident; ICU, intensive care unit.

between groups A and B (Table 1). The BMI was lower in group B than that in group A (21.7 ± 3.2 kg/m^2 vs. 23.0 ± 3.6 kg/m^2, p = 0.001). Compared to group A, group B had higher rates of Charlson Comorbidity Index ≥ 5 (43.1% vs. 7.1%, p < 0.001), ASA physical status classification > grade III (54.5% vs. 23.3%, p < 0.001) and a higher proportion of patients with multiple stones (69.1% vs. 57.1%, p = 0.031). The rates of myocardial infarction and chronic renal disease were significantly higher in group B—13.0% (p = 0.014) and 3.3% (p = 0.047), respectively—than in group A. However, the other demographic and disease characteristics did not differ significantly between the two groups, including sex ratio, previous abdominal surgery, previous gastrectomy, CBD diameter, maximum stone size, hypertension, diabetes, chronic obstructive pulmonary disease, cerebrovascular accident, dementia, liver disease, and preoperative ICU management (Table 1).

Surgical Outcomes

We compared surgical outcomes between groups A and B (Table 2). The methods of CBD repair (primary repair, internal drainage, or T-tube insertion) did not differ significantly (p = 0.420). While the operation time tended to be shorter in group B, the difference was not statistically significant (109.2 ± 45.1 minutes vs. 120.2 ± 58.0 minutes, p = 0.066). The estimated blood loss and open conversion rates did not differ significantly (p = 0.0268 and p = 1.000, respectively). The CBD stone clearance rate also did not differ significantly between the two groups (93.5% vs. 97.1%, p = 0.160). However, the postoperative hospital stay was significantly longer in group B compared to that in group A (7.6 ± 6.1 days vs. 6.2 ± 3.9 days, p = 0.013).

Postoperative Complications

The total postoperative complications did not differ significantly between the groups (13.8% in group A vs. 20.3% in group B, p = 0.130) (Table 3). One case of minor bile leakage and wound infection occurred in each group. The Clavien-Dindo classification grade II cases, including dysuria, hemobilia, ileus, intra-abdominal hematoma, pancreatitis, pneumonia, and UTI, also did not differ significantly between the groups. In addition, the rate of major

Table 2. Comparison of surgical outcomes between younger than 80 years old (A) and the 80 years old and older group (B)

Variable	Total (n = 363)	Group A (n = 240)	Group B (n = 123)	p-value
CBD drainage	165 (45.5)	115 (47.9)	50 (40.7)	0.221
Primary repair	198 (54.5)	125 (52.1)	73 (59.3)	0.420
Internal drainage	139 (38.3)	97 (40.4)	42 (34.1)	
T-tube insertion	26 (7.2)	18 (7.5)	8 (6.5)	
Clearance of CBD stone	348 (95.9)	233 (97.1)	115 (93.5)	0.160
Recurrence of CBD stone	50 (13.8)	39 (16.3)	11 (8.9)	0.076
Operation time (min)	116.5 ± 54.2	120.2 ± 58.0	109.2 ± 45.1	0.066
Estimated blood loss (mL)	43.3 ± 86.0	39.8 ± 53.6	50.4 ± 127.8	0.268
Open conversion	11 (3.0)	7 (2.9)	4 (3.3)	1.000
Postoperative overall complication	58 (16.0)	33 (13.8)	25 (20.3)	0.130
Postoperative major complication	27 (7.4)	16 (6.7)	11 (8.9)	0.526
Postoperative bile leakage	14 (3.9)	6 (2.5)	8 (6.5)	0.082
Postoperative hospital stays (day)	6.7 ± 4.8	6.2 ± 3.9	7.6 ± 6.1	0.013

CBD, common bile duct; SD, standard deviation.

Table 3. Comparison of postoperative complications between younger than 80 years old (A) and the 80 years old and older group (B)

Clavien-Dindo Classification	Complications	Total (n = 363)	Group A (n = 240)	Group B (n = 123)	p-value
Grade I		4 (1.1)	2 (0.8)	2 (1.6)	
	Bile leakage	2 (0.6)	1 (0.4)	1 (0.8)	1.000
	Wound infection	2 (0.6)	1 (0.4)	1 (0.8)	1.000
Grade II		27 (7.4)	15 (6.2)	12 (9.7)	
	Dysuria	5 (1.4)	4 (1.7)	1 (0.8)	0.666
	Hemobilia	1 (0.3)	1 (0.4)	0 (0)	1.000
	Ileus	4 (1.1)	2 (0.8)	2 (1.6)	0.607
	Intraabdominal hematoma	1 (0.3)	1 (0.4)	0 (0)	1.000
	Pancreatitis	1 (0.3)	0 (0)	1 (0.8)	0.339
	Pneumonia	14 (3.9)	6 (2.5)	8 (6.5)	0.082
	UTI	1 (0.3)	1 (0.4)	0 (0)	1.000
Grade IIIa		24 (6.6)	14 (5.8)	10 (8.1)	
	Bile leakage	12 (3.3)	5 (2.1)	7 (5.7)	0.116
	Intraabdominal fluid collection	7 (1.9)	7 (2.9)	0 (0)	0.100
	Pleural effusion	5 (1.4)	2 (0.8)	0 (0)	
Grade IIIb		2 (0.5)	2 (0.8)	0 (0)	
	Ileus	1 (0.3)	1 (0.4)	0 (0)	1.000
	Wound dehiscence	1 (0.3)	1 (0.4)	0 (0)	1.000
Grade IV		1 (0.3)	0 (0)	1 (0.8)	
	ARF	1 (0.3)	0 (0)	1 (0.8)	0.339
Total		58 (16.0)	33 (13.8)	25 (20.3)	0.130

UTI, urinary tract infection; ARF, acute renal failure.

complications also did not differ significantly between groups (8.9% vs. 6.7%, p = 0.526) (Table 2). Major bile leakage (Clavien-Dindo classification grade IIIa) occurred in seven cases (5.7%) in group B and in five cases (2.1%) in group A, while acute renal failure (Clavien-Dindo grade IV) occurred in one patient in group B.

Risk Factors for Postoperative Complications

The influence of sex, age, ASA score, surgical history, CBD diameter, stone size, stone number, preoperative bilirubin level, Charlson Comorbidity Index, and preoperative ICU management of postoperative complications after LCBDE are summarized in Table 4. A multivariate regression model included factors associated with overall postoperative complications at a $p < 0.15$ significance level

Table 4. Univariate and multivariate analyses of risk factor for postoperative complications

Factor	Univariate analysis		Multivariate analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Male	1.061 (0.605–1.860)	0.837		
Age ≥ 80 y	1.600 (0.903–2.837)	0.108		
BMI < 22.6 kg/m^2	1.010 (0.576–1.771)	0.972		
ASA PS classification ≥ 3	1.469 (0.827–2.610)	0.190		
Previous gastrectomy	1.547 (0.776–3.083)	0.215		
Previous abdominal surgery	1.277 (0.704–2.316)	0.420		
CBD diameter > 8 mm	2.647 (0.917–7.640)	0.072		
Largest stone size > 10 mm	1.988 (1.091–3.622)	0.025		
Multiple stone	1.652 (0.898–3.040)	0.107		
Total bilirubin > 1.3 mg/dL	1.384 (0.780–2.457)	0.267		
Charlson Comorbidity Index ≥ 5	1.771 (0.928–3.380)	0.083	2.307 (1.162–4.579)	0.017
Preop ICU management	1.733 (0.215–13.947)	0.605		
Operation time ≥ 2 hr	3.204 (1.802–5.695)	< 0.001	3.204 (1.802–5.695)	< 0.001
Biliary drainage (primary +/-)	0.741 (0.422–1.301)	0.297		

CBD, common bile duct; OR, odds ratio; CI, confidence interval; ASA PS, American Society of Anesthesiologists physical status; ICU, intensive care unit.

Table 5. Causes of endoscopic procedure failure

Cause	Total (n = 363)	Group A (n = 240)	Group B (n = 123)	p-value
ERCP cannulation failure	190 (52.3)	127 (52.9)	63 (51.2)	0.874
Bile duct cannulation failure	33 (9.1)	26 (10.8)	7 (5.7)	0.125
Periampullary diverticulum	27 (7.4)	20 (8.3)	7 (5.7)	0.407
Altered surgical anatomy	69 (19.0)	44 (18.3)	25 (20.3)	0.673
Poor cooperation of patient	51 (14.0)	30 (12.5)	21 (17.1)	0.265
Suspected ampulla malignancy	3 (0.8)	3 (1.3)	0 (0)	0.554
ERCP complication	7 (1.9)	4 (1.7)	3 (2.4)	0.693
Failure of stone removal after EST	70 (19.3)	47 (19.6)	23 (18.7)	0.874
Multiple stones	27 (7.4)	20 (8.3)	7 (5.7)	0.407
Large stone	43 (11.8)	27 (11.3)	16 (13.0)	0.611
ERCP no try	103 (28.4)	66 (27.5)	37 (30.1)	0.874
One-stage treatment	28 (7.7)	25 (10.4)	3 (2.4)	0.006
High risk	75 (20.7)	41 (17.1)	34 (27.6)	0.021

Values are presented as number (%).
ERCP; endoscopic retrograde cholangiopancreatography; EST, endoscopic sphincterotomy.

as determined by univariate analysis. In univariate analysis, age ≥ 80 years was not an independent factor for postoperative complications (odds ratio [OR] = 1.600; 95% confidence interval [CI], 0.903–2.837; p = 0.837). In multiple logistic regression analysis, Charlson Comorbidity Index ≥ 5 (OR = 2.307; 95% CI, 1.162–4.579; p = 0.017) and operation time ≥ 2 hours (OR = 3.204; 95% CI, 1.802–5.695, p < 0.001) were independent factors associated with postoperative complications.

Causes of Endoscopic Procedure Failure

The causes of endoscopic procedure failure are listed in Table 5. ERCP cannulation and stone removal failure did not differ significantly between the two groups (p = 0.874). Among patients who did not undergo ERCP, significantly more cases received one-stage treatment in group A (10.4% vs. 2.4%, p = 0.006), while group B had a higher proportion of patients at high risk for ERCP (27.6% vs. 17.1%, p = 0.021).

DISCUSSION

As the number of older patients increases in an aging society, several studies have demonstrated the safety and feasibility of LCBDE in patients aged ≥ 70 years.[10,16] However, no previous study has investigated the safety of LCBDE in patients aged ≥ 80 years. There-

fore, this study aimed to determine the safety of LCBDE and investigate the risk factors for postoperative complications by comparing the patient demographics, LCBDE results, and clinical factors affecting surgical outcomes between patients aged ≥ 80 years and < 80 years.

Choledocholithiasis is one of the most common causes of acute abdominal pain; moreover, the proportion of older patients with choledocholithiasis is increasing.[15,16] While LC is a basic treatment for gallstones, various methods for CBD stones are used in clinical practice.[17] One-stage treatment includes LCBDE with stone removal plus LC, while two-stage treatment includes ERCP with EST or endoscopic retrograde pancreatic drainage plus LC.[7] Despite these various treatment methods, an accurate consensus on the treatment of choledocholithiasis has not been established.[3,9] The results of a meta-analysis showed no differences between one- and two-stage treatment in overall morbidity (OR = 0.91; 95% CI, 0.66–0.24; p = 0.54) or mortality (OR = 0.36; 95% CI, 0.08–1.58; p = 0.18). The CBD stone clearance rate was higher in the two-stage treatment compared to that in the one-stage treatment (OR = 0.63; 95% CI, 1.16-2.28; p = 0.005), while the hospital stay was shorter for one-stage treatment (mean difference, -2.46 days; 95% CI, -3.67 to -1.24; p < 0.0001).[7] A meta-analysis reported a clearance rate of CBD stones after LCBDE of approximately 89.5%–100%.[17] In addition, Hua et al.[6] reported a stone clearance rate of 99%. These results are similar to the stone clearance rate of 95.9% in the present study, with no difference between groups A and B (97.1% vs. 93.5%, p = 0.160).

ERCP plus LC is a two-stage treatment; in these cases, LC can be a relatively simple surgery after endoscopic treatment. However, severe complications such as hemorrhage, pancreatitis, and duodenal injury can occur following ERCP and EST.[18] Recently, Hua et al.[6] reported a significantly greater number of patients with severe complications after two-stage treatment (Clavien-Dindo classification, > grade III: 10.7% vs. 0%, p = 0.004); however, the overall morbidity was comparable between the one- and two-stage treatment groups (23.8% vs. 22.6%, p = 1.000). Therefore, one-stage treatment may be necessary in certain cases, such as those conducted in high-risk patients with ERCP, those surgeries conducted by inexperienced endoscopists, or those conducted among patients who do not agree to undergo endoscopic treatment.[19] However, LCBDE is more difficult than LC; it must be performed by an experienced surgeon, and the operation time is longer than that of LC.[9]

Several studies have reported a higher incidence of postoperative complications in older patients.[20,21] Kim et al.[19] observed that as frailty increased, postoperative mortality (OR = 2.05, p < 0.001) and hospital stay (OR = 1.42, p = 0.001) increased after general surgery, while the risk of complications did not. Another study on postoperative complications in older patients > 80 years reported that preoperative ASA physical status classification ≥ 3 and longer operation time were dependent factors related to severe postoperative complications requiring ICU or transfer for complication management.[22] Similarly, our results showed a prolonged hospital stay in group B than in group A (7.5 ± 6.1 days vs. 6.2 ± 3.9 days, p = 0.013). However, the rates of postoperative complications (20.3% vs. 13.8%, p = 0.130) or major complications (8.9% vs. 6.7%, p = 0.526) did not differ significantly between the groups. Our results add to the evidence from the studies by Liu et al.[10] and Zheng et al.,[21] who reported that LCBDE can be considered a safe and effective treatment for CBD stones in patients aged > 70 years.

We also identified risk factors for postoperative complications after LCBDE. Liu et al.[23] showed that surgeon experience was the most important factor for bile leakage (OR = 4.228; 95% CI, 1.330–13.438; p = 0.03). Hua et al.[6] observed a significantly higher rate of bile leakage for slender CBD (< 8 mm vs. ≥ 8 mm: risk ratio = 9.87; 95% CI, 1.89–51.6; p = 0.007). In this study, the bile leakage rates did not differ between the two groups (5.7% vs. 2.1%, p = 0.116). However, multivariate analysis in the present study showed that Charlson Comorbidity Index ≥ 5 (OR = 2.307; 95% CI, 1.162–4.579; p = 0.017) and operation time ≥ 2 hours (OR = 3.204; 95% CI, 1.802–5.695; p < 0.001) were important risk factors for postoperative complications, while age ≥ 80 years was not (OR = 1.600; 95% CI, 0.903–2.837; p = 0.837). These results suggested that surgeons should carefully evaluate comorbidities and be cognizant of the operation time when operating on older patients.

We also investigated the differences in the causes of endoscopic failure according to age group (Table 5). The most common cause of ERCP failure was altered surgical anatomy (69/363; 19.0%). More patients were at high risk for ERCP in group B than in group A, and older patients tended to receive one-stage treatment. In addition, poor cooperation with ERCP was more common in group B (17.1%). A study comparing the results of LCBDE without ERCP and after failure of endoscopic stone removal reported no significant differences in the length of hospital stay, operation time, or number of complications.[24] Thus, one-stage treatment without attempting ERCP may be non-inferior. Analysis of the group of patients who did not undergo ERCP in this study showed that one-stage treatment was more common in younger patients (10.4% vs. 2.4%, p = 0.006), likely due to avoiding ERCP because post-ERCP pancreatitis is more likely to occur in younger patients.

Previous studies have demonstrated that primary repair is safe and should be an alternative to T-tube drainage and internal drainage during LCBDE.[25,26] In the present study, we most commonly

performed choledochotomy repair using the continuous primary repair method (198/363; 54.5%). The CBD drainage rates, such as T-tube or internal drainage, did not differ significantly between the two groups (p = 0.420).

This study had some limitations. First, since this was a single-institution retrospective study, the generalizability of the results to other populations is limited. However, it is important to note the safety of LCBDE in the oldest old patients aged ≥ 80 years. Second, the number of patients in the older group was only about half that in the younger group; therefore, the risk of bias was high. Finally, although an operation time of 2 hours or more was an independent risk factor for postoperative complications, there is a limit to applying these results in clinical practice as the operation time cannot be precisely predicted before surgery. However, these findings provide a basis for surgeons to be aware of operative time. Further research is needed to develop a method to predict operative time before surgery.

In conclusion, LCBDE can be safely performed in the oldest old patients aged ≥ 80 years. However, LCBDE should be carefully considered in patients with several comorbid diseases and those expected to have longer operative times.

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CONFLICT OF INTEREST

The researchers claim no conflicts of interest.

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AUTHOR CONTRIBUTION

Conceptualization, JIM; Data curation, HJY, JIM; Investigation and methodology, HJY, JIM; Project administration, HJY, JIM, SJL, ISC; Supervision, JIM, SJL, ISC; Writing-original draft, HJY, JIM; Writing-review & editing, HJY, JIM, SJL, ISC.

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