# Long-term outcome of laparoscopic common bile duct exploration: a retrospective study of 5-year experience

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**Purpose**
Validation of combined laparoscopic cholecystectomy (LC) and exploration of the common bile duct (LECBD) for concurrent cholelithiasis and choledocholithiasis.
**Patients and methods**
One hundred and four adult patients with cholelithiasis and choledocholithiasis who underwent combined LC/LECBD from January 2015 to December 2019 at Sohag University Hospital were retrospectively enrolled. Demographic and clinical data, postoperative complications, recurrence rate, and long-term treatment failure were analyzed.
**Results**
LC/LECBD was successfully completed in 101 patients (97.11%), whereas only three patients (2.88%) underwent conversion to open approach. Female/male ratio was 68/36 with mean age of 41.35 ± 9.08 years. Clearance of bile duct stones was accomplished in 103 (99.03%) patients. Minor postoperative complications were observed in seven patients (6.73%), among which bile leakage occurred in three patients (2.88%). Missed common bile duct stones developed in one patient (0.96%), superficial surgical-site infection in two (1.92%) patients, and slippage of T-tube in one (0.96%). Biliary injury or stricture was never reported during the follow-up period (range: 2–7) years.
**Conclusion**
LC/LECBD is safe and effective for management of concomitant cholelithiasis/choledocolithiasis with excellent long-term outcome.

**Keywords:**
choledocholithiasis, cholelithiasis, laparoscopic common bile duct exploration

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## Introduction

Common bile duct (CBD) stones (choledocholithiasis) occur in 10–15% of individuals with symptomatic gallbladder stones (cholelithiasis) [1]. CBD stones may remain asymptomatic for a long time. Contrarily, it could be associated with harmful complications, including recurrent biliary colic, calcular obstructive jaundice, cholangitis, acute pancreatitis [2], and bile leakage after cholecystectomy [3].

The ideal management of CBD stones remains controversial. A variety of techniques, including conventional open cholidocholithotomy, minimally invasive procedures (laparoscopic and robotic), and endoscopic and ultrasonic approaches, are available [4].

Prior to the advent of laparoscopic and endoscopic interventions, open cholecystectomy and choledocholithotomy were the standard treatment. During recent years, several minimally invasive techniques have remarkably replaced the conventional open approach [5], among them, endoscopic retrograde cholangiography (ERC) with laparoscopic cholecystectomy (LC) was widely applied for management of concomitant choleilithiasis/choledocholithiasis for many decades [6]. However, unfavorable drawbacks comprised not only the need for more than one stage but also serious morbidity such as bleeding, perforation, and possibly lethal pancreatitis [7].

The introduction of furtherly refined minimally invasive procedures, enhanced laparoscopic experience, and availability of modern equipment during the last two decades have popularized LECBD/LC as a safe and reliable one-stage procedure for cholelithiasis/choledocholithiasis [8].

Nonetheless, that the incidence of late (possibly years after LECBD) stricture of the CBD and recurrent ductal stones prompts meticulous observation to accurately assess the rate of long-term treatment failure [9]. Therefore, our study will address the safety

and effectiveness of LECBD, as well as the long-term outcome, including CBD strictures and recurrent stones.

## Patients and methods

Prospectively collected data from 104 patients for whom LC/LECBD was carried out due to cholelithiasis/choledocholithiasis (January 2015–December 2019) at Sohag University Hospital, Sohag, Egypt, were retrospectively analyzed. To assess safety and effectiveness of LECBD as a primary strategy for treatment of choledocholithiasis, postoperative events, including long-term consequences, were studied. The study was approved by Sohag University Medical Research Ethics Committee.

### Eligibility criteria

Adult patients (age >18 years) with cholelithiasis/choledocholithiasis and CBD diameter greater than 8 mm who underwent LC/LECBD were included in this series. Patients with intrahepatic biliary stones, CBD diameter less than 8 mm, pancreatitis, liver cirrhosis, and children were excluded.

### Preoperative assessment

All patients were meticulouly evaluated for medical history, clinical examination, and laboratory investigations (including routinely serum bilirubin and alkaline phosphatase levels). Preoperative medical imaging entailed abdominal ultrasonography and magnetic resonance cholangiopancreatography.

### Surgical procedure

All surgical procedures were performed under general anesthesia in reverse Trendelenburg position (with slight rotation to the left) by the same team of experienced laparoscopic surgeons.

The classic LC four-port configuration was applied, including subumbilical 10–12-mm camera port (inserted with open method or optical trocar insertion). Alternatively, insufflation with a Veress needle was first done followed by trocar insertion. Another 10–12-mm working trocar was placed through incision in the epigastric area inferior to the xiphoid process, while a third 5-mm working trocar was inserted in the right hypochondrial region in the midclavicular line. Another 5-mm port was introduced just below the subcostal margin in the right anterior axillary line.

The procedure commenced with dissection of the Calot's triangle and visualization of both cystic duct (CD) and artery. After careful dissection and exposure of the anterior surface of the supraduodenal part of the CBD, a longitudinal supraduodenal choledochotomy (1–1.5 cm) was performed using diathermy hook alone or with scissor. Subsequently, flexible fiber-optic choledochoscope 5 mm (Pentax Co., Germany) was used for stone visualization prior to extraction.

Extraction of stones was accomplished by milking of the CBD, irrigation of bile duct by saline, stone retrieval by Dormia basket, or balloon extraction. These techniques were used with and possible without using a 5-mm flexible fiber-optic choledochoscope during stone extraction and bile duct clearance.

Choledochotomy incision was then closed primarily by interrupted or continuous suture using 3/0 or 4/0 polygycolic acid sutures or alternatively over latex T-tube insertion. LC was then carried out before placement of single tubal drain at the end of the procedure in the Morison's pouch.

Patients with T-tube underwent transtubal cholangiography on the seventh to tenth postoperative days (preceded by intermittent clamping of the T-tube to test for bile leak). T-tube was removed after confirmation of the absence of bile leak and normal T-tube cholangiogram.

Transcystic exploration of the CBD was carried out in few patients in whom the CD was dilated via introduction of choledochoscope to visualize the stones inside the CBD. The extraction of stone(s) was done by the same previous techniques.

### Postoperative follow-up

All patients were monitored postoperatively for assessment of postoperative complications (within the early first 3 months) and long-term outcome (2–7 years). Serum bilirubin levels were measured every other day during hospital stay, repeated during the first year every 3 months, and annually thereafter. Assessment of the biliary strictures and recurrent ductal stones was performed by abdominal ultrasonography annually, symptomatic patients underwent magnetic resonance cholangiopancreatography.

### Data analysis

Statistical analysis was performed using SPSS Statistics for Windows, IBM Corp., Version 20, Armonk, NY. Data were recorded as mean±SD. *t*-Test was used to compare these data within the group. Results at $P$ less than or equal to 0.05 were considered statistically significant.

## Results

LECBD was successfully completed in 101 out of 104 patients. Three patients had conversion to open

approach (2.88%) due to massive adhesions, unclear anatomy, and large impacted stones. Preoperative patients' data are listed in Table 1.

The mean age was 41.35 ± 9.08. There was obvious predilection toward female gender (*n*=68, 65.38%). The common presenting complaint was jaundice (*n*=52, 50%), followed by pain (*n*=24, 23.07%). Sixteen patients had past history of cholangitis (*n*=16, 15.38%). In contrast, biliary stones were accidentally discovered in twelve (11.53%) patients. Two (1.92%) patients underwent ERCP preoperatively in both, failure of stone extraction was related to the large stone size. Endoscopic CBD stent was inserted to alleviate jaundice and removed subsequently during LECBD.

Successful CBD clearance was achieved in 103 patients, with a success rate of 99.03%. Retained bile duct stones were found in one patient (0.96%) who required postoperative extraction by ERCP.

In total, eight (7.69%) patients underwent transcystic exploration, while supraduodenal choledochotomy was done in the remaining 96 (92.30%).

After clearance of ductal system was performed, drainage by T-tube was carried out in 56 patients (53.84%), while primary CBD closure was performed in 40 patients (38.46%). The mean operative time was 120.05 ± 9.12 min and mean hospital stay was 5.40 ± 2.69/day (Table 2).

There was neither an intraoperative complication nor mortality in this series. Only minor early postoperative complications were encountered in seven patients (6.73%), including three (2.88%) cases of bile leak (<100 ml/24 h), which resolved spontaneously within 3–5 days. Two patients had superficial surgical-site infection around the exit site of the drain. Premature slippage of the T-tube occurred in one patient who consequently underwent ERCP with CBD stent insertion. The remaining one had retained CBD stone for which endoscopic treatment by ERCP was carried out.

Long-term follow-up was performed for 2–7 years postoperatively. Biliary fistula and/or stricture, cholangitis, or peritoneal were never reported. Recurrent stones were identified in only one patient [1 (0.96%)] and were treated by ERCP+ES (Table 3).

**Table 1 Demographic, clinical, and radiologic data**

| Parameter | LCBDE (*n*=104) [*n* (%)] |
|---|---|
| Age (years) | 20–68 (41.35 ± 9.08) |
| Sex (female/male) | 68/36 |
| Jaundice | 52 (50) |
| Pain abdomen | 24 (23.07) |
| Past h/o of cholangitis | 16 (15.38) |
| Accidental discovery | 12 (11.53) |
| Past h/o ERCP failure | 2 (1.92) |
| Mean diameter of CBD (mm) | 11.96 ± 2.7 |
| Mean diameter of CBDS (mm) | 1–2.6 (1.54 ± 0.54) |

CBD, common bile duct; CBDS, common bile duct stones; ERCP, endoscopic retrograde cholangiopancreatography; LCBDE, laparoscopic common bile duct exploration.

## Discussion

In this study, we demonstrated that LC/LECBD for cholelithiasis/choledocolithiasis is safe and effective with excellent long-term outcome.

During the recent surge of minimally invasive techniques, conventional surgical procedures for management of cholelithiasis/choledocolithiasis raised several concerns [10]. Thus, a number of studies have reported on the feasibility, safety, and effectiveness of ERCP followed by LC (ERCP/LC) versus combined LC/LECBD [11].

**Table 2 Intraoperative details**

| Parameters LCBDE | *n*=104 [*n* (%)] |
|---|---|
| Mean choledochotomy length (cm) | 1–1.5 |
| Approach for LCBDE | |
| Transcystic | 8 (7.69) |
| Choledochotomy | 96 (92.30) |
| CBD closure | |
| Primary repair | 40 (38.46) |
| Over T-tube | 56 (53.84) |
| Conversion to open | 3 (2.88) |
| Intraoperative complication | 0 |
| Mean operative time (min) | 90–180 (120.05 ± 9.12) |
| Postoperative hospital stay (days) | 4–10 (5.40 ± 2.69) |

CBD, common bile duct; LCBDE, laparoscopic common bile duct exploration.

**Table 3 Postoperative Complications**

| Complication (*n*=104) | LCBDE [*n* (%)] |
|---|---|
| Early complications (first postoperative six months) | |
| Bile leakage | 3 (2.88) |
| Missed CBD stone | 1 (0.96) |
| Pritubal infection | 2 (1.92) |
| Slippage of T-tube | 1 (0.96) |
| Late complications (from 6 months up to 84 months) | |
| Biliary fistula | 0 |
| Biliary stricture | 0 |
| Recurrent cholangitis | 0 |
| Recurrent stones | 1 (0.96) |
| Peritoneal sepsis and abscess | 0 |

CBD, common bile duct; LCBDE, laparoscopic common bile duct exploration.

ERCP/LC represents currently the preferred procedure in many centers worldwide. However, an increasing number of specialized medical centers with advanced laparoscopic equipment and surgical experience reported that LC/LECBD is associated with superior results [12].

Overall, the results of our study, which demonstrated excellent long-term outcome after LC/LECBD, confirm with previous clinical trials in which patients were followed up for up to 62 months postoperatively [13,14]. Those studies have not shown any evidence on late biliary complications. In another study [15], an extremely low frequency of recurrent CBD stones (0.96%) was observed. In addition, the incidence of bile duct stricture was zero [15].

On the other hand, a prospective randomized trial [16] and a meta-analysis on seven prospective randomized trials, including 787 patients, have shown that LC/LECBD compared with ERCP/LC result in almost similar long-term and short-term results [16,17]. The authors found that LC/LECBD and ERCP/LC exhibit no statistically significant difference with regard to clearance of ductal stones, postoperative morbidity, and mortality.

One-stage procedure, LC/LECBD may provide several advantages in comparison with ERC/LC as a two-stage endo-laparoscopic procedure. For instance, ERC/LC may be associated with lethal morbidities such as bleeding, perforation, and pancreatitis [18]. ERCP/LC could also result in serious complications with grave long-term consequences such as sphincter of Oddi disruption with subsequent failure of its function as a barrier against duodenobiliary reflux [19]. Duodenobiliary reflux is associated with influx of bacteria, a well-documented mechanism for formation of ductal stone, ascending cholangitis, multiple liver abscesses, and even malignancy [20,21].

Likewise, clearance of CBD stones by ERCP is liable to failure due to inability of retrograde intubation in some patients with duodenal diverticulum and anomalous pancreaticobiliary ductal junction. Therefore, recurrences of CBD stones seem more likely a two-stage group [22,23] after long-term follow-up periods.

LCBDE can be carried out through the transductal or the transcystic approach. In the present study, transcystic approach was performed in eight (7.69%) patients and choledochotomy approach in the remaining 96 (92.30%) patients. While choledochotomy provides unrestricted access and enhanced view of the bile duct [24]. The advantages of transcystic approach include its simplicity as well as preservation of the integrity of the biliary system. Likewise, closure of CD stump is not technically demanding as it is usually closed without sutures. Thus, the approach is associated with lower morbidity compared with choledochotomy [25].

In our series, transcystic approach was successfully performed in 8 patients. In line with previous studies, there was no increase in morbidity or mortality and long-term complication [26]. Despite the encouraging results in those patients, CD approach required complex mechanical or pneumatic dilatation [26]. Given that mechanical or pneumatic dilatators are not always available in our center, we used them in a relatively small number of patients.

A number of studies demonstrated that mucosal ischemia during choledochotomy procedure represents the main risk of long-term morbidity, particularly with the inappropriate use of electrocautery and extended longitudinal choledochotomy. Similarly, long-term complications might relate to recurrent cholangitis, direct trauma from stones, pancreatitis, and strictures that may result from insertion of large T-tube, which does not match with ductal lumen diameter [27,28]. Contrary to those reports, our results showed no increased risk of long-term morbidity among patients who underwent choledochotomy during LECBD. The impact of choledocotomy technique on postoperative complications and long-term outcome after LECBD remains controvesial. Opening of the bile duct with diathermy hook or ultrasonic device was reported to be risky [29]. In contrast, others studies found no correlation between the choledochotomy techniques and postoperative morbidity [30]. In our series, we found that choledochotomy using electrocautery hook, scissor, or both was not associated with increased morbidity or delayed complications.

Choledochotomy closure after ductal clearance during LECBD can be accomplished by primary suturing or T-tube drainage. The current literature provides evidence that primary closure is superior with regard to safety and feasibility with faster postoperative recovery and lower morbidity [31]. Nevertheless, other studies demonstrated that T-tube drainage exhibits no influence on long-term complication [32,33].

Among our patients, drainage by T-tube was carried out in 56 (53.84%), whereas primary closure was performed in the remaining 40 (38.46%). This accords with our results, which indicated that there was no significant difference between both techniques with regard to early postoperative complications as well as the long-term outcome.

## Conclusion

Single-stage management of concomitant cholelithiasis/choledocolithiasis by LC/LCBDE is safe and effective. LC/LCBDE was not associated with delayed biliary strictures or recurrent stones.

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### Conflicts of interest

There are no conflicts of interest.

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