Laparoscopic exploration can salvage failed endoscopic bile duct stone extraction

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INTRODUCTION Conventionally, patients who failed endoscopic removal of common bile duct stones (CBDS) by endoscopic retrograde cholangiopancreaticography (ERCP) would be treated with open cholecystectomy and common bile duct exploration. Laparoscopic common bile duct exploration (LCBDE) is an established option for treating CBDS. The aim of this paper was to look at the feasibility of LCBDE as a salvage procedure after failed endoscopic stone extraction (ESE). The secondary endpoint was to examine the short-term outcomes of our LCBDE series.

METHODS We retrospectively reviewed a prospective database to study the feasibility of LCBDE as a salvage procedure for failed ERCP.

RESULTS Since its inception in 2006, 43 patients had undergone LCBDE at our centre. This was achieved via a transcystic approach in 25 patients and laparoscopic choledochotomy in 15 patients. There were three conversions. Of these 43 patients, 21 had a pre-operative attempt at ESE, but only six patients had their ducts cleared endoscopically. The 15 patients who failed ESE underwent LCBDE, of which 14 achieved successful stone clearance and one required open conversion. One patient developed a bile leak, which resolved spontaneously. The median length of stay (LOS) for these 15 patients was three days, while the median LOS for the whole cohort was two days.

CONCLUSION LCBDE has been shown to be a safe and effective method for treating CBDS, with the added bonus of a short hospital stay. Where the expertise is available, LCBDE is a safe option as a salvage procedure for failed ESE.

Keywords: bile duct exploration, cholecystectomy, common bile duct stones, endoscopic stone extraction, laparoscopy
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INTRODUCTION

Common bile duct stones (CBDS) are encountered in approximately 10%–15% of patients with cholelithiasis.[1] The incidence of CBDS increases in elderly patients. There is also a possibility of incidental detection of CBDS during elective laparoscopic cholecystectomy.[2] With the advent of laparoscopic cholecystectomy, the conventional treatment approach of CBDS is pre-operative endoscopic retrograde cholangiopancreaticography (ERCP) with endoscopic stone extraction (ESE), followed by laparoscopic cholecystectomy. However, should ESE fail, the patient is usually subjected to an open common bile duct exploration. Laparoscopic common bile duct exploration (LCBDE) has been proven to be a safe, reliable and effective treatment for CBDS, and has gained wider acceptance with its added advantage of being a single-stage procedure.[3-6] The purpose of this study was to present our early experience of LCBDE, with special emphasis on the utility of LCBDE as a salvage procedure for failed ESE.

METHODS

This was a retrospective review of a prospective electronic database. Demographics, comorbid conditions, presenting symptoms, pre-operative liver function tests, imaging and ERCP findings, type of admission, American Society of Anesthesiologists (ASA) status, operative data, drains and T-tubes, length of stay, open conversions and complications were recorded and studied.

LCBDE was performed mainly as an elective procedure. Patients with suspected CBDS were given two treatment options, one-stage LCBDE or a two-stage treatment that entails ERCP followed by laparoscopic cholecystectomy. LCBDE was also offered to those who failed ESE. In patients with acute cholangitis, management was centred on the resolution of infection first, as recommended by the Tokyo guidelines.[7] These include anti-microbial treatment coupled with biliary decompression when required, usually by ERCP or percutaneous transhepatic cholangiography (PTC), should ERCP fail. In patients with failed ESE, LCBDE was performed only after the resolution of the acute infective episode. The technical operative details were recorded for the type of LCBDE performed. All the patients underwent standard four-port cholecystectomy with carbon dioxide pneumoperitoneum at 12 mmHg pressure. We performed selective transcystic intra-operative cholangiogram in patients with a history of jaundice, deranged liver function test, biliary pancreatitis and those with a dilated common bile duct and/or ductal stones on pre-operative imaging.

LCBDE was performed only upon confirmation of CBDS based on the intra-operative cholangiogram. LCBDE was performed either via the transcystic route or via a laparoscopically created longitudinal choledochotomy. The transcystic route was our preferred method of performing LCBDE. If that failed, or if the stones were in the proximal

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common hepatic duct and the common bile duct size was more than 10 mm in diameter, a choledochotomy was made for LCBDE. Transcystic exploration was performed with either a Nathanson Common Bile Duct Exploration set (CDES 550-Nathanson, Cook, Brisbane, Australia) or a 2.8-mm choledochoscope. In the latter approach, the stone extraction was done with the ZeroTip Nitinol stone retrieval basket (Boston Scientific-Microvasive, Natick, MA, USA) introduced through the working port. The cystic duct stump was then clipped after confirmed stone clearance on completion of cholangiogram or check choledochoscopy. Laparoscopic choledochotomy was performed in selected cases, and LCBDE was performed with a 5-mm choledochoscope. All the longitudinal choledochotomies were closed primarily with intracorporeal suturing with 4-0 absorbable polyglactin 910 over a T-tube or an internal biliary stent.

Closed suction abdominal drain was placed in the right hepatorenal pouch of Morrison at the discretion of the operating surgeon. Drains were removed when the drainage was less than 20 cc per day. Bile leak was defined as having one or more of the following: (a) any bilious peritoneal drainage beyond the third postoperative day; (b) bilious drainage > 50 ml any day postoperatively; (c) re-operation for biliary peritonitis; (d) radiological drainage of a biloma.

Patients were discharged once they could tolerate diet, ambulate independently and had an ambulatory pain score < 2. All patients discharged with T-tubes were instructed on the care of the tube by a dedicated specialist hepatobiliary nurse clinician. For these patients, a T-tube cholangiogram was performed on the seventh postoperative day as an outpatient procedure, and an early clinic appointment was arranged to review the images and results. In patients with complete stone clearance, the T-tube would then be clamped and subsequently removed at the next clinic review, usually about four weeks later, so as to allow time for the tract to mature. For patients in whom internal biliary stents were placed, the stents were removed endoscopically about four weeks after discharge as a day procedure.

LCBDE was offered either as ambulatory surgery (AS 23) or same day admission. It was also offered to inpatients in selected circumstances. All AS 23 patients were reviewed the following morning by a duty medical officer before discharge. All complications were graded according to the classification system described by Dindo et al.[8]

RESULTS

Since the inception of the LCBDE programme in 2006, 43 patients had undergone LCBDE at Tan Tock Seng Hospital, a 1,300-bedded, tertiary care teaching hospital. Of these, 29 were female (67.4%) and 14 were male (32.6%), with a median age of 61 (range 27–85) years. Out of the 43 patients, 26 had at least one comorbid condition. Four patients had previous abdominal surgery, including one patient with a previous laparoscopic cholecystectomy. Abdominal pain (55.9%) and obstructive jaundice (44.2%) were the most common presenting complaints. Table I summarises the patients' demographics and presentations.

Table I. Patient demographics, comorbid conditions, clinical presentation and ASA status (n = 43).

Parameter	No. (%)
Gender	
Female	29 (67.4)
Male	14 (32.6)
Race	
Chinese	37 (86.0)
Malay	4 (9.4)
Indian	1 (2.3)
Others	1 (2.3)
Comorbidities	
Hypertension	23 (53.5)
Diabetes mellitus	7 (16.3)
Ischaemic heart disease	4 (9.3)
Renal failure	2 (4.6)
COPD	1 (2.3)
Overall comorbidity	26 (60.5)
Presenting complaints	
Abdominal pain	24 (55.8)
Jaundice	19 (44.2)
Cholangitis	12 (27.9)
Pancreatitis	4 (9.3)
Cholecystitis	4 (9.3)
ASA grade	
ASA 1	2 (4.6)
ASA 2	34 (79.1)
ASA 3	7 (16.3)

COPD: chronic obstructive pulmonary disease; ASA: American Society of Anesthesiologists

A total of 22 patients opted for single-stage LCBDE, while therapeutic ESE was attempted in the remaining 21 patients. There were 26 attempts at ESE (three patients had two attempts each and one patient had three attempts) made equally by the gastroenterologist and hepatobiliary surgical colleagues. Out of these 21 patients, four were cleared of CBDS and no evidence of ductal stones on ERCP was found in two patients. Interestingly, in these six patients, subsequent intra-operative cholangiogram (IOC) detected the presence of CBDS, which then required LCBDE to be performed. Of the 15 patients who failed ESE, endoscopic sphincterotomy and stenting were performed in four patients, sphincterotomy alone in two patients and stenting alone in one patient. Table II summarises the details of the ERCP findings. These 15 patients were referred to the hepatobiliary surgical division, and LCBDE was offered as a salvage procedure. The treatment plan and operative approach for our series are summarised in Table III.

Out of the 15 patients, transcystic exploration was attempted in nine patients and laparoscopic choledochotomy was performed in six patients. The median operating time for these 15 patients was 250 (range 140–465) minutes. There was one complication and one conversion. The patient with complication developed a bile leak that resolved spontaneously with observation and was discharged on the fourth day with a drainage

Table II. ERCP findings (n = 21).

ERCP	No. of patients
Successful cannulation and removal of stones	4
Successful cannulation with no stones seen	2
Failed stone clearance	15
Failure of cannulation	8
Endoscopic sphincterotomy alone	2
Sphincterotomy and stenting	4
Stenting alone	1

ERCP: endoscopic retrograde cholangiopancreaticography

Table III. Treatment plan and operative approach.

Parameter	No. of patients
Treatment plan	
Opted for single-stage LCBDE	22
Subjected to pre-operative ERCP	21
Failed ESE	15
Operative approach	
Transcystic LCBDE	25
Laparoscopic choledochotomy*	15
Conversion to open surgery	3
Median operating time; range (min)	
Overall	185 (75–465)
Transcystic approach	170 (75–465)
Laparoscopic choledochotomy	265 (185–415)

*Includes one patient with laparoscopic choledochoduodenostomy.
LCBDE: laparoscopic common bile duct exploration; ERCP: endoscopic retrograde cholangiopancreaticography; ESE: endoscopic stone extraction

tube *in situ*. The drainage tube was removed in the clinic two weeks later. The patient with open conversion due to dense adhesions at the Calot's triangle was planned for an LCBDE via the transcystic approach. She had presented with acute biliary pancreatitis. Subsequent ERCP and ESE failed due to stone impaction. She then underwent sphincterotomy and stenting for decompression of the biliary tree as well as surgery at the same admission, five days after the failed ERCP attempt.

Among the 43 patients, transcystic exploration was attempted in 28 (65.1%) patients and laparoscopic choledochotomy was performed in 15 (34.9%), among whom there was one patient with a laparoscopic choledochoduodenostomy performed as well. This was a 76-year-old female patient with a past history of cholecystectomy five years ago who presented with acute cholangitis. In view of her age, multiple ductal stones and a common bile duct size of 25 mm on pre-operative computed tomography (CT) imaging, laparoscopic choledochoduodenostomy was performed after the resolution of her cholangitis. She was discharged well on postoperative Day 4.

The median operating time of all the patients in our series was 185 (75–465) minutes. The median operating time for the transcystic approach was 170 (75–465) minutes and that for laparoscopic choledochotomy was 265 (185–415) minutes. Out of the 43 patients, 17 underwent same-day admission and a similar number of patients were offered ambulatory care surgery. Nine patients who were already admitted for their illness were offered LCBDE in the same admission. The median length of hospital stay was two (range 1–11) days. After successful stone clearance, completion IOC was done in 34 (79.1%) patients, and in nine patients, choledochoscopy was considered sufficient for confirming stone clearance. We did not use laparoscopic ultrasonography for LCBDE. In 30 patients, closed suction abdominal drainage tubes were placed. The drainage tube was always placed in the Morrison's pouch, and the tube was removed after a median duration of two days. Eight patients had a T-tube inserted, with a mean duration to T-tube removal of 35 days.

Overall, there were three conversions in the series (n=43). One patient had an inadvertent passage of the cholangiogram catheter through a false opening in the posterior wall of the cystic duct and required open conversion to exclude biliary injury. Two other patients had open conversions; one due to dense adhesions and the other due to a lost stone in the peritoneal cavity. One of the above conversions was included in the group of 15 patients who had salvage LCBDE. One patient had failed LCBDE and three patients developed complications. A 36-year-old female patient presented with obstructive jaundice. She had successful ESE and was listed for interval elective laparoscopic cholecystectomy. At the time of laparoscopic cholecystectomy, a common bile duct and common hepatic duct stone was evident at IOC. An LCBDE via the transcystic route was performed. The common hepatic duct stone could not be retrieved due to technical difficulty, and the patient's bile duct was deemed too small to allow a safe choledochotomy. She was planned for ERCP the following day, and her postoperative ESE was successful. One patient developed a bile leak (Grade 1 complication), which was mentioned earlier. This was the only patient in the series who was discharged with an abdominal drainage tube *in situ*. A 67-year-old female patient who presented with cholangitis had a retained stone (Grade 3 complication) and required additional ERCP for stone clearance. She had an unsuccessful attempt at ESE and stenting was performed. Three weeks later, she underwent elective LCBDE, and stone clearance was confirmed. The stent was left *in situ*. At the postoperative endoscopy for stent removal, a small CBDS was identified and retrieved. The final patient had a retained stone that presented as a bile leak. Transcystic exploration was performed, and as completion cholangiogram was apparently normal, no drain was placed. The patient developed fever on postoperative Day 5 and CT confirmed a collection in the Morrison's pouch. Percutaneous drainage of the collection revealed bile. ERCP was performed and the retained stone was found and removed, and her bile duct was stented. The patient recovered, and the stent was removed after four weeks. All three patients with retained stones received postoperative ERCP, and ESE was successful. There was no mortality in our study.

DISCUSSION

About 10% of patients with calculous gallbladder disease present with CBDS, particularly with increasing patient age. Hence, it is important that expertise in dealing with CBDS is routinely available. CBDS are commonly managed by ESE, followed by laparoscopic cholecystectomy (two-stage approach). The safety

and efficacy of the two-stage approach have been proven, and its long-term results have been shown to be satisfactory. The risks associated with ERCP and the morbidity associated with open surgery have paved the way for considering LCBDE. This was supported with technological advancement. Recently, single-stage LCBDE has been increasingly reported as a safe and effective treatment option.[3-6,9]

ERCP has been a valuable tool for the management of CBDS. However, with the advent of magnetic resonance cholangiopancreaticography and endoscopic ultrasonography, the role of diagnostic ERCP has become obsolete. Even when the pre-operative diagnosis of CBDS is confirmed radiologically, the routine use of ERCP has several disadvantages, including significant short-term risks such as bleeding, pancreatitis, cholangitis and perforation. The long-term risk of ERCP includes stenosis of sphincter of Oddi, reflux of duodenal contents into the common bile duct, with bactibilia and ascending cholangitis and possible cholangiocarcinoma. The pre-operative predictors of CBDS are accurate in less than 75% of patients.[10] In a review of 400 patients with positive predictors suggesting CBDS, Chen et al found that ERCP in up to 42% of patients did not detect any evidence of CBDS.[11] Martin et al reported that up to 50% of patients would be exposed to the unnecessary risks of ERCP.[12] Some patients may even be subjected to multiple attempts of ESE should their initial attempts fail to remove all the stones. In our series, four patients had multiple attempts for endoscopic stone extraction. In experienced hands, the overall success of ESE for CBDS is encouraging. Hence, there is a definite role for ESE in the management algorithm of CBDS when technical expertise is available, particularly in patients with prohibitive risks for operation.

If and when ESE fails, surgical exploration of the common bile duct is mandatory. Conventional open surgical exploration has been the gold standard management option. LCBDE offers an opportunity to clear the CBDS without the morbidity associated with ERCP or open common bile duct exploration. Moreover, transcystic exploration and laparoscopic choledochotomy can achieve CBDS clearance most of the time, with little necessity for antegrade sphincterotomy, hence preserving the anatomical sphincter along with its physiological benefits. A review by Martin et al[13] and two published meta-analyses[14,15] have provided strong evidence that LCBDE is at least as safe and effective in achieving stone clearance with low cost incurred from a single hospitalisation, along with low morbidity and mortality. LCBDE has the added benefit of avoiding potential complications associated with ERCP.[16-18] In a recent report, Campbell-Lloyd et al[4] found that LCBDE did not appear to increase the incidence of long-term adverse sequel beyond the reported prevalence of post-cholecystectomy syndrome. LCBDE also eliminates the waiting interval following ESE and elective laparoscopic cholecystectomy. Hence, LCBDE has the potential to be considered as a gold standard first-line treatment option for CBDS.

The management of CBDS is dictated by the availability of resources and local expertise. At our institution, both single-stage and two-stage procedures were offered to our patients. LCBDE was attempted in all 43 patients, including the 21 in whom ERCP was performed. As demonstrated in our study, CBDS can still be detected intra-operatively despite an apparently successful ESE. This fact stresses the importance of recognising that the passage of stone from the gallbladder is not an uncommon phenomenon. Thus, the ability to perform LCBDE becomes invaluable when such unsuspecting situations arise.

Based on an intention-to-treat analysis, our stone clearance rate using LCBDE was 93.3% (14 out of 15 patients). This takes into account the one open conversion and CBDS clearance by open common bile duct exploration. The stone clearance rate from our early experience is still comparable to that of other published data.[3,4,6,9] The overall stone clearance rate in our series was 86.0% (37 out of 43 patients), taking into account the three open conversions. Three patients with retained stones required postoperative ERCP. As three patients needed rescue ERCP following LCBDE, it is thus apparent that ERCP and LCBDE have distinct, yet complementary roles.

In Singapore, the predominant approach for CBDS clearance is still ERCP and ESE first, followed by laparoscopic cholecystectomy. We believe, however, that the pendulum will eventually swing toward LCBDE as the treatment of choice for CBDS. With this paper, we hope, at the least, to recommend LCBDE as a salvage procedure for failed ERCP. It is unlikely that LCBDE will replace ERCP completely, but both the procedures have to be considered as complementary and their roles have to be redefined. ERCP with ESE should be recommended for high-risk surgical patients as a rescue procedure for retained stones after LCBDE and for the endoscopic management of post-operative biliary leakage. The incidence of retained CBDS after LCBDE should decrease with experience and refinements in technology. We are convinced that LCBDE should be offered as an alternative first-line treatment option for CBDS. We strongly propose LCBDE as a salvage procedure for failed CBDS clearance at ERCP.

CONCLUSION

LCBDE is safe and effective, and evidence supports its use as a first-line alternative treatment for CBDS. Although LCBDE cannot completely replace ERCP, both techniques should be considered complementary and their roles defined appropriately according to the locally available resources and expertise. LCBDE can be safely used as a salvage procedure for failed ERCP.

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