Laparoscopic CBD exploration.our experience

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Abstract: Background: Common bile duct (CBD) stone is the strong indication for surgical therapy, especially in patients with obstructive jaundice. With the development of laparoscopic equipment and technology, laparoscopic common bile duct exploration (LCBDE) has been widely used in clinical practice. Many previous studies have demonstrated that LCBDE is less invasive than conventional open surgery and it permits single-stage management of CBD stone. **The aim** of the study was to evaluate the safety and feasibility of laparoscopic common bile duct exploration (LCBDE) through cholangiotomy with T-tube placement in management of common bile duct stones (CBDS). **Patients and methods:** A total of 17 patients who were diagnosed with concomitant choledocholithiasis and cholelithiasis have undergone LCBDE using a choledochotomy (CBD) from December 2014 to janauary2017. The choledochoscope was inserted into the lumen of the CBD, all CBD stones were retrieved using a basket or a Fogarty balloon catheter or were irrigated with saline. After CBD clearance was confirmed using the choledochoscope, the choledochotomy was closed with the bard absorbable suture material **Results:** total of 17 patients **(**12males and 5 females) were recruited; the mean patient age in the present study was 47.88 ± 14.7 years. Preoperative liver function tests were obtained on the day before surgery. The bilirubin level ranged from 0.28 to 6.47 mg/dl (mean 3.13 ± 2.50 mg/dl), and gallstone pancreatitis was present in three patients which were treated preoperatively in a conservative manner with fluid resuscitation and nutritional support; surgery was performed when the symptoms were relieved and laboratory result return to normal. In terms of disease characteristics, the diameter of the CBD ranged from 8 to 27 mm (mean 12.2 ± 4.2 mm), and the number of CBD stones ranged from 1 to 4. The size of the largest CBD stone in each case ranged from 5 to 27 mm (mean 9.6 ± 7.4 mm). The mean operative time was **108.88 ± 30.3** min, and the mean length of the postoperative hospital stay was 6.0 ± 4.6 days. In patients who had large stones (over 10 mm, we used stone forceps to fragment and retrieve the stones. No patient developed symptoms or clinical signs that could be interpreted as late stricture. Four patients were converted to open surgery due to bleeding, severe inflammation, problems with equipment, or difficulties in introducing the T-tube. At follow-up, ALT, AST, ALP, and bilirubin returned to normal in all patients. Apart from that, no imaging or re-intervention was required for any of the patients. All patients recovered without any postoperative complications, except for 2 patients, one patient who developed postoperative pancreatitis and other patient develop biliary leakage and there were no recurrent stones. No death within 30 days after surgery was seen. **Conclusions**, LCBDE is a safe and feasible alternative for managing CBDS. The advantages are most pronounced in the case of multiple and large CBDS. The risk for retained stones and stricture is low.

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1. Introduction

Surgical common bile duct (CBD) exploration is one of the treatment modalities for choledocholithiasis, which is the second most common complication of cholelithiasis, occurring in approximately 10–15 % of cholelithiasis patients **[1-3]**. This approach has advantages over endoscopic retrograde cholangiopancreatography (ERCP) with endoscopic sphincterotomy (EST), which is a widely used treatment for choledocholithiasis but carries a significant risk of complications such as acute pancreatitis, duodenal perforation, bleeding, and, importantly, iatrogenic injury to the muscles of the sphincter of Oddi **[4-7].** With advances in laparoscopic techniques and instruments, laparoscopic CBD exploration (LCBDE) has been performed more frequently, and there have been many reports that laparoscopic choledocholithotomy is less invasive than open surgery **[8-9]**. LCBDE was first reported in 1991, and has been performed in combination with new technologies. It is considered safe and efficient **[7, 8]**. However, LCBDE has especially high technical requirements and may involve extensive manipulation of instruments such as balloon dilators, guide wires, catheters, and baskets, as well as laparoscopic suturing of the CBD **(8-10).** However, in some patients with a narrow CBD, LCBDE is associated with a high risk of postoperative CBD stricture and bile leakage due to technical difficulty. To prevent these complications, surgeons have inserted T-tubes during LCBDE; however, T-tube insertion is nevertheless associated with complications, including infections that ascend

through the drain, dislocation of the T-tube (which results in bile leakage), and most importantly, patient inconvenience due to prolonged T-tube placement **[10-13]**. Surgeons have proposed a variety of techniques for laparoscopic choledocholithotomy, although there remains no consensus as to the best surgical treatment method **[14-17].**

2. Patients and Methods

A total of 17 patients who were diagnosed with concomitant choledocholithiasis and cholelithiasis have undergone surgery in Ainshams university hospital from December 2014 to janauary2017. This study was approved by the ethics committee and all the patients provided their informed consent for the publication of this study. These 17 patients (12 patients were diagnosed as obstructive jaundice by MRCP, and five patients with past history of failed ERCP. Patients were included in study with no history of previous surgery and no contraindications for the laparoscopic approach. Preoperative diagnosis was confirmed according to clinical features, laboratory results, including unexplained elevated liver function tests, sonographic evidence of bile duct stones showing a dilated ductal system, and radiologic tests including magnetic resonance cholangiopancreatography or computed tomography (CT) scan. Radiographic evidence of common bile duct obstruction in which the diameter of CBD is more than 0.8 cm; with several large stones and a distal stricture which is highly likely to fail ERCP.. All medical data were prospectively collected, including the following: demographic and clinical features (age, sex, American Society of Anesthesiologists (ASA) grade, body mass index (BMI) and preoperative laboratory results); disease characteristics (size and number of stones, diameter of the CBD and the presence of gallstone pancreatitis); and surgical outcomes (CBD clearance, operative time, conversion to laparotomy, length of postoperative hospital stay, postoperative morbidity and mortality). An unstable patient, and local conditions in the porta hepatis that would make exploration hazardous are the primary contraindications to laparoscopic common bile duct exploration. The LCBDE was usually performed using a four-port technique. All patients were placed in the supine position under general anesthesia, and the surgeon and second assistant (who held the laparoscope) were positioned to the left side of the patient. The first assistant stood on the opposite side. For the procedure, we used the following four trocars: one 10-mm trocar on the transumbilicus for the scope; one 5-mm trocar on the subxiphoid process for the flexible choledochoscope; and an additional two 5-mm trocars for the surgeon's working channel (one at the right subphrenic area and the other at the right anterior axillary line). Sometimes an extra 5 mm trocar was inserted between the subxiphoid and subcostal trocar ports. Appropriate location for the extra port was determined by inserting an 18-G needle through the abdominal wall. Hartman's pouch of the gallbladder was grasped and retracted superiorly and laterally by the first assistant to facilitate the dissection of Calot's triangle carefully. After the cystic artery was clipped and excised, the cystic duct was also clipped to prevent the passage of any gallbladder stones into the CBD during manipulation. Peritoneum on the CBD along the free edge of the lesser omentum was divided, thereby exposing the anterior surface of the CBD. In the case of uncertainty regarding the anatomy, bile was aspirated from the CBD with a needle. Choledochotomy was performed with a conventional technique, using standard laparoscopic instruments. It was made vertically in the supraduodenal portion of the CBD with a retractable blade or scissors (Parrot scissors). The vessels located on either side of the CBD were avoided. The length of the incision was determined according to the size of the CBD stones. It was a maximum of 10 mm but long enough to extract all calculi. A 3.5 mm choledochoscope (Storz) for choledochoscopy and a dormia basket (Boston Scientific) 1.6 mm were used to extract the calculi. It was introduced via a 5-mm subxiphoid trocar and inserted into the lumen of the CBD through incision. All stones in the lumen of the CBD were retrieved using a wire basket, Fogarty balloon catheter, saline irrigation with suction, or direct manipulation with atraumatic forceps. In cases with a very large and compacted stone, we fragmented the stones using the stone forceps and then retrieved the fragments. During the procedure, lap-gauze was placed at Morrison's pouch to prevent the spillage of extracted stones. To confirm the clearance of the CBD, the choledochoscope was passed downwards and advanced to just proximal to the ampulla of Vater (AOV. The lumen of the ascending CBD was also assessed for the absence of remnant stones by moving the choledochoscope upward. The number of stones extracted and the size of the largest stone were documented. A prefashioned T-tube, guttered along one third of its circumference lengthwise, was used, for cutting the T limb to appropriate size. The two short limbs were cut to 1 and 1.5 cm, respectively. The shorter limb was introduced toward the distal part of the CBD at a safe distance from the ampulla of Vater and the longer limb was directed upwards in order to prevent dislocation of the T-tube. The T end was introduced into the abdomen through the epigastric port. The choledochotomy incision was sutured snugly around the T-tube with polyglactin 910 (Vicryl coated) 4-0. After completion of the cholangiotomy, the operation was concluded by performing a

cholecystectomy. The gallbladder and the extracted stones were bagged and retrieved through the umbilical trocar site. A closed suction drain was inserted through a lateral 5-mm trocar and placed in Morrison's pouch. After completion of the cholecystectomy, the longer limb of the T-tube catheter was brought out through the lateral port in the abdominal wall. The drain was removed on the 2– 4 postoperative day, as long as the drainage was <50 ml/day and free of bile. Care was taken not to dislocate the T-tube. The T-tube was left for a period of 10 days, allowing the patient to recover. The T-tube was left open to allow bile to flow freely, thereby reducing pressure on the choledochotomy until sphincter spasm had ceased. A T-tube cholangiography was performed on the tenth postoperative day. The T-tube was routinely clamped for 6 h on day 2 (36 h after surgery) and 24 h on day 3. During the period of clamping, the patient was monitored for pain, leakage around the tube, and fever. If none of the above features were seen, free flow of bile into the duodenum was assumed. If the T-tube cholangiography was normal, The T-tube was removed by gentle traction and the patient was monitored for development of abdominal signs some hours after removal. Care was taken to ensure complete removal of the horizontal limb of the T-tube, without fracturing any of the limbs. Once the tubes had been removed without complication, the patient was discharged home. Follow-up was done as a clinical examination 3 months after surgery. ALT, AST, ALP, and bilirubin were controlled at follow-up. If any of these were elevated, new samples were taken 3 months later.

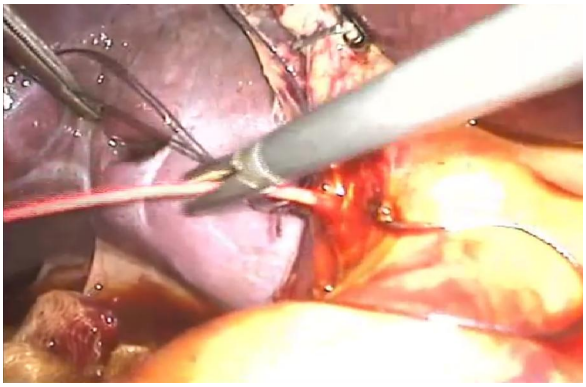

Figure (1) shows stone extraction by fogarty cathter

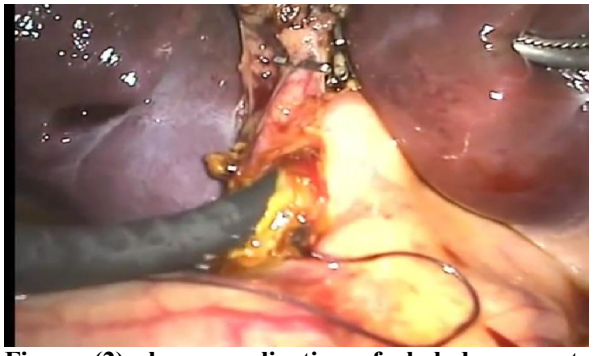

Figure (2) shows application of cholodecosope to confirm stone clearance

Figure (3) shows closure of cholodocotomy

Figure (4) shows application of (T) tube in CBD before closure

3. Results

The procedure has been performed in a total of 17 patients. These patients' demographic and clinical features are shown in Table 1. 12males and 5 females were recruited; the mean patient age in the present study was 47.88 ± 14.7 years. Five patients with past history of failed ERCP and twelve patients will undergo LCBD exploration according to MRCP. Preoperative liver function tests were obtained on the day before surgery. The bilirubin level ranged from 0.28 to 6.47 mg/dl (mean 3.13 ± 2.50 mg/dl), and gallstone pancreatitis was present in three patients which were treated preoperatively in a conservative manner with fluid resuscitation and nutritional support. These three patients underwent surgery was

performed when the symptoms were relieved and laboratory result return to normal. In terms of disease characteristics, the diameter of the CBD ranged from 8 to 27 mm (mean 12.2 ± 4.2 mm), and the number of CBD stones ranged from 1 to 4. The size of the largest CBD stone in each case ranged from 5 to 27 mm (mean 9.6 ± 7.4 mm). No patient developed symptoms or clinical signs that could be interpreted as late stricture. Four patients were converted to open surgery due to bleeding, severe inflammation, problems with equipment, or difficulties in introducing the T-tube in first cases because of lack of experience. At follow-up, ALT, AST, ALP, and bilirubin returned to normal in all patients. Apart from that, no imaging or re-intervention was required for any of the patients.

Table (1) shows Demographic features and clinical characteristics of patients

Demograpgic Data	
Mean Age	47.88 ± 14.7
Sex Male Female	 12/17 5/17
Past Failed ERCP MRCP	5/17 12/17
Bilirubin Level	mean 3.13 ± 2.50 mg/dl
Cbd Diameter	mean 12.2 ± 4.2 mm
Diameter Of Stones	(mean 9.6 ± 7.4 mm).
Ebl	15 -70 ml
Operative Time	**108.88 ± 30.3**
Hospital Stay	6.0 ± 4.6 days

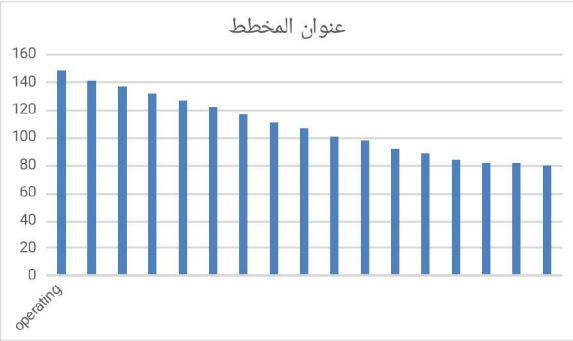

Figure (5) shows operative time diagram for LCBD

The mean operative time was **108 .88± 30.3** min, with a range **of 80 to 149 min**. In terms of estimated blood loss, minimal blood loss was observed in each case (15 to 70 ml), and no intraoperative transfusions were required. In this study, the mean length of the postoperative hospital stay was 6.0 ± 4.6 days (range, 3 to 17 days). The longest hospital stay was 17 days which occur in two cases (one case because of pancreatitis and other due to biliary leak may have required prolonged fasting and nutritional support. CBD stones were successfully cleared in all cases. Postoperative total morbidity was observed in only two patients (11.76 %) who developed fever with postoperative pancreatitis and other was biliary leak. Both patients began an oral diet on postoperative day 11 and improved without any additional complications. All other patients recovered normally, and no deaths were observed in our study. The mean follow up period was 83.0 ± 50.7 days, and no other complications were observed during follow-up.

Table (2) shows peroperative complications

Complications		
Bleeding	1/17	5.88%
Conversion	4/17	23.52%
Complete Cbd Clearance	17/17	100%
Bile Leakage and Morbidity	1/17	5.88%
Post Operative Total Morbiity	2/17	11.76 %

Discussion

In the era of mini-invasive surgery, laparoscopic cholecystectomy (LC) has been the standard therapy for symptomatic gallstones. However, debate continues regarding the best treatment for managing cholecystocholedocholithiasis, and a consensus has not been reached **[18-21]**. In patients with cholecystocholedocholithiasis, ERCP with stone extraction might be performed selectively before, during or after cholecystectomy. However, there were several limitations about ERCP therapy **[22,23]**. The role of ERCP in diagnosis of CBD stones has been replaced by MRCP, Preoperative investigation by means of MRCP can facilitate this operative decision making and in particular inform upon the need to proceed to choledochotomy and performing ERCP after surgery would raise the dilemma of managing CBD stones whenever ERCP failed to retrieve them because a third procedure would then be needed (24). To avoid these limitations, LCBDE was used to access to a common bile duct without causing damage to the biliary sphincter and also with the high clearance rate **[25-27]**. **LCBDE** is successful laparoscopic management of CBDS and dependent on several factors including surgical expertise, adequate equipment, the biliary anatomy and the number and size of CBD stones **(28-30)**. Although it has a crucial advantage in that it simultaneously treats cholelithiasis and choledocholithiasis, there by shortening hospital stays and reducing hospital costs, only surgeons with advanced laparoscopic skills can perform LCBDE because the procedure requires very specialized laparoscopic techniques and equipment **(30-33)**. It appears that LCDE adds approximately one hour or more to the procedure time. Interestingly, this added time is not solely due to technical manipulations, but includes equipment set up time, and often the need to

perform additional surgery. Additionally, these patients are often older, with more chronic changes in the tissues in the porta hepatis, making dissection more difficult **(34,35)**. The mean operative time in our study was **(108.88 ± 30.3)** which is longer than in other study (102.6 ± 15.2 min) due to lack of our experience specially in early cases and in cases post failed ERCP (22,232). Postoperative hospitalization was longer in our study (6.0 ± 4.6 days) in comparison to other studies (4.9 ± 3.2 d) **(22,32)**. Postoperative total morbidity was observed in two patients (11.76%) in our study while morbidity in other studies associated with LCDE occurs in approximately, with rates of 15.0% and includes those problems typically associated with general surgery and laparoscopy: nausea, diarrhea, ileus, ecchymosis, atelectasis, fever, phlebitis, urinary retention, urinary tract infection, wound infection/inflammation, biliary leak, dislodged T-tube, sub-hepatic fluid collection, pulmonary embolus, and myocardial infarction **(36-39)**. Bile leakage negatively influences the postoperative recovery and patient might need additional imaging study and even reoperation. Another factor affecting the incidence of bile leakage was the diameter of CBD, which was in accordance with Hua's study (23). Bile leakage occur in our study in one patient (5.88%) while in other studies was most common complication (7.8%,) (23-26). In many studies, bile leakage occur In patients with slender CBD, it occurred more frequently (<1 VS ≥1 cm, 31.6% VS 7.0%,) **(40-43)**. Possible reasons for this tendency were as follows: (1) the wall was thin in patients with slender CBD, and the bile could leak from the needle pinprick; (2) when suturing, surgeons might stitch too little tissue because of the fear of CBD stricture; (3) after suturing, transient stenosis of CBD might occur due to the tissue edema, and pressure increased within the biliary tree, then bile leakage occurred. **No mortality in our study which is the same as other studies**, it is zero to 1% in the hands of experienced laparoscopic biliary tract surgeons **(44-46)**. Conversion occurred in four patients (23.52%) were converted to open surgery due to bleeding, severe inflammation, problems with equipment, or difficulties in introducing the T-tube and occurred in first four cases due to lack of experience and in cases followed failed ERCP, While in other studies conversion rate from LCBDE to either OCBDE or ERCP of 12% and 7.5% **(47-48).** In the follow-up period, no CBD stricture was observed In our study in comparison to other two review articles **[2, 3]**. Ductal clearance rates in our study is 100% while in other studies in the order of 84–97% **(49,50).** Ductal clearance is best confirmed after choledochotomy with choledochoscopy. On the basis of the experience of open CBD exploration, T-tube drainage has been widely adopted in the past two decades. However, T-tube drainage has many problems, such as fluid and electrolyte disturbance, sepsis, premature dislodgement, bile leakage, prolonged biliary fistula, late bile duct stricture, and possible peritonitis after removal of the T-tube, which accounted for 15% of all patients in other studies **[6]**. In the present study, one patient with bile leakage related to the T-tube was seen. Nevertheless, the risk for problems related to the T-tube makes it necessary to carefully consider the need for the T-tube at each procedure. These complications and the need of satisfactory follow-up cholangiography prolonged the hospital stay and increased hospital expenses **[7,51-53].**

Conclusion

If performed by a surgeon familiar with the technique, LCBDE is a safe, with little risk for stone retention with low risk of stricture. The advantages are most pronounced in the case of multiple and large CBDS. Even if it requires a trained team, experienced surgeon, and special equipment, it should be considered one of the first alternatives for managing CBDS, especially at centers with high volume. Further studies, however, are required to fully evaluate this technique.

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