# Comparison of endoscopic retrograde cholangiopancreatography then laparoscopic cholecystectomy and laparoscopic common bile duct exploration in patients with common bile duct stones

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***Background*** Choledocholithiasis is concomitant with gallstones in ∼3–10% of patients. In the pre-endoscopic and prelaparoscopic era, the standard treatment for patients suffering from gallstones accompanied with common bile duct stones (CBDS) was open cholecystectomy and common bile duct (CBD) exploration. With the advent of laparoscopic and endoscopic techniques, several alternative treatments, such as laparoscopic cholecystectomy (LC), preoperative or postoperative endoscopic retrograde cholangiopancreatography (ERCP) with sphincterotomy and laparoscopic common bile duct exploration (LCBDE), have been developed to treat cholelithiasis. The management of stones in the CBD in the laparoscopic era is controversial. The aim of this study was to compare the efficacy, safety, and surgical outcomes of the LCBDE and ERCP with sphincterotomy, in patients with CBDS.

***Patients and methods*** The study was performed on 60 patients suffering from CBDS who were admitted and treated in our department in Al-Zahra Hospital and Al-Ameen Hospital, KSA between January 2014 and January 2016.The patients were divided into two groups according to the method of treatment. Group A included 20 patients who were treated by LCBDE whereas group B included 40 patients were treated by ERCP with sphincterotomy.

***Results*** This study was carried out on 60 patients with CBD stones. The patients were divided into two groups according to the method of treatment. Group A included 20 patients who were treated by LCBDE, whereas group B included 40 patients who were treated by ERCP with sphincterotomy.

***Conclusion*** The optimal management of patients with CBDS should depend on the condition of the patients, and the expertise of the operators. LCBDE is a feasible, safe, and effective procedure that carries low morbidity and mortality and will decrease the need for unnecessary ERCP in the future for suspected or proved choledocholithiasis.

*Sci J Al-Azhar Med Fac, Girls* 2017 1:69–74



**The Scientific Journal of Al-Azhar Medical Faculty, Girls**
2017 1:69–74

**Keywords:** ckpholycyctectomy, ERCP, laparoscooic

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**Received** 2 January 2018 **Accepted** 2 January 2018

## Introduction

Prior to the introduction of LC, choledocholithiasis was documented in ∼9–16% of those patients who presented for open cholecystectomy [1].

The incidence of common bile duct stones (CBDS) remains around 10% today [2]. Definitive treatment of these patients includes cholecystectomy and clearance of the ductal system. In 1890, nearly 8 years after Langenbuch performed the first 'open' cholecystectomy, Courvoisier showed that indeed the CBD could be cleared at the time of cholecystectomy, around years ago [3].

In 1968, endoscopic retrograde cholangiopancreatography (ERCP) was introduced as a diagnostic tool to aid in the management of biliary and pancreatic diseases. Five years later, with the development of endoscopic sphincterotomy (ES), ERCP was transformed into a therapeutic modality [4].

The ideal treatment for CBDS is still controversial. The options are that of surgical treatment alone (open or laparoscopic surgery) or a combination of endoscopy with surgical treatment (prelaparoscopic, intralaparoscopic, or post-LC ERCP) to clear the CBDS. In the era of open cholecystectomy, most CBDS found at surgery were managed at the time, with only a minority managed by the alternative, namely, ERCP with or without ES. Studies have suggested that surgical CBDS extraction was the recommended option for routine cases [5].

In the early days of laparoscopic biliary surgery, operative clearance of CBDS alone with LC was not considered technically possible. Either open surgical clearance or, more commonly, ERCP/sphincterotomy became the techniques used to clear CBDS. Endoscopic intervention helps the removal of stones from the duct so that surgical exploration of the bile duct can be avoided. When the duct is cleared by ERCP, the patient can then proceed to LC [6].

ERCP (either preoperatively or postoperatively) remains the preferred approach at most centers for managing patients with suspected CBDS. However, ERCP is associated with complications such as pancreatitis, hemorrhage, cholangitis, duodenal perforation (5–11%), and mortality of up to 1% [7].

Failure rates of 5–10% are reported with ERCP. Also, when patients proceed to ERCP, a significant number of them may not have stones. The rate of negative ERCP (without stones), determined on the basis of absence of CBDS, can vary from 15 to 25% [8].

Laparoscopic exploration and clearance of CBDS has become technically feasible, and several studies have shown that laparoscopic treatment of CBDS is possible and is potentially as effective as ERCP [6].

Clayton *et al.* [9] demonstrated that ERCP and laparoscopic common bile duct exploration (LCBDE) have similar rates of stone clearance, morbidity, and mortality. Advantages of surgical common bile duct (CBD) exploration are that the sphincter anatomy is not distorted and that the cholecystectomy is performed during the same procedure.

## Patients and methods

Sixty patients, who were admitted and treated in our department in Al-Zahra Hospital and Al-Ameen Hospital, KSA with the diagnoses of CBDS between January 2014 and January 2016 were included in the study. The patients were divided into two groups according to the method of treatment. Group A included 20 patients who were treated by LCBDE whereas group B included 40 patients who were treated by ERCP with sphincterotomy.

### Inclusion criteria

All patients presenting with CBD stones and with no contraindications for general anesthesia.

CBD stones were diagnosed by the following:

(1) Clinical presentation (biliary colic with or without jaundice).
(2) Elevation of bilirubin level of obstructive pattern (mainly direct hyperbilirubinemia).
(3) Elevated alkaline phosphatase and γ-glutamyl transferase.
(4) CBD dilation greater than 9 mm in diameter as measured at ultrasonography.
(5) CBD stones at MRCP.

### Exclusion criteria

(1) Patients with cholangitis or pancreatitis were excluded.
(2) Further exclusion criteria were the following: suspected CBD malignancy, previous cholecystectomy, pregnancy, contraindications to ERCP and patients having gastrectomy and marked liver cirrhosis.

All the patients included in the study were subjected to the following.

History taking, general and local examination, and investigations. Laboratory investigations include full blood count; prothrombin time, partial thromboplastin time; kidney and liver function tests, tests for sodium and potassium levels. Radiological: all patients will have preoperative pelviabdominal ultrasound commenting on: gall bladder status, CBD diameter, and presence of stones; liver size, texture, presence of focal lesions, and dilatation of intrahepatic biliary radicals.

### Group A: laparoscopic common bile duct exploration

*Operative technique*

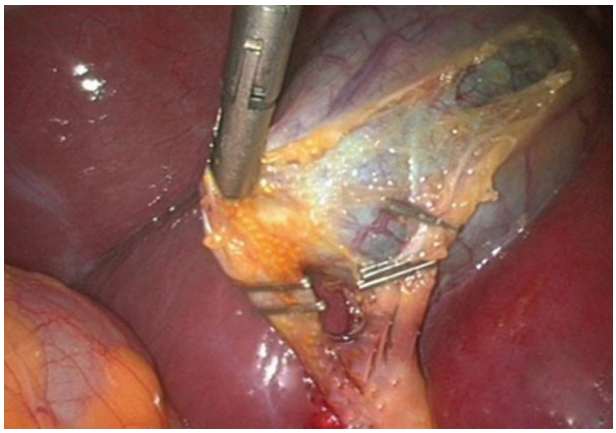
Trocar placement for LCBDE is similar to that of routine LC.

The initial safe trocar access was achieved at the umbilicus; the operating port was placed in the epigastrium. The epigastric cannula was 10 mm, two 5 mm trocars were placed laterally just below the costal margin, one along the midclavicular line and the other along the anterior axillary line.

After clearing the structures from the apex of the Calot's triangle, the junction between the infundibulum and the origin of the proximal cystic duct can be identified clearly. The strands of peritoneal, lymphatic, and neurovascular tissue are stripped away from the cystic duct to clear a segment from the surrounding tissue. Curved dissecting forceps are helpful in creating a window around the posterior aspect of the cystic duct to skeletonize the duct itself. The cystic artery is separated from the surrounding tissue by similar blunt dissection. The distal cystic duct is dissected free down to the CBD. The anterior part of the CBD is prepared over a distance of 2–3 cm. The distal part of the cystic duct is thus clearly identified, and controlled proximally with clips (Fig. 1).

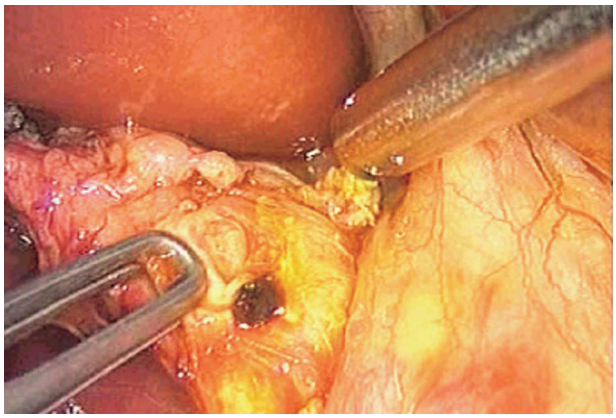
The choledochotomy is placed in the anterior aspect of the CBD, preferably below the junction of the cystic duct into the CBD. This placement results in less

**Figure 1**



Clipping the cystic artery and duct.

**Figure 2**



Choledochotomy.

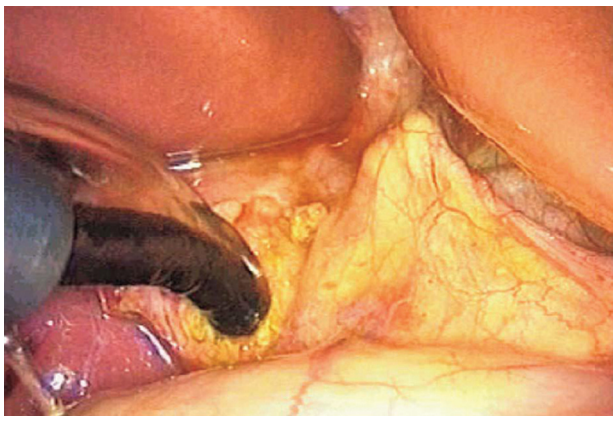
chance of compromise to the lumen during closure of the choledochotomy (Fig. 2).

The most efficient technique is to insert a choledochoscope into the CBD and irrigate with a warm saline solution.

The choledochoscope should be oriented so that flexion is in a vertical manner, as this assists in its passage through the choledochotomy (Fig. 3).

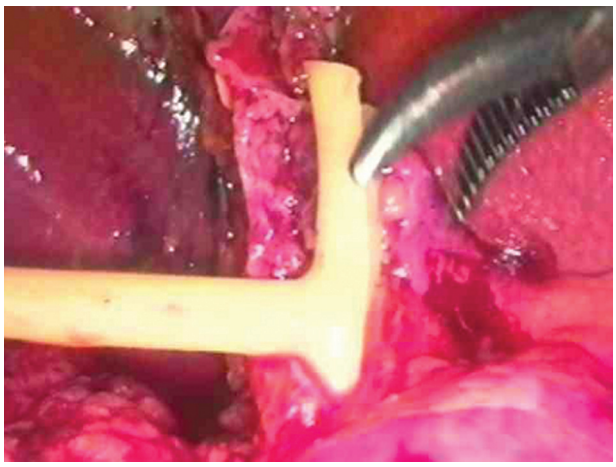
The CBD should be entered at a right angle, and the scope turned after entering the CBD. A biliary balloon catheter, wire basket, or both can be used to remove calculi in most patients. After the CBD is cleared, a latex T-tube must be inserted (Fig. 4). The ductotomy is closed with fine absorbable sutures using intracorporeal suturing techniques, and the T-tube is exteriorized through the lateral port site. A drain was placed routinely in the subhepatic space and is brought out through the most lateral port.

**Figure 3**



Insertion of the choledochoscope.

**Figure 4**



T-tube insertion.

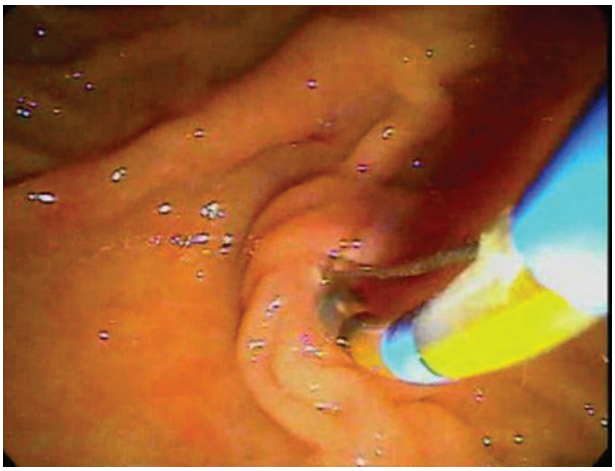
### Group B: endoscopic retrograde cholangiopancreatography with sphincterotomy

*Technique*

A pancreatocholangioscope (JF240 or JF200; Olympus) was inserted into the duodenum through the mouth with the patient in left lateral position. The papilla was cannulated through its punctum using sphincterotome or after doing needle knife papillotomy when cannulation through the punctum was difficult (Fig. 5). Cholangiogram was done and ES was performed once stones were found (Fig. 6). Stones were removed by basket or balloon catheters (Fig. 7).

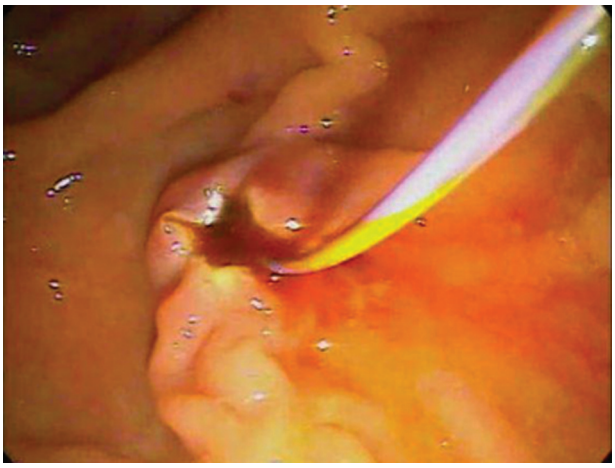
In the few situations in which stone extraction is incomplete or impossible because of the stone size, local anatomy, bleeding, or technical difficulty leading to incomplete ES, biliary stent must be inserted to provide biliary decompression and prevent stone impaction in the distal CBD (Fig. 8). This is a temporizing therapy to allow the patient's clinical

**Figure 5**



Canulation of the papilla.

**Figure 6**



Sphincterotomy completed.

**Figure 7**

Basket extraction of distal common bile duct stone.

**Figure 8**

Biliary stent.

condition to improve, until complete stone clearance is achieved through additional endoscopic maneuvers or surgery.

## Results

This study was carried out on 60 patients with CBD stones. Patients were divided into two groups according to the method of treatment. Group A included 20 patients who were treated by LCBDE, whereas group B included 40 patients who were treated by ERCP with sphincterotomy.

The age of the patients ranged from 27 to 80 years with a mean of 54.2 years. The number of patients below 30 years was three (5%) in group A and four (6.7%) in group B; the number of patients aged 30–40 years was six (10%) in group A and nine (15%) in group B; the number of patients aged 40–50 years was six (10%) in group A and 12 (20%) in group B; the patients aged 50–60 years was five (8.4%) in group A and nine (15%) in group B, whereas the number of patients who were aged above 60 years was six (10%) in group B (Table 1).

The sex distribution is eight (40%) men in group A and 17 (42.5%) men in group B, whereas 12 (30%) women in group A and 23 (57.5%) women in group B (Table 2).

**Table 1 Age distribution**

| Age (years) | Group A [*n* (%)] | Group B [*n* (%)] |
|---|---|---|
| Below 30 | 3 (5) | 4 (6.7) |
| 30–40 | 6 (10) | 9 (15) |
| 40–50 | 6 (10) | 12 (20) |
| 50–60 | 5 (8.4) | 9 (15) |
| Above 60 | 0 (0) | 6 (10) |

The comparison between the number and size of CBD stones in groups A and B is shown in Table 3.

**Table 2 Sex distribution**

| Sex | Group A [*n* (%)] | Group B [*n* (%)] |
|---|---|---|
| Male | 8 (40) | 17 (42.5) |
| Female | 12 (60) | 23 (57.5) |

**Table 3 Common bile duct stones in groups A and B**

| | CBD stones by US [*n* (%)] | | | |
|---|---|---|---|---|
| | Stone number | | Stone size | |
| | Single | Multiple | Small | Large than 15 ml |
| Group A | 3 (5) | 15 (25) | 15 (25) | 3 (5) |
| Group B | 12 (20) | 30 (50) | 36 (60) | 6 (10) |

CBD; common bile duct; US, ultrasound.

### Morbidity and mortality

In group A failure of the procedure was encountered in two (11.1%) patients due to adhesions and was converted to open surgery. One patient was complicated by port site infection (5.5%), and one patient was complicated by bile discharge that started after removal of the T-tube in the drain the amount of which ranged between 50 and 70 ml and was managed conservatively. No mortality was recorded in this group. In group B Cannulation was easy in 40 (95.2%) patients. Failed cannulation occurred in two (4.7%) patients due to the failure to locate the opening of the CBD in the papilla. ES failed in one (2.3%) patient due to failed canulation. CBD clearance is achieved in 36 (85.7%) patients. Extraction balloon and Dormia basket are used for CBD clearance. There was failure to clear the CBD in the first sitting ERCP in three (7.1%) patients of whom one (2.3%) patient's was due to failed cannulation and in two (4.7%) patients due to the discrepancy between the size of the stone and the diameter of the CBD. Failure to clear the CBD was the major problem and occurred in three (7.1%) patients. Complications related to stent placement were encountered in three (7.1%) patients and were due to obstruction of the stent and the patients developed cholangitis and were managed by endoscopic removal of the obstructed stent.

One (2.3%) patient was complicated by pancreatitis and was managed conservatively. No mortality was recorded in this group. The operative time in group A was 110–190 min, mean of 132, whereas in group B 35–70 min, mean of 50; hospital stay, in group A from 2 to 5 days, mean of 2.9, while in group B from 1 to 2 days mean of 1.7. The follow-up period ranged from 2 to 24 months.

## Discussion

CBDS have been noted in 10–15% of patients with cholelithiasis and this incidence increases with female sex [10]. Incidence of CBD stones varies widely with age. The frequency ranges from 4 to 7% in patients younger than 60 years. This incidence increases to 18% in those patients aged 70–79 years and more than 30% for those over 80 years [11]. The incidence increases to more than 80% in those who are over 90 years old [10]. In the pre-endoscopic and prelaparoscopic era, the standard treatment for patients suffering from gallstones accompanied with CBDS was open cholecystectomy and CBD exploration. With the advent of laparoscopic and endoscopic techniques, several alternative treatments, such as LC, preoperative or postoperative ERCP and ES (ERCP+ES) and LCBDE, have been developed to treat cholelithiasis [12]. In the laparoscopic era, the vast majority of patients who suffered from concomitant gallstones and CBDS were routinely managed by ERCP either preoperatively prior to LC or postoperatively [13]. Although this approach is effective and safe for removing the CBDS, it also has several drawbacks. First, it requires two periods of anesthesia and occasionally two hospital admissions, which may increase the length of hospital stay [12]. Both preoperative and postoperative ERCP are likely to lead to some short-term and long-term complications. For instance, they may result in postoperative complications, including bleeding, perforation, pancreatitis, and even death [14]. Moreover, it is notable that the intact sphincter of Oddi is destroyed after ES so that the biliary sphincter function is permanently lost, which damages the barrier of the sphincter that prevents duodenobiliary reflux [15]. Reflux from the duodenum into the bile duct is responsible for the high rate of bacterobilia occurring after ES, and chronic bacterobilia may even cause neoplastic changes in the biliary epithelium [12].

With the improvement in laparoscopic equipment and skills, LCBDE has been increasingly used to remove the CBDS. It is considered to be a safe, efficient, and cost-effective treatment for choledocholithiasis; it is associated with a high stone clearance rate ranging from 84 to 97%, a postoperative morbidity rate of

4–16%, and a mortality rate of ~0–0.8% [16]. However, to decompress the bile duct and decrease biliary complications, T-tube drainage has been routinely used after choledochotomy, which is inevitable with complications including bile leakage, bile infection, and wound infection. Furthermore, the patients have to keep the bile drainage tube in place for several weeks before removal, causing great discomfort and delaying their return to work [17].

Nevertheless, according to a recent meta-analysis, primary closure might be as effective as T-tube drainage in the prevention of postoperative complications after choledochotomy. Consequently, it seems that LCBDE is a commendable alternative to the use of ERCP [18].

## Summary

Choledocholithiasis is concomitant with gallstones in ~3–10% of patients. In the pre-endoscopic and prelaparoscopic era, the standard treatment for patients suffering from gallstones accompanied with CBDS was open cholecystectomy and CBD exploration. With the advent of laparoscopic and endoscopic techniques, several alternative treatments, such as LC, preoperative or postoperative ERCP and ES and LCBDE, have been developed to treat cholelithiasis. Although ERCP with sphincterotomy has been proven to be a safe and effective option for extracting CBDS in most cases, it also has some adverse effects. It not only induces several postoperative complications, including bleeding, perforation and pancreatitis, but also leads to the disruption of the intact sphincter of Oddi, so that biliary sphincter function is permanently lost, which damages the barrier of the sphincter that prevents duodenobiliary reflux. Therefore, ERCP with sphincterotomy should be adopted on a selective basis, that is in patients with acute obstructive suppurative cholangitis, severe biliary pancreatitis, ampullary stone impaction, or severe comorbidity. LCBDE has the advantage of reducing the two-stage approach to a single-stage approach by a minimally invasive surgery. It is considered to be a safe, efficient, and cost-effective treatment for choledocholithiasis; it is associated with a high stone clearance rate.

## Conclusion

LCBDE is a feasible, safe, and effective procedure that carries low morbidity and mortality and will decrease the need for unnecessary ERCP in the future for suspected or proved choledocholithiasis. If laparoscopic experience is limited, it is advisable that CBDS should be removed by either preoperative or postoperative ES and LC. Also in the elderly and unfit patients, ERCP and stone extraction from the CBD is the initial and probably the definitive treatment. It is also the initial treatment in patients presenting with jaundice, cholangitis, or severe pancreatitis. LC is undertaken once the condition of the patient has improved.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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