Single-session endoscopic retrograde cholangiopancreatography (ERCP) and laparoscopic cholecystectomy (LC) vs. Two-stage Endoscopic Stone Extraction during ERCP followed by LC: a multicenter experience

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Background
The best way to handle gallbladder stones and common bile duct stones that are present simultaneously is up for dispute. The combination of endoscopic ERCP stone extraction and laparoscopic cholecystectomy has been the standard of care since the development of endoscopic and laparoscopic methods.
Objective
The current study aimed to evaluate single-stage ERCP/laparoscopic cholecystectomy (LC) and two-stage ERCP/LC in terms of imaging frequency, length of anesthesia, mean operating time, length of stay, and expenditures.
Patients and methods
Between June 2020 and January 2023, this multicenter retrospective comparative analysis was carried out in Qena University Hospitals, South Valley University, Qena and Assiut University Hospitals, Assiut University, Assiut.
Results
This research covered 220 participants. At ERCP, all patients had their bile ducts cleared. Regarding baseline variables such as age, sex, abdominal pain, preoperative liver function test, bilirubin, and alkaline phosphatase level, there is no difference between the two groups. The length of hospital stay varies significantly.
Conclusion
When compared with two separate procedures, single-session ERCP/LC has been safely and successfully utilized in some circumstances and is related to a shorter hospital stay, a reduced frequency of imaging, and better patient satisfaction.

Keywords:
common bile duct stones, endoscopic retrograde cholangiopancreatography, laparoscopic cholecystectomy, two sessions, two stages

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Introduction

Approximately 10–15% of patients with gallstones have concomitant common bile duct (CBD) stones [1]. Also, 3.4–7.2% of patients undergoing cholecystectomy for gallstones have common bile duct (CBD) stones at the time of operation [2–4]. Common bile duct stones must be identified and treated quickly to prevent serious consequences such as acute ascending cholangitis, secondary sclerosing cholangitis, and acute biliary pancreatitis [5].

Although laparoscopic cholecystectomy is now frequently recommended as the treatment of choice for symptomatic gallbladder stones, [6] there is disagreement among surgeons regarding the best course of action for concomitant gallbladder and common bile duct stones. Endoscopic retrograde cholangiopancreatography (ERCP) followed by laparoscopic cholecystectomy (LC) in two sessions or ERCP and LC in the same session [7,8], laparoscopic common bile duct exploration, or combined laparoscopic cholecystectomy and ERCP (rendezvous technique) [9], are just a few of the treatment options for this condition that have been described. The final decision between various treatment approaches often depends on what is available, skilled, and experienced locally [10,11].

The standard of care for patients with CBD stones before the development of laparoscopy and endoscopic technology was open cholecystectomy and CBD exploration. Since endoscopic retrograde cholangiopancreatography (ERCP) became available,

endoscopic stone extraction (ESE) followed by LC is presently the chosen therapeutic strategy [12]. Secondary CBD stones can be diagnosed and treated with ERCP, and 80–85% of patients get stone removal [12]. With the increased experience of surgeons with sophisticated laparoscopic and endoscopic methods, single-stage treatment of concurrent gallbladder and common bile duct stones in the same anesthetic session is becoming more popular [8,11]. It has several benefits, including it reduces the number of anesthetic sessions, the duration of hospital stays, hospital fees, and preoperative days while avoiding the morbidity and mortality associated with ERCP as well as the requirement for numerous procedures [13] and ERCP morbidity and mortality. The post-ERCP intestinal dilatation that might interfere with the LC procedure and cause additional surgical problems is the anticipated disadvantage of this method [14,15]. Further research with a larger study population is necessary to determine the additional benefits of this procedure.

The purpose of this study is to compare the outcomes of single-session ERCP and laparoscopic cholecystectomy (LC) versus two-stage ERCP and LC with endoscopic stone extraction in terms of success rate, postoperative complications, overall operative time, length of hospital stay, and cost-effectiveness.

Patients and methods

Between June 2020 and January 2023, general surgery departments at Qena University Hospitals, South Valley University, Qena, and Assiut University Hospitals, Assiut University, Assiut, undertook this multicenter retrospective randomized cohort comparative analysis.

Patients were included in this study and were divided into two groups:

Group A: Single-session ERCP and laparoscopic cholecystectomy
Group B: Two-stage ERCP followed by laparoscopic cholecystectomy after a time interval (1-3 week after ERCP).

In this study, we included all data of patients between the ages of 15 and 80 years with gallbladder stones and concomitant CBD stones verified by abdominal sonography (US), magnetic resonance cholangiography (MRCP) (Fig. 2), or endosonography and we excluded from the study, data of patients with cholangitis, acute cholecystitis, an earlier hepatobiliary surgical history, patients whose ERCP has failed, severe obesity, coagulopathy that cannot be reversed, illness with an ASA class 4 or class 5 classification, those who are under 15 years old, upper gastric tract anastomosis, surgical or general anesthesia contraindications, patients with pancreatitis due to gallstones and pregnant women.

Ethical approval

The study was approved by the Institutional Ethics Committee.

Patients who had gallbladder stones and concomitant common bile duct (CBD) stones had undergone routine laboratory examinations, such as liver function tests and imaging, as well as clinical evaluation. Before enrolling a patient in this study, a magnetic resonance cholangiopancreatography (MRCP) was performed to confirm the presence of stones in the CBD if an abdominal ultrasonography examination revealed gallbladder stones and suspicion of CBD stones with a CBD diameter larger than 10 mm.

The technique of endoscopic stone extraction

Each of our surgeon's endoscopists has completed more than 500 ERCP operations and has more than 5 years of expertise in the field.

In our institution, all procedures (ERCP and laparoscopic cholecystectomy) were done by surgeons who have experience in both techniques.

We collected data from patients' files about intraoperative and postoperative outcomes such as operative time, complications, difficulty of the surgery, hospital stay, pain score, cost of the procedure, and patients' satisfaction.

Statistical analysis

For statistical analysis, we utilized the SPSS program (Statistical Package for the Social Sciences ver. 16, SPSS Inc, Chicago, Illinois, USA). Statistical significance was defined as a probability value (*P*-value) of 0.05.

Results

In all, 260 patients with concurrent gallbladder and CBD stones visited the general surgery departments of the hospitals affiliated with Qena University, South Valley University, and Assiut University between June

(2020) and January (2023) of that year. Of those, 220 patients were included in this study, of whom 100 were treated using ERCP and laparoscopic cholecystectomy in the same session (group A), and 120 were treated using ERCP followed by laparoscopic cholecystectomy at a time interval of 1–3 weeks and group (B), as indicated in the CONSORT diagram (Fig. 1), with the remaining 40 patients being excluded for a variety of reasons.

Their ages varied from 20 to 66 years, with group (A) having a mean age of 41.56 years and a standard deviation of 16.5, and group (B) having a mean age of 45.34 years and a standard deviation of 13.6, respectively. Male: female ratios were 1: 2.3 in group (A) and 1: 2.7 in group (B), respectively, with 68 (68%) and 87 (72.5%) female patients in each group (Table 1).

Regarding demographic characteristics and the presence of clinical symptoms, both groups were closely matched (Table 1). All baseline characteristics were not statistically different between the two groups.

As regards operative details, the mean operative time was 85±33.4 min (60–125 min) in group (A) and 110 ±35 (75–145) in group (B), which is statistically significant (0.00136). Successful clearance of CBD was 97.5% in group (A) and 95.8 in group (B). The causes of ERCP failure were the inability to identify the papilla (1 patient), unsuccessful cannulation (3 patients), inability to remove impacted CBD stones (3 patients), and mild duodenal bleeding (one patient) (Fig. 3).

As regards the conversion rate, only one patient in group (A) and seven patients in group (B) were converted from laparoscopic to open cholecystectomy, with the causes being colon hyperinflation in the case of only one patient in group (A) and hyperinflation was overcome suction of air during the procedure and operating in low inflation level, and seven patients in group (B), converted due to severe adhesion in five patients, and intraoperative bleeding in two patients.

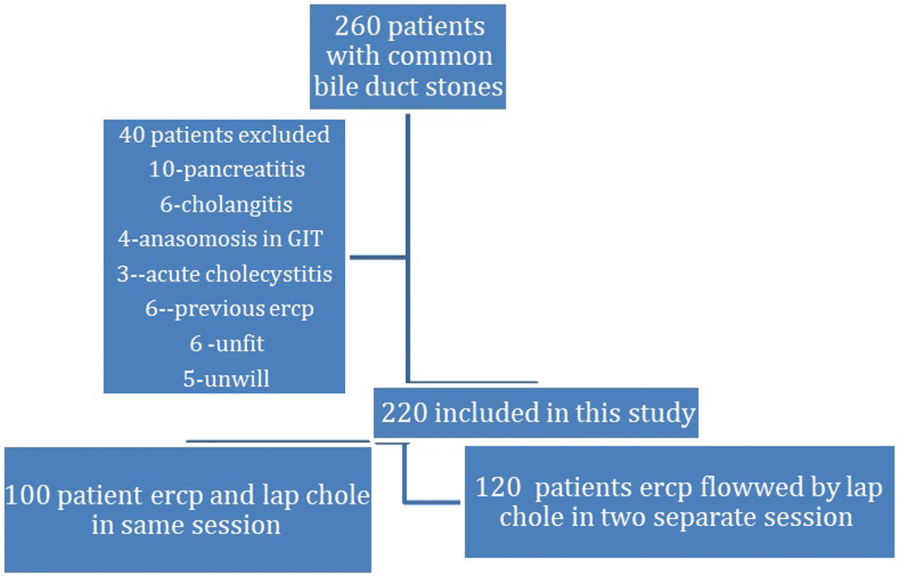
Only one patient (1%) in group (A) and five patients (4.1) in group (B) experienced postoperative pancreatitis and mild duodenal bleeding in one patient in group (B) and cholangitis in one patient in group (B) and all were treated conservatively.

As regards the length of hospital stays, it was 3.2±1.7 days in group (A) with a range from one to 5 days and was 6.3±6.2 in group (B) with a range from 3 to 13 days with a *P* value less than 0.05, which is statistically significant Also costs were higher in group (B) than in group (A) with a *P* value of 0.001, which is statistically significant and the patient satisfaction was higher in group (A) than in group (B) (Table 2).

Discussions

The argument over the best way to treat gallbladder stones that also happen to have concomitant common bile duct stones (CBD) has been reignited by the development of endoscopy and laparoscopy. Gall bladder stones associated with common bile duct stones can be managed in a variety of ways. Although a common minimally invasive approach, CBD clearing using laparoscopic methods often

Figure 1



Flowchart shows all patients included in this study.

requires laparoscopic expertise that may not be easily available. Laparoscopic CBD exploration is not a first-line option of choice at our centers, as shown by a recent study by Darrien *et al.*, which demonstrates that there can still be a relatively high rate of technical failure with even more simplistic variations to this approach, especially when this is being used selectively rather than as a routine treatment [16].

Laparoscopic cholecystectomy (LC), either before or after endoscopic bile duct stone clearing using endoscopic retrograde cholangiopancreatography (ERCP), has been suggested [17]. LC after ERCP is a recommended course of therapy for gallstones with concomitant CBD stones [18]. According to Pencev *et al.*, ERCP can be successfully performed following ERCP in the same session, although difficulties could arise if CBD stones are not removed promptly [19].

Although there are many benefits of performing LC and ERCP during the same anesthetic session it included a reduction of the number of anesthetic sessions, reduced hospital stay and costs, and offers the least invasive therapeutic options [20,21], still the option for performing ERCP and laparoscopic cholecystectomy (LC) for the management of choledocholithiasis in the same operative session is often overlooked. So, in our study, we compared the success, safety, and cost of ERCP and LC when

Table 1 Demographic data (age, sex, clinical pictures, and liver function tests)

Parameter	Group (A) *N*=100	Group (B) *N*=120	*P* value
Age			
Mean ± SD (years)	41.56±16.5	45.34±13.6	0.36
Range (years)	20–66	23–67	
Sex			
Male	32 (32%)	33 (27.5%)	0.243
Female	68 (68%)	87 (72.5%)	0.257
M: F	32 :68(1:2.3)	33:87(1:2.7)	0.065
Symptoms			
Pain in the abdomen	98/100 (98%)	116/120 (97%)	0.879
Jaundice	88 /100 (88%)	110/120 (92%)	0.085
Preoperative serum investigation			
Total leukocyte count (cells/mm3)	8,1±2,83	7,02±2,1	0.13
Proportion of abnormal LFT (%)	94/100(94%)	115/120(95%)	
Bilirubin level (mg/dl)	6.85±3.5	5.05±3.2	0.273
Alkaline phosphatase (IU/dl)	430.1±532.6	504.6±324.6	0.15

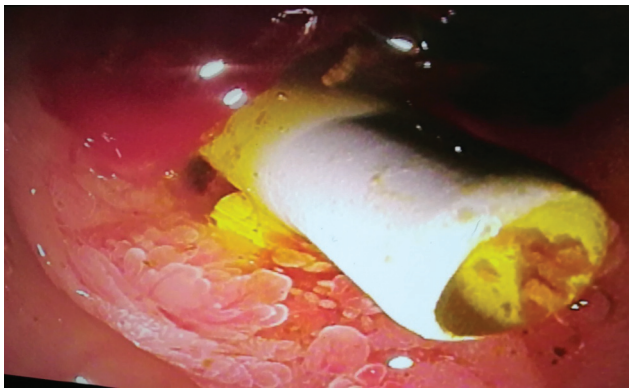
Table 2 Operative parameters and postoperative complications

Parameter	Group A	Group B	*P* value
Mean operative time (mins)	85±33.4(60–125)	110±35 (75–145)	0.00136
CBD cannulation			
Standard	99	118	
Precut	1	2	0.684
Dormia basket extraction	75/100	90/120	0.754
Balloon extraction	25/100	30/120	0.065
Mechanical lithotripsy	1/100	1/120	0.0543
Intraoperative bleeding (mild)	1/100	3/120	0.12
Intraoperative adhesion	5/100	25/120	0.0213
Conversion to open	1/100	7/120	0.00256
Successful CBD clearance	97/100(97%)	115/120(95%)	0.00132
ERCP stent placement	2/100 (2%)	11/120 (9.2%)	0.242
Postoperative pancreatitis	1/100	5/120	0.0004
Cholangitis	0/100	1/120	0.021
Perforation	0/100	0/120	
Post-ERCP bleeding	0/100	1/120	
Length of hospital stay	3.2±1.7	6.3 ±6.2	0.00621
Days (ranges)	1.5–5	3–13	
Total hospital cost	(990$)	(3436$)	0.0095
Range	860–3800	1850–5890	
Patient satisfaction score	2.76±0.3	1.32±0.7	0.001

Figure 2

MRCP shows gallbladder and common bile duct stones.

Figure 3



Biliary stent after ERCP.

performed in either a single session or in separate sessions.

We noticed when we are doing this study and from previous studies that one of the predominant limiting factors in the acceptance of single-session ERCP and LC is the difficulty of coordination between providers and availability of operating rooms, and integration of endoscopic and surgical facilities is not widespread, and more typically separated units might add logistical challenges at other centers. In our study in a single-session ERCP and cholecystectomy, ERCP was performed with the patient under the same general anesthesia in the same operating room on the same fluoroscopy-suitable table as used for laparoscopic cholecystectomy. Our main advantage was the fact that the same surgeon performed both procedures and had experience in both endoscopic ERCP and laparoscopy. This approach has considerable advantages as it avoids delay and organizational problems as the same surgeon is responsible for the whole treatment and follow-up of the patients, which also leads to successful patients' management and monitoring.

In our study, endoscopic CBD cannulation and clearance rates were potentially high (bile duct stone clearance was achieved in the majority of patients and ERCP morbidity was very low), and this was due to the advantages of a high-volume center with significant technical expertise. This success rate was comparable to many other studies, including the study by Bakman and Freeman [22], who described numerous discrete factors that could potentially make bile duct cannulation during ERCP challenging [22]. Papillary size, stenosis, tortuosity, or abnormal papillary location are some of these causes [23,24].

The majority of the patients who participated in our research had their common bile duct cannulated utilizing the standard protocol. Three patients (one in group A and two in group B) whose cannulation was extremely challenging were given CBD using the precut approach. Change from left lateral posture to supine position was simple for group (A) patients receiving single-stage surgery right after ERCP before starting LC. One benefit of a combined endoscopic and laparoscopic approach is that it can be used to manage failed cannulations, especially those caused by aberrant anatomy, such as an intra-diverticular papilla, by using the rendezvous technique, in which a guidewire was passed through the cystic duct, common bile duct, and second part of the duodenum [25].

Although there was some technical difficulty in our study due to endoscopic air hyperinflation of the bowel, particularly if ERCP is prolonged, this was overcome by slight insufflations of the bowel and suction after the ERCP procedure. This is similar to many studies, such as a study by Borreca *et al.* [26] in which they note in their recent retrospective evaluation that ERCP can be performed first safely with only a slight insufflation of the bowel and suction.

In our study, ERCP was done before laparoscopic cholecystectomy as done by many authors [18,27,28] but in some other studies, many authors as Williams, G.L *et al.* [10] claimed that there is some advantage of

doing cholecystectomy first as there is an option to perform intraoperative cholangiography during cholecystectomy in patients with equivocal suspicion of CBD stones [10], and this eliminates the need for ERCP postcholecystectomy if the result is negative for CBD stones; also avoid intraoperative insufflation of the bowel.

Regarding the length of hospitalization, our study found a difference between the two groups, with the hospital stay in group (A) during the same session being shorter than group (B) and these differences have been noted in many studies [27,29,30]. In addition, in group (B), some patients required admission in between the two procedures.

As regards the mean overall operative time, there was a significant reduction in group (A) same session (was 85 ±33.4 min vs. 110±35 min) similar to <AQ: Pls check for clarity of meaning>many studies [29,30]. This difference in the mean operative time may be due to extensive scarring, adhesion, and fibrosis of the biliary tree and Calot's triangle in group B (separate session), which makes the surgeon very cautious during the dissection of the Calot triangle. Also, our result showed that the conversion rate was significantly reduced in group (A) (one patient in group A and 7 patients in group B). The conversion rate was mostly due to inflammatory adhesions and bleeding during dissection, and this agreed with other studies [11,15,28–31].

Conclusion

As a result, our study demonstrates that ERCP and LC, when carried out at a tertiary center during the same anesthetic session, are an efficient and safe option. They are also linked to shorter hospital stays and shorter rates of imaging and postoperative complications. Indirect expenses and the danger of two anesthetic sittings should also be taken into account when comparing the direct costs of the two methods. A cost analysis of this kind seems to favor a single step of surgery.

An ERCP operation was carried out using a duodenoscope with side viewing. (Olympus sideviewing endoscopes TJF-160VR are used). After cannulation with a sphincterotome assisted with a guidewire, a contrast agent was injected through the sphincterotome to confirm the presence of CBD stones. A retrieval balloon or a stone retrieval Dormia basket was used to remove the stones. Each ERCP was followed by an occlusion cholangiography (balloon catheter cholangiogram) to make sure no stones were missed (Figs. 3 and 4).

Laparoscopic cholecystectomy (LC) was carried out with the patient under general anesthesia, utilizing the traditional four-trocar approach and CO_2 insufflations (Figs. 5 and 6).

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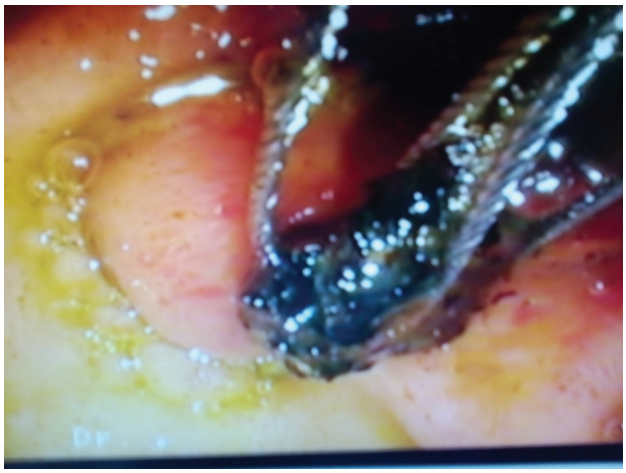
Nil.

Conflicts of interest

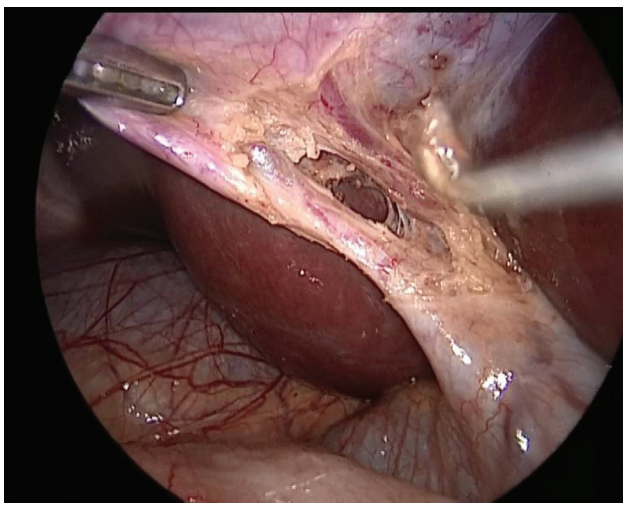
There are no conflicts of interest.

Figure 4



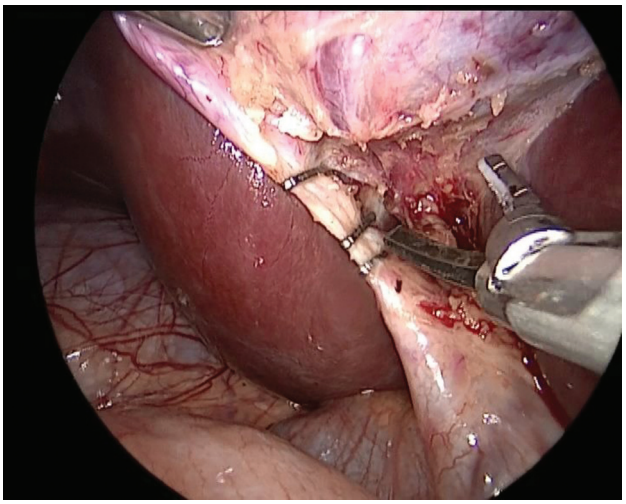
Extraction of stone by Dormia basket.

Figure 5



During laparoscopic Calot triangle dissection.

Figure 6



Minor bleeding and adhesion during dissection, group (B).

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