

## Outcome of Common Bile Duct Exploration without Intraoperative Cholangiography: a Case Series and Review of Literature

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### Abstract

**Background:** Open or laparoscopic surgical exploration of common bile duct (CBD) is performed when endoscopic approaches fail to extract CBD stones. Intraoperative cholangiography (IOC) through T-tube is performed in order to reduce the rate of retained stones. The aim of this study was to evaluate results of CBD exploration without IOC through T-tube and reviewing existing literature.

**Methods:** A retrospective medical chart review of 392 patients who underwent surgical CBD exploration was performed. All patients had proven CBD stones and had previously undergone failed attempts of endoscopic retrograde cholangiopancreatography (ERCP) and endoscopic sphincterotomy (ES). T-tube insertion or biliary-enteric anastomosis was performed after open CBD exploration with regard to patient's presentation and CBD diameter. IOC was not performed after T-tube insertion and cholangiography was postponed until 7th postoperative day. Postoperative retained stone and their management were reviewed.

**Results:** Of 392 patients with CBD explorations, T-tube was placed in 215 (54.8%) including 66 (30.7%) emergent biliary drainage and 149 (69.3%) elective operations. A number of 177 of 392 (45.2%) patients underwent biliary-enteric anastomosis. In 6 of 215 patients (2.8%) with T-tube placement, retained CBD stones were detected by T-tube cholangiography during postoperative period. All of them were treated successfully by ERCP.

**Conclusions:** T-tube placement without IOC is accompanied by a low rate of retained stone. Omitting IOC may decrease the operation time which is especially important in emergent cases. Retained stones following CBD exploration and T-tube placement can be treated successfully using ERCP.

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### Introduction

The ideal treatment for common bile duct (CBD) stones remains controversial with options ranging from single staged open or laparoscopic CBD exploration to two-stage endoscopic retrograde cholangiopancreatography (ERCP), endoscopic sphincterotomy (ES) and cholecystectomy (1).

The open approach for CBD exploration is still indicated despite introduction of endoscopic and laparoscopic methods (2). It is performed in emergent situations (such as presence of severe necrotizing pancreatitis, and deteriorating acute cholangitis) when laparoscopic and endoscopic approaches fail, when laparoscopic approach is impossible or difficult (due to

previous surgery and extensive adhesions) and finally, unavailability of equipment and insufficient expertise for laparoscopic or endoscopic approaches. Thus, taking into consideration the ongoing application of open approach, further investigations on this approach seems to be mandatory to obviate its shortcomings and modify the approach.

A proposed part of open management of CBD stones has been intraoperative cholangiography (IOC). Open surgical or laparoscopic exploration of CBD is usually done in case of large CBD stones or if endoscopic approaches fail to extract the CBD stones. In some centers, IOC through T-tube is routinely performed in order to reduce the rate of retained stones (3-11). The main roles of T-tube are postoperative decompression of biliary tract, visualization of CBD

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and availability to extract retained stones (12-14). The frequency of retained stones after IOC is reported to be up to 15 % in different studies (15-20).

The efficacy of IOC for detecting retained stones is well established (21, 22); however recent studies debate on necessity of performing IOC routinely after laparoscopic cholecystectomy (4-11, 23-29). These studies discuss its benefit over other techniques such as intraoperative laparoscopic sonography or simultaneous intraoperative ERCP (30).

This study aimed to determine the rate of retained stone in a series of patients with surgical CBD exploration without IOC. We also compared our findings with existing data from other series with or without IOC to discuss about the necessity of this intraoperative diagnostic procedure.

## Materials and Methods

We performed a retrospective chart review of 399 patients who underwent open surgical CBD exploration between April 2007 and June 2012 in Shariati Hospital, tertiary care center affiliated to Tehran University of Medical Sciences (Tehran, Iran). We excluded 7 patients with ultimate diagnoses other than stone such as *Ascaris lumbricoides*, hydatid daughter cysts, tumoral obstruction or stricture and ampullary carcinoma.

Indications of surgical exploration in these patients included: 1) Failure of ERCP and ES, 2) ERCP was not indicated due to large diameter of CBD stone(s) in preoperative evaluations like endoscopic ultrasound (EUS) or magnetic resonance cholangiopancreatography (MRCP), 3) The presence of moderate to severe pancreatitis with potential risk of aggravating pancreatitis by ERCP, 4) Emergent cases with acute and severe cholangitis with hemodynamic instability that could not tolerate the endoscopic procedure and mandated emergent surgical exploration. Most of the failed ERCP+ES attempts were due to multiple, large size (stones >2 cm) or impacted CBD stones.

Diagnosis of CBD stone was based on clinical presentation and laboratory tests followed by imaging techniques. Patients with acute cholangitis or pancreatitis presented with abdominal pain and/or fever, intermittent or constant obstructive jaundice, elevated white blood cell count, liver enzymes or serum amylase. Transabdominal ultrasonography (TUS) was performed for all patients. For elective patients, EUS was requested. Patients with negative TUS and EUS but still with high degree of suspicion for CBD stone underwent MRCP. Finally, decision for ERCP+ES was made according to the results of EUS or MRCP.

Patients with acute pancreatitis were observed with non-surgical management until the acute pancreatitis symptoms subsided and then these group of patients underwent elective ERCP+ES if EUS did prove a CBD stone. However, patients with mild pancreatitis and concomitant acute cholangitis underwent emergent ERCP+ES. Patients with cholangitis and acute

necrotizing pancreatitis, according to laboratory tests, TUS, and Computed tomography (CT) scan results, were considered for emergent surgical operation.

Collected data included comorbidities (consisted of hypertension (HTN), diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD), ischemic heart disease (IHD) and miscellaneous), size of stones according to MRCP or EUS, types of surgery, postoperative T-tube cholangiography results, length of hospitalization, ICU admission, postoperative mortality.

Antibiotic therapy was started for acute cholangitis with Ceftriaxone (1gr/IV/BID) and Metronidazole (500 mg/IV/TID) after admission.

Management in elective operations was based on CBD diameter, which was determined by preoperative imaging, and intraoperative evaluation. In elective operations, CBD exploration and T-tube placement were performed when CBD diameter was less than 12mm.

Biliary-enteric anastomosis (choledochoduodenostomy or choledochojejunostomy) was considered if CBD diameter was more than 12 mm.

CBD exploration and T-tube placement was performed after complete stone extraction. Complete stone extraction was performed by 1) washing out the CBD and proximal ducts using Nelaton Catheter and Saline, 2) exploring proximal and distal ducts using straight and curved Randall stone forceps, and 3) passing the appropriate size dilator through left and right hepatic duct and sphincter of Oddi. Appropriate size T-tube (12-16 French) was used based on the CBD diameter. Antibiotic therapy was discontinued after 5-7 days in emergent operations and after 24 hours in elective surgeries.

We did not perform IOC after T-tube placement, taking into consideration reducing operation time and relying on complete intraoperative evaluation of biliary tree using saline flashing, stone forceps, and biliary tract dilators.

T-tube cholangiography was performed 7-8 days after surgery and patients with retained stones were managed with ERCP+ES for stone removal. T-tube was removed on 14th postoperative day in all patients.

Data were analyzed using SPSS for windows (version 20; SPSS Inc., Chicago, IL, USA). Quantitative variables, mean, standard deviation and ranges were calculated, and reported. Continuous data with normal distribution and without normal distribution were tested by student t-test and Mann-Whitney U-test respectively. We analyzed qualitative data using Chi-square test. P-values < 0.05 were considered statistically significant.

## Results

Of 392 patients with CBD exploration, 196 (50%) were male. The mean (SD) age of patients was 59.3±14.7 years (range: 23 to 85 years).

In all patients stones were detected during the

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**Table 2.** Results of some studies on patients with CBD stone.

Pesce A <i>et al</i> <sup>11</sup>	2012	1100	laparoscopic	without	4(0.36%)	Italy
Ammori <i>et al</i> <sup>25</sup>	2012	717	laparoscopic	without	3(0.4%)	UK
Mostafa A <i>et al</i> <sup>7</sup>	2011	2714	laparoscopic	without	6(0.22%)	Egypt
Al-Qahtani <i>et al</i> <sup>6</sup>	2011	116	open	without	5(4.3%)	Saudi Arabia
Khan <i>et al</i> <sup>26</sup>	2011	190	laparoscopic	With/without	0/0	UK
James Horwood <i>et al</i> <sup>27</sup>	2010	501:166/335	laparoscopic	With/without	4(2.4%)/3(0.9%)	UK
Amott <i>et al</i> <sup>8</sup>	2005	303	laparoscopic	with	8(2.64%)	Australia
Singh G <i>et al</i> <sup>10</sup>	2000	134	open	with	2(1.5%)	India
Nies <i>et al</i> <sup>28</sup>	1997	275:138/137	open	With/without	0/4(2.9%)	Germany
Sharma <i>et al</i> <sup>9</sup>	1993	167	open	with	0	UK
Hauer-jensen <i>et al</i> <sup>29</sup>	1993	280	open	With/without	0/0	Norway
Present study	2012	215	open	without	6(2.8%)	Iran
Size of the largest stone, mean $\pm$ SD, mm					12.5 $\pm$ 3.5	13.8 $\pm$ 3.8

\* $p < 0.05$

surgery. A number of 177 (45.2%) patients underwent elective biliary-enteric anastomosis and 215 (54.8%) CBD exploration with T-tube placement. Sixty six (30.7%) patients with T-tube placement had emergent operations and 149 (69.3%) elective operations. Among emergent cases, 50 operations were due to cholangitis and 16 because of acute biliary pancreatitis. Cholecystectomy was performed simultaneously with CBD exploration in 263 patients (67.1%) and 129 patients (32.9%) had history of previous cholecystectomy.

Initial ERCP+ES had been failed in 149 patients who had been presented with acute cholangitis or acute biliary pancreatitis (121 cholangitis+ 28 pancreatitis). In 66 (44.3%) cases of these patients, emergent CBD exploration + T-tube placement was performed and in the other 83 (55.7%) patients, who responded to initial antibiotic therapy, elective surgery was performed (T-tube placement in 33 patients and biliary-enteric anastomosis in 50 patients).

Twenty-eight patients (7.1%) presented mainly with acute pancreatitis. Twelve of them finally underwent elective operation (6 T-tube placement and 6 biliary-enteric anastomoses). Other 16 patients underwent emergent CBD exploration and T-tube placement due to the presence of severe pancreatitis and concomitant cholangitis.

Table 1 shows the comparison between patients with T-tube placement and biliary-enteric anastomosis. Average hospital stay for patients with biliary-enteric anastomosis was 14.3 $\pm$ 10.7 days, and for patients with T-tube placement it was 11.0 $\pm$ 6.6 days ( $p < 0.01$ ). The mean size of the largest stone was 12.5  $\pm$  3.5 mm and 13.8  $\pm$  3.8 mm in patients with T-tube placement and biliary-enteric anastomosis respectively ( $p > 0.05$ ). Patients with biliary-enteric anastomosis had a mean CBD diameter of 16.3  $\pm$  3.7 mm and in those who underwent T-tube insertion mean CBD diameter was 12.8  $\pm$  2.5 mm ( $p < 0.05$ ).

Four deaths (1.8 %) occurred in T-tube inserted patients. Two of them were due to sepsis in the setting

of severe infected necrotizing pancreatitis which did not responded to T-tube placement and multiple debridement and drainage of pancreas. Other two patients experienced multiorgan failure due to the severe septic shock following acute cholangitis which did not respond to CBD drainage and broad spectrum antibiotic therapy.

Mean age of patients who admitted to ICU after surgery was 67.6 years and for patients without ICU admission, was 56.9 years, and this difference between two groups was significant ( $p < 0.05$ ).

Some 127 (32.4%) of 392 patients had major comorbidities beside CBD stone. The mean age of these patients was 62.2 years and those without comorbidities was 57.9 years, and the difference was statistically significant ( $p < 0.05$ ). 82 (64.6%) of these patients underwent T-tube insertion, including 37 emergent operations.

Postoperative cholangiography though T-tube revealed that retained stones was present in six cases (2.8%) of 215 patients with T-tube placement. All of these patients were treated successfully by postoperative ERCP+ES with no further complication.

In the follow-up with a median of 14 months, none of the patients showed any sign of retained stone, stricture, or any complication related to their biliary surgery.

Our management protocol for patients with CBD stones was based on patients' condition that may be an emergent condition with acute cholangitis (with or without pancreatitis) or an elective situation, and diameter of CBD at the time of surgery. We performed CBD exploration and T-tube placement without intraoperative T-tube cholangiography in 215 patients and retained stones were seen only in 6 cases (2.8%), which were managed through postoperative ERCP+ES.

Table 2 shows results of some studies on patients with CBD stone. These studies represent comparable outcomes (rate of retained stone) when performing IOC or omitting it in the process of managing CBD stones (Table 2).

The frequency of retained CBD stones varies from 3% to 15% in patients undergoing CBD exploration depending on the type of procedure (3,6,15,20).

Two types of interventions have significant roles in managing CBD stones: ERCP+ES and surgical CBD exploration. During recent decades ERCP and endoscopic sphincterotomy (ES) has gained wide acceptance as an effective alternative to other techniques in management of CBD stones (31-33). Stone recurrence rate after ES, ranged between 6% and 21%, as has been reported in both Western and Asian cohort studies with long-term follow-ups (34-37); however rate of retained stones after sphincterotomy without subsequent cholecystectomy was more than 20% (18).

In our center, we usually perform open exploration of CBD when ERCP and ES has been failed. This may raise the question that why other alternatives such as laparoscopic exploration are not elected after ERCP failure. To proceed to laparoscopic surgery, one must be cognizant of the resources and required expertise. Laparoscopic CBD exploration and stone removal are technically challenging and only skilled laparoscopic surgeons can readily accomplish this operation when appropriate instruments are available. Although we perform laparoscopic cholecystectomy in our center for most of patients with gall bladder stone or cholecystitis, however we have not required facilities for laparoscopic CBD exploration yet, especially in patients who had previous upper abdominal operations. The 32.9% rate of previous history of cholecystectomy and relatively high incidence of co-morbidities in our patients were challenges against performing laparoscopic exploration of the CBD that could cause more extended time of operation as well.

Since its introduction, the T-tube has had an important role in biliary surgery. The rationale for the use of T-tube is to ensure biliary decompression, to permit the healing of choledochotomy and to create a track lined by fibrous tissue for later imaging and probable percutaneous stone extraction (12-14,38). However the latter has been under question after widespread acceptance of endoscopic stone extraction techniques in the treatment of residual bile duct stones in which T-tube can potentially poses a mechanical barrier to spontaneous passage of stones, basketing or balloon catheters through ERCP+ES in patients who had CBD exploration and T-tube in place (3).

Intraoperative cholangiography (IOC) during laparoscopic cholecystectomy is generally accepted as an integrated part of CBD assessment. The main reason for studying bile duct is to seek for common bile duct stones and assessing anatomy of CBD. After identifying stones within cystic duct using IOC, in centers which have related experience and facilities, appropriate stone extraction method is used including laparoscopic or open bile duct exploration, intraoperative ERCP, or postoperative ERCP and ES (23). In a systematic review by Ford, he reviewed the randomized clinical trials about IOC performed to detect choledocholithiasis and identify or prevent bile

duct injury. He concluded there was no robust evidence to support or abandon the use of IOC to prevent retained CBD stones or bile duct injury (5). In another study Hauer-Jensen assessed the value of routine IOC during cholecystectomy for gallstone disease, and concluded that when clinical criteria suggest the presence of CBD abnormalities, IOC should be performed (29).

On the other hand some studies showed that IOC after T-tube insertion is not required to be performed after open CBD exploration or laparoscopic cholecystectomy routinely and does not affect outcome of surgery in relation to the frequency of retained stones and CBD injury (6,7,10,11,25-29). In a prospective study by Singh to determine whether to perform selective or routine IOC in patients undergoing open cholecystectomy for gallstones diseases, he concluded that routine IOC during cholecystectomy is not essential for the prevention of retained stones (10). In a retrospective study by Pesce to review the results of 1100 patients who underwent laparoscopic cholecystectomy (LC) without the use of IOC in relation to biliary complications, he concluded that LC can be performed safely without IOC (11).

According to our protocol, T-tube placement was performed in emergent operations because of acute cholangitis (with or without pancreatitis). In elective cases with choledocholithiasis, those who had CBD diameter of less than 12 mm and in some patients who had high risk for general anesthesia and poor clinical conditions. Therefore, we considered the importance of reducing the operation time and low probability of retained stones after exploration of CBD and we preferred not to perform IOC after T-tube placement.

Al-Qahtani in a retrospective study determined the long-term outcome of cholecystectomy without IOC in patients recovering from acute gallstone pancreatitis with normal liver function test and imaging. In this study the incidence of bilio-pancreatic complications from unsuspected CBD stones in the patients who underwent cholecystectomy without IOC was very low. He concluded that a routine IOC in these patients can be omitted safely (6).

Intraoperative ultrasound or choledochoscopy was not an option in our protocol because of lack of equipment; although they cannot definitely rule out the risk of retained stones and therefore, the indication for T-tube placement persists after performing these techniques.

Frequency of retained stone in our patients (with T-tube insertion without performing routine IOC through T-tubes) was 2.8%, which is acceptable and comparable with other studies (Table 2). In a prospective cohort study by Amott, he compared the policies of routine and selective IOC, and concluded that there was no difference between them in relation to retained CBD stones (2.64%), operating times, and CBD injury (8). Stone basketing and extraction with ERCP+ES postoperatively was completely successful in those patients; similar to our study.

Mostafa in a retrospective study reviewed the results of a relatively large multi-center series of LC

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without IOC with regard to major biliary complications. He concluded that LC can be performed safely without doing IOC with acceptable low rates of biliary complications (7).

A final consideration concerns the risk of postoperative ES failure and the possible need for a second operation to clear the bile duct (23). Re-exploration of CBD carries a postoperative mortality varying from 3% to 28% and morbidity from 20% to 30% (41, 42). It also might be followed by failure of complete bile duct clearance (43). In this study, we did not have any patient who has been required re-exploration of CBD due to postoperative ERCP+ES failure. It should be mentioned that after open CBD exploration and T-tube placement, if any residual stone has been retained, it is most probably small enough to be extracted through ERCP+ES.

Our protocol for CBD stone management in this study, leads to a stepwise removal of CBD stone: 1) ERCP+ES, 2) open CBD exploration in case of ERCP failure, 3) postoperative T-tube cholangiography, after one week, and 4) if required, the secondary ERCP to extract the retained stones. These treatment protocol permits a safe endoscopic management of retained stones, since all patients have previously underwent CBD exploration, therefore the retained stones are less likely to be large or impacted, and can be easily extracted by ERCP+ ES, and if necessary, using stone basketing and other ERCP techniques.

False positive results and an increase in operation time besides risks of morbidity and mortality makes the value of IOC more and more questionable (44). In 2013, AL-Jiffry et al proposed an algorithm, and patients who required IOC were selected based on the following inclusion criteria: abnormal liver function tests (LFT) with normal preoperative ultrasonography (US) and MRCP, and patients with abnormal US and CBD dilatation when ERCP failed. Indeed, for patients who had normal LFT, IOC has not been performed in that study (45).

Laparoscopic subtotal cholecystectomy (LSC) for cholecystitis was discussed in literature with or without IOC. Kuwabara et al reported similar hospital stay and operation time for LSC with IOC in comparison to LSC without IOC. They suggested the aid of IOC along with LSC as a good and reasonable procedure (46).

Postoperative endoscopic stone removal in our approach did not carry any risk to the patients. previous attempts to extract CBD stones through ES, smaller size of retained stones, and presence of reliable imaging of biliary tree (through postoperative T-tube cholangiography) are the factors in favor of an easier secondary access to biliary tree in such cases. This subject was confirmed in our study and all patients with retained stones (6 out of 215 patients) were managed successfully with secondary ERCP and stone extraction without facing any complication or further need to surgical procedures. On the other hand, in cases with retained stone ERCP was performed after one week of T-tube insertion, then after the second week we removed the T-tube. If we want to extract the stone

through tract of T-tube then we should wait until the fourth week and this is a longer period with probable morbidities and more challenging stone extraction through T-tube tract.

## Conclusion

The present study discusses about the role of IOC through T-tube that can detects bile duct retained stones; however there remains risk of retained stone beside the extension of operation time, therefore it is not necessary that IOC be routinely performed for this purpose and we can select patients who need and could benefit from this procedure. This approach can decrease the operation time while not affecting the outcome in relation to rate of retained stones.

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