Surgical Management of Major Extra Hepatic Bile Ducts Calculi

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ABSTRACT:

BACKGROUND:

Common bile duct stones or choledocholithiasis are present in 10% of people with gall stones disease. Patients may be asymptomatic or presented with jaundice, abdominal pain and fever. CBD stones can be single or multiple. The vast majority of common bile stones are secondary to the passage of stone from the gall bladder.

Pre-operative detection of choledocholithiasis is usually by imaging study, either abdominal ultrasonography (US) or magnetic resonance imaging (MRI).

Management of choledocholithiasis is usually done by means of endoscopic retrograde cholangio-pancreatography (ERCP), but sometimes this is not feasible for variable reasons and surgical exploration and stone extraction is needed.

There are variable methods for surgical management of choledocholithiasis, each method has its advantage and disadvantage.

OBJECTIVE:

The aim of our study is to compare these surgical methods and compare the outcome of each procedure

METHODS:

One hundred patients with CBD stones were included in the study and divided into five groups according to the choice of surgical intervention used, the outcome of each group was compared.

CONCLUSION:

There are several surgical methods to deal with CBD stones, each has its advantage and its disadvantage and there is no single best method over the other.

KEY WARDS: common bile duct stones, common bile duct exploration.

INTRODUCTION:

Although the era of intervention for choledocholithiasis can be traced to over a century ago, with the first successful common bile duct (CBD) exploration by Thornton in 1889 and with the introduction of catheter-based biliary decompression by Courvoisier and Kehr, significant advances and refinements did not occur until recent decades. For many years, open cholecystectomy and exploration of the CBD remained the standard treatment for patients with choledocholithiasis, and it was a procedure carried out on a regular basis by most general surgeons. During that era, the morbidity and mortality rates of CBD exploration were very low, the percentage of retained stones was only 1% to 3%, and in long-term follow-up, revision surgery was necessary in only about 10% of the patients.[1]

The union of the right and left hepatic ducts is usually extra hepatic (90% within 1.0 cm of liver parenchyma), it receives the cystic duct lower down, whereupon it becomes the common bile duct. It is customary, however, in surgical anatomy to use the term CBD or simply' bile duct' for the entire extra hepatic conduit as it obviates difficulties in nomenclature, especially when there is a low insertion of the cystic duct. The junction of the right and left hepatic ducts is also referred to as the hilar bifurcation. [2]

Common bile duct stones may be small or large and single or multiple, and are found in 6% to 12%of patients with stones in the gallbladder. The incidence increases with age. About 20% to 25% of patients above the age of 60 with symptomatic

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gallstones have stones in the common bile duct as well as in the gallbladder. The vast majority of ductal stones in Western countries are formed within the gallbladder and migrate down the cystic duct to the common bile duct. These are classified as secondary common bile duct stones, in contrast to the primary stones that form in the bile ducts. The secondary stones are usually cholesterol stones, whereas the primary stones are usually of the brown pigment type. The primary stones are associated with biliary stasis and infection and are more commonly seen in Asian populations. The causes of biliary stasis that lead to the development of primary stones include biliary stricture, papillary stenosis, tumors, or other (secondary) stones.[3]

As Choledocholithiasis is present in around 10% of patients with cholelithiasis, If ultrasound detects intrahepatic and extrahepatic ductal dilatation in the setting of biliary colic, the most likely diagnosis is choledocholithiasis. Indicators of choledocholithiasis include evidence of stones on imaging, persistent jaundice (total bilirubin >3 mg/dL) especially in the setting of duct dilation (>8 mm), a history of jaundice or gall stone pancreatitis, or modest elevation of transaminases or alkaline phosphatase. Although intra-operative cholangiography is the "gold standard" for diagnosis, common bile duct stones can be diagnosed with ERCP, ultrasound, or MRCP. If diagnosed preoperatively, several treatment options are available but are determined by the patient's age and condition, the presence of jaundice or cholangitis, the size of the duct and stone, and the availability of a skilled endoscopist [4].

ERCP with sphincterotomy and stone extraction should be considered for the following patients: choledocholithiasis diagnosed preoperatively, small (<5 mm) common bile duct, portal hypertension, severe peri-portal inflammation, and cholangitis with septic shock. If ERCP is unsuccessful or predicted to be unsuccessful, the obstruction will require relief via laparoscopic or open cholecystectomy and common bile duct exploration. These findings warrant a common duct exploration during cholecystectomy. [5]

There are two methods of CBD exploration: supra-duodenal and trans-duodenal. [6]

In supra-duodenal approach the CBD was opened through a supra-duodenal vertical incision between stay sutures (Figure 1).

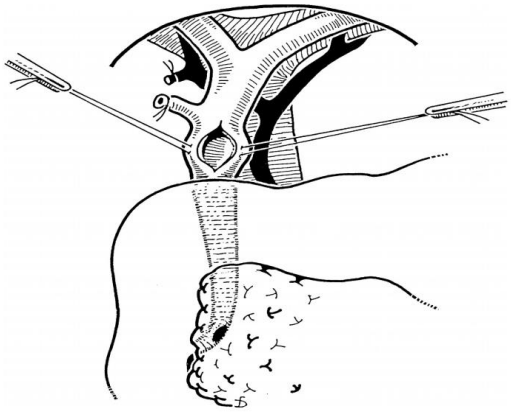

Figure 1: Supra-duodenal exploration.

There are several methods of closing the common bile duct after exploration. One of these methods is closure over a T-tube.

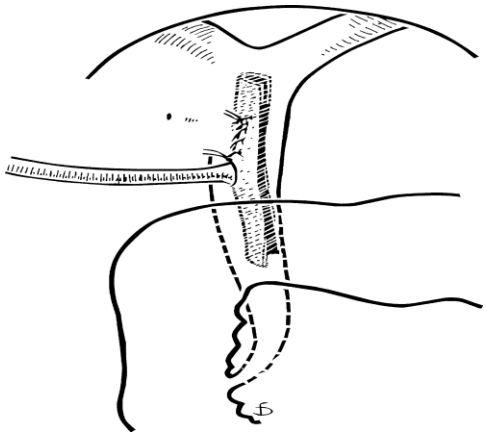

Figure 2:T-tube.

A T-tube is placed to decompress the system and facilitate the removal of any retained stones in the postoperative period. The tube should be at least 14 French gauge to facilitate percutaneous extraction techniques. The T-limb is displaced to the lower limit of the choledochotomy so that closure can proceed from above using interrupted 4-0 polydioxanone sutures, ensuring that full-thickness bites of the duct are taken but avoiding narrowing of the lumen. It would not normally be necessary to perform a completion cholangiogram if adequate examination of the ducts has been undertaken with cholodochoscopy. Stones may be suspected falsely because of previous introduction of air bubbles, and failure of contrast to enter the duodenum may result from sphincter spasm.[4]

When the stones cannot be cleared and/or when the duct is much dilated (>1.5 cm in diameter), a choledochal drainage procedure is performed (Fig.3). Choledochoduodenostomyis performed by mobilizing the second part of the duodenum(a Kocher maneuver) and anastomosing it side to side with the common bile duct.Acholedocho-jejunostomy is done by bringing up a 45-cmRoux-en-Y limb of jejunum and anastomosing it end to side to the common bile duct.Choledocho-jejunostomycan also be used.[5,6]

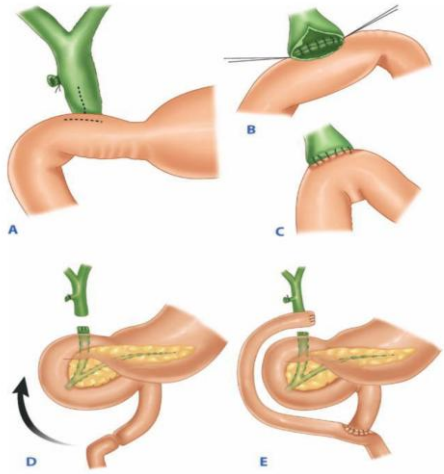

Figure 3: A, B, C show choledocho-duodenostomy. D and E show choledocho-jejunostomy.

In the trans-duodenal sphincteroplasty, a longitudinal duodenotomy of about 5 cm then localization of the ampulla, a sphincterotomy at 11o'clock position over the probed distal CBD to avoid the pancreatic duct orifice, then a stone grasper used to extract the stone and wash, the edge of the ampulla is sutured to the duodenal mucosa with absorbable sutures. (Figure 4)

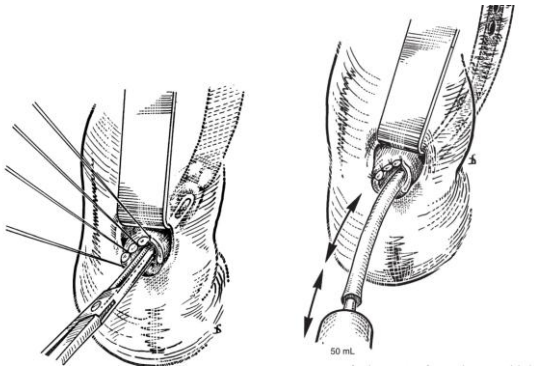

Figure 4: Trans-duodenal sphincteroplasty.

The last 3 decades have shown major changes in the management of choledocholithiasis, prompted by the introduction of high-quality noninvasive imaging, the more widespread availability of percutaneous and endoscopic approaches to duct clearance and the introduction of minimally invasive surgical approaches in the performance of cholecystectomy and CBD exploration. Although the overwhelming majority of cholecystectomies are now performed laparoscopically, laparoscopic exploration of the common bile duct (LCBDE) is infrequently performed, given the advanced skills typically required and the availability of endoscopic retrograde cholangiopancreatography. In a recent survey of general surgeons practicing in a rural area of theUnited States, the preferred approach to choledocholithiasis was ERCP (75%), followed by laparoscopic (21%) and open (4%) exploration. Despite these considerations, there remain indications for operative choledochotomy and, more specifically, for open exploration. [(1)]

Also in less developed health care environments, where endoscopic or percutaneous approaches to biliary decompression and stone clearance are limited, open cholecystectomy with bile duct exploration is indicated in patients with a strong clinical suspicion for common duct stones, such as those with abnormal LFTs or cholangitis, as well as when palpable stones are present in the CBD, or when stones are visualized on an intraoperative cholangiogram.

In more developed health care settings with access to endoscopic, radiologic, or laparoscopic expertise, there will still be some patients in whom an open approach to CBD exploration is required. These include 1) patients with large or impacted CBD stones, in whom biliary enteric drainage is indicated; 2) those with anatomic considerations that preclude endoscopic treatment, such as prior gastric resection, duodenal diverticulae, and so on; and 3) patients who require an open approach for cholecystectomy, including those with Mirizzi syndrome, biliary-enteric fistula, a high index of suspicion for cancer, and those with CBD stones demonstrated by palpation or cholangiogram.[(4)]

AIM:

To compare the different methods of surgical management of common bile stones in terms of outcome and complications.

MATERIALS AND METHODS:

A prospective cohort study done in the Gastroenterology and Hepatology Teaching Hospital, department of surgery, from December 2013 to November 2016. Statistical analysis was performed using SPSS 11.0. Chi-square test was used to compare the outcome of the procedures.

One hundred patients with CBD stones had been enrolled in the study, they undergone open CBD exploration. Patients with malignancy were excluded.

All patients were sent for blood sugar, renal and liver function, complete blood count, clotting profile, hepatitis B and C virology screen and blood group. Abdominal Ultrasonography was done to all patients and in case of doubt, MRCP also arranged.

Patients underwent surgery either after failure of ERCP trial or from the start as in those with big CBD stone > 1.5 cm, those with long stricture, those with previous upper GIT surgery (e.g. gastric bypass, previous Roux en Y biliary drainage) and

those with large number of extra and intra hepatic stones difficult to be cleared by endoscopy.

Demographic data, symptoms and signs, laboratory tests and radiological findings have been documented. The endoscopic findings, operative procedure, operative findings, postoperative course, complications, and mortality were all recorded.

The criteria for CBD exploration were obstructive jaundice, CBD stones on ultrasound examination or MRCP, and stones persisting after ERCP.

All patients were given prophylactic antibiotics.

Abdomen explored by either an upper midline or right oblique transverse sub costal incision, Cholecystectomy was done if not previously.

The operative procedures accordingly were, 13 patients underwent primary closure alone, 24 underwent primary closure with T-tube drainage, 51 received choledocho-duodenostomy, 4 patients underwent choledocho-jejune stormy and 8 patients underwent trans-duodenal sphincteroplasty.

The choice of operation depends on: first is the presence of common bile duct stricture which mandates a drainage procedure of choledoch-duodenostomy or choledocho-jejunostomy, second factor is the patient's general condition and co-morbidities; an ill elderly patient may challenge additional procedure. Third factor is the surgeon's preference.

CBD exploration was done either by supra-duodenal or trans-duodenal approach with sphincteroplasty.

In supra-duodenal approach after mobilization of the duodenum, the CBD was opened through a supra-duodenal 2 cm vertical incision between stay sutures. The stones were extracted, thorough wash of the biliary tree by normal saline and flexible choledochscope used to exclude missed stone and stricture.

In cases where T-tube was used; we adopt the size of it according to that of CBD, after 2 weeks, cholangiography through T-tube was done before removal.

While in cases where choledocho-duodenostomy or choledocho-jejunostomy was chosen, we perform a side-to-side anastomosis.

In trans-duodenal sphincteroplasty; a 5 cm longitudinal duodenotomy at the second part of duodenum was done, the ampulla was localized with the help of already probed distal CBD (probe inserted through cystic duct), then sphincterotomy at 11o'clock position to avoid the pancreatic duct orifice, a stone grasper used to extract stone or stones, wash and then suturing the edge of the ampulla to duodenal mucosa with absorbable sutures.

Abdomen closed in layer after insertion of sub hepatic drain, postoperatively, patients monitored by liver function test and drain removed after 48 hour if no drainage, on the other hand, if bile leakage occurs, drain kept till it stopped.

Patients were discharged within 5 – 7 days.

We compared the groups in terms of postoperative complications and hospital stay.

Follow-up period ranged from 9 - 18 months. There was no case of stone recurrence in any of the five groups during the follow-up period.

RESULTS:

Of the one hundred patients, 81 patients referred to surgery after failure of ERCP for stone extraction, and 19 patients were referred from the start to surgery.

88 had no previous history of CBD, while12 patients had recurrent stones.

The primary closure group included 13 patients (13.0%), while the primary closure over T-tube group was 24 patients (24%).The choledocho-duodenostomy anastamosis group included 51 patients (51%), while choledocho-jejunostomy anastamosis group was 4 patients (4%) and the trans-duodenal sphincteroplasty group was 8 patients (8%).

The mean age of our patients was 45.6 years old. 56 patients were females and 44 were males.

89 patients were clinically jaundiced. 86 patients had abdominal pain located in the right hypochondrium. 51 patients were febrile at one point during their presentation. The number of stones in each patient was recorded and the patients divided in two groups; either single stone or multiple stones. The operative time for each procedure is recorded and the average calculated.

Detailed data for the groups are presented in Table 1.

There was no mortality recorded in our patients during the follow-up period.

Postoperative bile leakage, a major complication, was seen in 1patient from the primary closure over T-tube drainage group and in 2 patients from the choledocho-duodenostomy group, and in zero patients from patients with primary closure, choledocho-jejunostomy and trans-duodenal sphincteroplasty groups (Table 2), there was no significant association with any type of operations(P>0.05).

There were no residual stones in any of our groups.

Wound infection occurred in 8 patients, all were treated conservatively with daily dressing and antibiotics, also no significant relation to the type of surgery.

Respiratory complications occurred in 5 patients who were treated by chest physiotherapy, still no significant relation to the type of surgery.

Cardiac complications (myocardial ischemia) occurred in two patients and were referred to cardiac care unit and were discharged home after improvement of their general condition.

One patient had an unusual complication, during removal of the sub-hepatic drain the drain has broken in two parts and the intra-abdominal part was retrieved in the operating room under general anesthesia.

The mean total hospitalization times in the primary closure, primary closure with T-tube drainage, choledocho-duodenostomy, choledocho-duodenostomy-jejunostomy and trans-duodenal sphincteroplasty groups were 4, 5, 5, 6, and 5 days, respectively.

There were no significant differences among the groups in terms of total complications, as in Table 2.

Table 1: General data of the patients.

Characteristics	Primary repair	Primary repair with T-tube	Choledocho-duodenostomy	Choledocho-jejune stony	Trans-duodenal sphincteroplasty
Number	13	24	51	4	8
Age (mean,years)	48	49	45	42	40
Sex (female/male)	7/6	14/10	30/21	2/2	3/5
Jaundice	12	22	43	4	8
Abdominal pain	10	18	46	4	8
Fever	5	13	27	1	5
Previous stones	0	2	7	2	1
Total bilirubin mean (mg/dl)	5	7	8	4	6
Stones Single/multiple	8/5	16/8	22/29	1/3	7/1
Diameter of CBD mean (cm)	1.3	1.6	1.9	1.7	1.7
Operative time mean (hours)	1.4	1.6	2.1	2.3	1.3
Hospital stay mean (days)	4	5	5	6	5

Table 2:Postoperative complications.

Complication	Primary closure	Closure with T-tube	Choledocho-duodenostomy	Choledocho-jejune stormy	Trans duodenal sphincteroplasty	Total No. and %	P-value
Bile leak	0	1	2	0	0	3 (3%)	>0.05
Residual stone	0	0	0	0	0	0 (0%)	>0.05
Wound Infection	0	2	5	0	1	8 (8%)	>0.05
Pulmonary complications	0	1	2	1	1	5 (5%)	>0.05
Cardiac complications	1	0	1	0	0	2 (2%)	>0.05
Others	0	1*	0	0	0	1 (1%)	>0.05
Total	1	5	10	1	2	19 (19%)	>0.05

*patient had the sub-hepatic drain cut in half during removal

DISCUSSION:

In the early 1970s, ES (Endoscopic sphincterotomy) was introduced as a treatment modality for CBD stones. During the following decades, it gained wide acceptance as a less invasive, highly effective alternative for the treatment of biliary obstruction as a result of gallstones. However, in patients with residual stones in the gallbladder, subsequent cholecystectomy was considered necessary. In a prospective randomized trial, it was demonstrated that ES before open cholecystectomy did not lead to earlier recovery or less postoperative morbidity compared with primary open cholecystectomy combined with CBD exploration, although Hammarstrom and colleagues showed that only 20% of the patients after ES alone needed cholecystectomy during follow-up. [7]

The current orthodox treatment for ductal calculi is by endoscopic sphincterotomy and stone extraction and in patients requiring cholecystectomy for symptomatic gallstone disease, endoscopic stone extraction is performed before the operation preferably during the same hospital admission. [8]

However, surgical treatment of CBD stones is indicated when endoscopic treatment is unsuccessful. [9-11]

Routine exploration of the CBD should be tried through a supra-duodenal choledochotomy, the trans-duodenal route being reserved for patients in whom stones cannot be removed readily from above. Although impacted stones at the ampulla may be broken down and removed by a supra-duodenal approach, they probably should be removed by means of a trans-duodenal sphincteroplasty, because it is less traumatic in such circumstances. [1]

Although choledochal exploration can be performed laparoscopically, this is still a growing procedure because it needs certain instruments and expertise to do it.

In supra-duodenal approach is the closure of the common bile duct is a major concern. Primary closure over T-tube is conventional, however bile leakage and bacteraemia may follow removal in 10%–19% of the cases [11-14], to avoid these complications, choledochoduodenostomy or choledocho-jejunostomymay be preferred in appropriate cases.

Although various prerequisites applied for them, the most important of which is the bile duct diameter, which should be at least 1–1.2 cm [14,15]. Primary closure is the most basic and well known method [16], however, the most important prerequisite for the procedure is a low bile duct pressure that may be achieved by a previously performed ERCP and sphincterotomy [17]. Intra-operative control of the distal CBD with a choledochoscope or dilator is feasible [18].

Trans-duodenal sphincteroplasty is rarely needed, but it's very useful in cases of impacted stones in the distal common bile duct [2]

Comparing these methods, one of the most important problems is bile leakage, it was found in4.7% of the primary closure with T-tube drainage group, and in 3.9% of the choledochoduodenostomy group, while there was no bile leakage in the other groups. Ambreen et al [19] and Yamazaki et al [20] reported bile leakage rates of 10.5% and 11.7%, in cases with T-tube drainage respectively. Deutsch et al.[21] and De Aretxabala and Bahamondes [22] reported a rates of bile leakage of about 3% in cases undergoing choledochoduodenostomy.

Similarly, Ambreen et al. [19] reported bile leakage in only one patient (6.3%) with primary closure, while Yamazaki et al. [20] reported a rate of 5.8%. Assessed in this way, cases with primary closure had low bile leakage rates in our series and in the literature.Another point of comparison concerns postoperative complications as well as length of hospital stay. In this study, patients with primary closure exhibited better results than the other groups in terms of postoperative complications and length of hospital stay. In general, similar results have been obtained in the literature.

Sealeand Ledet reported that primary closure led to a short hospitalization period and was cost-effective, and that the procedure did not cause any surgical site infections or intra-abdominal infections [16].

The surgical choice in which postoperative complications are most frequently observed is primary closure over the T-tube. The main advantages of this procedure are the ability to observe the bile ducts in the postoperative period by means of cholangiography and the drainage of residual stone particles or removal of residual stones using percutaneous choledochoscope. Complications include dislocation of the T-tube, duodenal erosion, tearing in the main bile duct during extraction and related bile leaks and biliary peritonitis, prolonged hospital stay, a long treatment period, electrolyte loss and consequent

acute renal failure in elderly patients and increased costs [20]. In addition Seale and Ledet stated that in T-tube patients, the increase observed in the incidence of thromboembolism and pancreatitis was directly related to infected bile [16]. Another disadvantage in these patients is bile drainage lasting for at least 3 weeks, resulting in loss of productivity [23].

The most important problem incholedochoduodenostomy is to find an appropriate bile duct. It is not technically possible to perform this anastomosis for every bile duct. The most frequently used (and our preferred) method in choledochoduodenostomyis side–to-side anastomosis [24].

The general morbidity of choledochoduodenostomy is 10% and the mortality is2%–3%. Other complications include cholangitis, surgical site infections, and anastomosis leakage, the incidence of cholangitis is 0%–6% [21,22].

Good to excellent results can be achieved from trans-duodenal surgical sphincteroplasty when patient carefully selected.

Miccini et al. performed trans-duodenal sphincteroplasty on 82 patients and reported bile leak and collection in 1.2% and no mortality [25]. Madura et al. studied trans-duodenal sphincteroplasty in 446 patients between 1978 to 2002 and reported leak in 1.8% patients, he also reported pulmonary complications in 4.8%, and mortality in 0.4% [26].

In bilio-enteric anastomosis, choledocho-duodenostomy was the most preferred method because it's more physiological and requires only one anastomosis, but in some cases it was not feasible due to tension and so choledocho-jejunostomy was performed instead, complications were comparable with the other methods of biliary drainage [27].

CONCLUSION:

Surgical management of common bile duct stones is still an important method of stone extraction, especially when less invasive methods (ERCP) fail to do so.

There is no best method of surgical management over the other and each procedure has its role in different patients, so all procedures should be learned and practiced accordingly. The morbidity and mortality of all these methods are comparable.

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