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A Comparison Study of Choledocholithotomy with T-tube Drainage and Choledochoduodenostomy for Surgically Managing Choledocholithiasis

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ABSTRACT

Background and aim: Though recent trends in the management of choledocholithiasis shifted to endoscopic retrograde cholangiopancreatography (ERCP) and Laparoscopy, the traditional methods of choledochotomy and T-tube drainage and choledochoduodenostomy (CDD) are still relevant. Residual or missed stones and cholangitis are the problems faced by surgeons following biliary surgery for CBD stones. We aim to compare the outcome of the two traditional methods.

Material and Methods: In this retrospective study, 47 patients with choledocholithiasis were included, out of which 19 patients whose CBD was dilated more than 12mm choledochoduodenostomy was performed, and in the remaining 28 patients, choledocholithotomy and T-tube drainage were performed, and their outcomes reviewed. Intra-operative findings, including any difficulty encountered and postoperative findings like any complications, duration of total hospital stay, and incidence of retained stones, were recorded.

Results: The patients with post-cholecystectomy status encountered considerable adhesions. The wound infection rate was 14.3% in the T-tube group and 10.5% in the CDD group. One patient with CDD had 400ml of bile in the drain, which subsided spontaneously. Another with T-tube drainage had a collection of around 300ml of bile following T-tube removal. Hospital stay in the T-tube drainage group was longer. In two cases of the T-tube group, there were retained stones, whereas in the CDD group, there were none.

Conclusions: Open surgical procedures for choledocholithiasis still have an important role to play. Both techniques are easy and safe to perform. Choledochoduodenostomy lowers the chances of retained and recurrent stones.

1. Introduction

Stones in the common bile duct (CBD) or choledocholithiasis is a very common disease encountered by surgeons. More than 85% of common bile duct stones are secondary, and the stone passes from the gallbladder through the cystic duct to the bile ducts. However, in some other situations, they may form primarily in the bile duct. Stones in the bile duct may be asymptomatic without causing any problems but may progress to serious life-threatening conditions like obstructive jaundice, cholangitis, and biliary pancreatitis.[1] So, early detection and intervention are essential to reduce morbidity and mortality. Over the last few decades, there has been considerable evolution in the treatment of Common bile duct stones.[2] Traditional methods for bile duct stones are supraduodenal choledocholithotomy with T-tube drainage or choledochoduodenostomy (CDD). However, in the era of minimally invasive surgery and due to the development of modern techniques of endoscopic interventions like endoscopic retrograde cholangiopancreatography (ERCP), the interest has shifted to laparoscopic bile duct exploration and ERCP procedures. It is now well-accepted that ERCP with endoscopic sphincterotomy is the treatment of choice for patients with bile duct stones, followed by laparoscopic Cholecystectomy.[3] In spite of these recent developments, open surgical exploration will be required to cope with situations where endoscopic or laparoscopic treatment fails or when the facilities and expertise are not available. Choledochoduodenostomy still has an important role in the management of CBD stones, and everyone should be familiar with the surgery, which may have to be performed as an alternative or as a salvage procedure.[4] However, the procedures that will be chosen will depend upon intraoperative findings. We aim to compare the results of a supraduodenal choledocholithotomy with T-tube drainage and choledochoduodenostomy in open bile duct exploration.

2. Material and methods

It is a hospital-based retrospective analytical study performed on patients with bile duct stones in the Department of Surgery. The study was initiated

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after approval of the institutional ethical and scientific committee (IEC No; 006/2021/TMCH Dated 17.03.21). Data were collected from medical records of forty-seven patients with bile duct stones, which were operated either with open choledocholithotomy followed by T-tube drainage or with a choledochoduodenostomy from January 2018 to December 2019. Ultrasonography and Magnetic Resonance Cholangiopancreatography (MRCP) were the mainstays of diagnosis, and details of the findings like the condition of the gallbladder, size of the CBD, types of stones, condition of the intrahepatic biliary tree were noted. Data were collected regarding the findings of physical examinations, routine blood investigations, liver function tests (LFT), renal profiles, and viral markers. Patients who were unfit for surgery and patients with associated malignancy of the hepato-pancreato-biliary system are excluded from our study. Open common bile duct exploration was performed in all the patients with an incision of 2.5cm in the supraduodenal part of the CBD, and stones were extracted and sludges, if present, removed. The bile ducts were flushed with water, and the patency of the distal opening was confirmed by passing a bougie and an 8F-sized feeding tube to the intestine. Patients with CBD dilatation of more than 12 mm, either with single or multiple stones, with excessive sludges, and patients with intrahepatic lithiasis were subjected to CDD. In all the cases of CDD, the duodenum was opened along its longitudinal axis, and the anastomosis was performed in a single layer with a 3-0 polyglactin suture material. Upon the remaining patients, a 10-12 F-sized T-tube was placed for external biliary drainage. Detailed surgical techniques like the choice of incision, intra-operative findings like adhesions, size of the CBD, nature of stones encountered, the character of bile, and the procedure undertaken after evaluation of intra-operative findings were recorded.

Peroperative problems encountered during the procedures, amount of blood loss, and time taken to complete the surgeries were noted. Post-operative findings of any complications developed and how they were tackled, as well as total hospital stay in days, were recorded. Follow-ups of the patients with CDD were done after two weeks and six weeks following discharge, and findings were recorded. In each case of CDD, ultrasonography was performed six weeks after the surgery to detect any retained stone. In all the cases of the T-tube drainage group, a postoperative T-tube cholangiogram was performed around 14 days after gradual clamping of the T-tube from the 10th day onwards, and if the results were satisfactory, the T-tube drain was removed by the 18th day. Results are analyzed in consultation with a statistician, and tests of significance are performed. For statistical analysis, the statistical software package SPSS 25 was used, with the application of the chi-square test.

3. Results

There were 47 patients with choledocholithiasis in our study. Out of which, 21 were male and 26 were female. Their age ranged from 17-76 years, with a mean age of 45.6 years. Female preponderance is observed in the study group, with a male-to-female ratio of 1:1.24. Predominant symptoms were pain in the right upper and mid abdomen in all 47 cases. Icterus was positive in 44 cases out of 47, with the highest bilirubin level of 16.4mg/dl observed in an intrahepatic lithiasis case. Eight out of 47 of our patients were with post cholecystectomy status, of which two of them presented to us within two years of surgery, and the remaining six patients presented more than two years after. In our study, 28 patients (60%) were treated with choledocholithotomy followed by T-tube drainage (Gr A) and 19 patients (40%) with choledochoduodenostomy (Gr B). The 19 CDD patients had their CBD dilated more than 12mm, and in the T-tube group, the CBD diameter was smaller than that. All four patients with intrahepatic lithiasis were treated with CDD.

Intraoperative findings

Out of 47 patients, 8 patients are with post cholecystectomy status. Adhesions are encountered in all eight of them. In 2 of them, the adhesions were extensive, and CBD could be reached with difficulty. In the remaining 39 patients, no adhesion was encountered. CBD was dilated more than 12mm in 19 patients and was treated by CDD. In the remaining 28 patients, CBD diameter was smaller, and choledocholithotomy with T-tube drainage was performed (Table 1). A choledochotomy was performed in all the cases in the supraduodenal portion of the bile duct. The bile was found to be dirty in 9 of the cases. In the remaining cases, it looks normal. In our study, there were 38 patients with multiple stones, and out of them, 16 were treated with CDD, which included four cases with intrahepatic lithiasis and 22 with T-tube drainage (Table 2). There were 9 cases with a single stone. Out of them, in six cases, choledocholithotomy with T-tube drainage was performed as their CBD was smaller in caliber. In three cases, CDD was performed. In two cases, there were single stones that were impacted in the outlet but could be retrieved safely with kocherization of the duodenum. In all three cases, the CBD was dilated. In our cases, blood loss was minimal in both groups except in the post-cholecystectomy cases where, due to adhesions, there was slightly more bleeding, and in two cases, blood loss was around 300ml and 400ml. In one of them, one unit of blood had to be transfused because the patient was anaemic. The duration of surgery in both groups ranged from 85-160 minutes. The mean duration of surgery in the T-tube group was 96 minutes, whereas the mean in the CDD group was 118 minutes. In the post-cholecystectomy cases and the cases with intrahepatic lithiasis, the duration of surgery was longer.

Table 1. CBD diameter and procedure undertaken.

Size of CBD	Number of cases	Operation undertaken	Mean	SD	Mean CBD diameter±SD	*P-value*
< 10mm	9	T-Tube drainage	11.11	0.916	11.11 (±0.916) mm = (10.194, 12.026)	0.001
10-12mm	19	T-Tube drainage				
>12-15mm	10	CDD	15.89	1.595	15.89 (±1.595) mm = (14.295, 17.485)	
>15mm	9	CDD				

Table 2. Types of stone and procedure undertaken.

Types of stone	Total	Group A T-tube drainage	Group B Choledochoduodenostomy	*P-value*
Single stone	7	6	1	0.3187
Impacted stone (single)	2	0	2	
Multiple stone	34	22	12	
Intrahepatic lithiasis	4	0	4	

Postoperative findings

During the immediate postoperative period, no significant problem was encountered in the groups. One patient with CDD had a bile leak of around 400ml from the second day onwards, which gradually came down to nil by the sixth day. Wound infection was observed in four patients in the T-tube drainage group and in two patients in the CDD group, which could be managed without any difficulty. All 28 patients of group A underwent postoperative T-tube cholangiogram for confirmation of CBD clearance prior to its removal, and out of them, in two cases, there were retained stones. Both the patients were managed later in a higher center by ERCP. In group B with CDD, all patients were subjected to ultrasonography six weeks after discharge, and the findings were satisfactory without any residual or missed stones. One patient with T-tube drainage on its removal had severe pain, for which ultrasonography was done the next day to find a 300 ml bile collection in the hepato-renal pouch. The patient was treated with antibiotics and analgesics, recovered in 2-3 days, and was discharged. One patient with CDD reported fever, chill, and rigor without jaundice three weeks after surgery, which could be managed with a course of antibiotics (Table 3).

Table 3. Postoperative complications in the two groups.

Complications	Group A T-tube drainage	Group B Choledochoduodenostomy	*P-value*
Wound infection	4	2	0.7046
Cholangitis	0	1	0.2202
Bile leak	1	1	0.777
Retained stone	2	0	0.239

Regarding hospital stay, in the CDD group, it ranges from 6-9 days with a mean stay of 7.10 days. In the T-tube group, 16 patients stayed till the T-tube cholangiogram and removal of the tube. In the remaining 12 patients, we discharged the patient early in 4-7 days, again to admit later for T-tube management. So, the hospital stays in this group range from 9 to 18 days, with a mean stay of 13.25 days.

4. Discussion

In patients with CBD stones, the primary aim of the treatment is clearing the CBD of stones and sludges and ensuring the free flow of bile to the duodenum. For that, the surgeon has to choose the right kind of procedure depending upon the expertise and availability of the resources. Nowadays, many centers are developing ERCP and laparoscopic management of CBD stones. However, not all centers have the facilities, and they have to be content with traditional open surgeries. Moreover, when the treatment with the more advanced options fails, obviously, surgeons have to opt for open methods like choledocholithotomy followed by T-tube drainage and choledochoduodenostomy. Retained or residual stones are the major problems faced by the surgeons doing choledocholithotomy and T-tube drainage. Extensive studies have been carried out on this topic, and many studies observed that patients with multiple stones, CBD stones with intrahepatic lithiasis, and markedly dilated CBD were found to be the main risk factors for retained stones.[5, 6] Ampullary stenosis and impacted stones are other factors that might cause incomplete evacuation of stones. Dilated CBD also predisposes bile stasis, leading to infection and, subsequently, mucosal damage and the chances of stone formation later. So, though it is still in the debate regarding which method is optimal for CBD stone clearance, it is almost certain that the CBD must be completely cleared of stones and sludge, and there is effective bile flow to the intestine without any stasis; otherwise, chances of missed or retained stones will increase. Ali MM et al., in their study of 43 patients with choledochotomy and T-tube drainage, found that the incidence of retained stones was 8.43%.[5] Redwan AA et al. found missed or retained stones in 7% of their cases.[7] In the present study, it is observed that missed or retained stones occurred in two out of 28 patients (7.1%) with choledochotomy with T-tube drainage, whereas in the CDD group, the incident is found to be nil. The two cases that were missed were tackled with ERCP in another center. Choledochoduodenostomy is one of the most commonly performed biliary drainage surgeries, with very satisfactory results and the least postoperative complications.[8, 9] However, the optimal CBD diameter is vital for a successful choledochoduodenostomy. Malik AA et al., after they analyzed 270 cases of CDD, emphasize that CDD is effective in non-neoplastic distal CBD obstruction and dilatation of more than 15mm is essential for the construction of the anastomosis for a good result.[10] According to Gupta et al., the optimal diameter of CBD was 15mm, whereas Aydin MC et al. created side-to-side anastomosis in all their cases of at least 3 cm long with a median CBD diameter of 15 (10-40) mm.[11, 12] In our study, we performed CDD with a diameter of more than 12mm. In our study, 4 out of 28 cases (14.3%) of T-tube drainage cases and 2 out of 19 cases (10.5%) of choledochoduodenostomy had wound infection, whereas in the study of Ali et al., they reported wound infection in 9.3% and 5% of their cases respectively.[5] In a study by Asad S et al., they observed wound infection in 10.59% of their choledochoduodenostomy cases, whereas Leppard et al. found wound infection in 20% of their cases[13,14] Out of 19 cases of CDD, leakage of bile was observed in one patient (5%). The patient had a bile leak of around 400 ml from the second day onwards, but it gradually came down to nil by the sixth day. Leppard et al., in a study, observed bile leakage in 13%

of their cases, which is slightly in the higher range.[14] In the choledocholithotomy and T-tube drainage group of 28 patients, one patient (3.6%) on the removal of the tube had severe pain, for which ultrasonography was done on the next day to find 300 ml of bile leak in the hepato-renal pouch. The patient was treated with antibiotics and analgesics, recovered in 2-3 days, and was discharged.

Regarding hospital stay, it is observed that the T-tube drainage group of 28 patients had to stay longer in the hospital than the CDD group because they had to wait for their T-tube to be removed, which was done between 14-18th days. Though we could discharge 12 patients on the 4-7th day, they had to be readmitted again later for a T-tube cholangiogram and subsequently their removal. So, in our study, the average stay in the T-tube group was 13.25 days, whereas in the CDD group, it was 7.10 days. Following a choledochoduodenostomy over the years, surgeons fear that cholangitis may be a problem due to the upward reflux of duodenal content into the biliary tree, but this theory proved to be wrong following experiments on dogs and other clinical findings.[10] In some large series of longer periods of studies, the incidence of cholangitis was found to be in the range of 0-6%.[13, 15, 16] In our study, one patient of CDD suspected to be suffering from cholangitis three weeks after the surgery (5.1%) recovered uneventfully following a course of antibiotics. No other patients reported cholangitis during our study period. None of our cases presented with sump syndrome, which is supposed to occur due to the collection of food residue, stones, and sludge in the blind pouch created in the distal bile duct following a CDD and leading to cholangitis, liver abscess, and pancreatitis. Non-reporting of the syndrome in our study may be due to our short-term follow-up, but many authors in their studies have not recorded this complication.[17] On the other hand, some recent studies have reported a prevalence of 0–5.2%.[13, 15, 16]

5. Conclusion

Although there are some hesitations in performing bilio-enteric anastomosis due to its possible complications, choledochoduodenostomy is easy to perform with satisfactory results and is a safe alternative procedure. However, a proper intraoperative decision has to be made when choosing the correct method. The chances of retained or recurrent stones are lesser in choledochoduodenostomy than in the T-tube drainage group. Moreover, the possibility of postoperative pancreatitis is also less, probably due to the bypass of the common channel.

Conflict of Interest

The authors declared that there is no conflict of interest.

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