Section: General Surgery

Original Research Article

A COMPARATIVE ANALYSIS OF COMMON BILE DUCT DRAINAGE TECHNIQUES: T-TUBE VS. CHOLEDOCHODUODENOSTOMY FOR COMMON BILE DUCT STONES

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ABSTRACT

Background: The aim of this study was to investigate and compare the utilization of 'T' tube drainage and choledochoduodenostomy for cases involving common bile duct stones. **Materials and Methods:** A prospective study was conducted at Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, between September 2022 and May 2023, covering a period of 8 months, including the follow-up period. The study enrolled 50 patients diagnosed with choledocholithiasis. Asymptomatic cases of CBD stones detected incidentally during investigations such as Ultrasonography of the upper abdomen for chronic calculus cholecystitis, or those identified during cholecystectomy surgery, were also included. **Result:** Among the cases analyzed, the majority of patients (62%) did not exhibit sludge. Choledochoduodenostomy was the preferred procedure when sludge was present (P=0.041), while 'T'-tube drainage was utilized in cases without sludge. Only 19 cases (38%) displayed sludge, which was more commonly observed in patients with a larger diameter CBD (P value = 0.012). **Conclusion:** Both surgical procedures demonstrated no mortality in this study. However, some patients experienced complications, possibly due to the higher proportion of elderly individuals in the study population, with most complications noted in patients with acute cholangitis. Wound infection emerged as the most common complication in both groups, but all patients were successfully treated conservatively.

INTRODUCTION

Cholelithiasis, commonly known as gallstones, is often linked to the presence of stones in the common bile duct. Published data indicates that approximately 15% of patients with cholelithiasis also have choledocholithiasis when subjected to cholecystectomy for gallstones. On the other hand, 95% of patients with stones in the common bile duct also have gallstones. The presence of common bile duct stones can lead to increased morbidity and mortality, especially in patients presenting with jaundice and pancreatitis.[1]

Initially, external drainage of the common bile duct was the widely practiced procedure. However, surgeons began exploring other methods of drainage to avoid unnecessary bile loss into the exterior and to reduce the incidence of overlooked stones leading to subsequent obstruction. Choledochoduodenostomy was introduced as a technique to internally drain the bile into the duodenum, with the expectation that any residual stones would pass through the stoma into the duodenum. Despite being performed and published over 90 years ago, and having several supporting papers from different centers, universal acceptance of choledochoduodenostomy as an effective procedure for benign biliary obstruction remains uncertain. This is primarily due to the lack of satisfactory analysis on the long-term effects of this operation on the common bile duct and the liver in a large patient group.[2]

Choledochoduodenostomy, an anastomosis between the lower end of the common bile duct and the duodenum, has specific but limited indications. Although described long ago, the indications for this procedure have remained consistent over the years.

This study includes 50 cases in which the common bile duct was explored for stones. Among them, 30 cases underwent choledocholithotomy followed by T-tube drainage, while lateral

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choledochoduodenostomy was chosen for the remaining 20 cases. All patients were admitted to Sri Krishna Medical College and Hospital in Muzaffarpur, Bihar, between September 2022 and May 2023 under the Department of Surgery. Thorough pre-operative investigations were conducted using biochemical and radiological methods to determine the appropriate surgical approach. Postoperatively, patients were assessed for jaundice recurrence, liver function deterioration, and ascending infection through clinical, biochemical, and radiological evaluations. The results of this series were compared with other published studies after reviewing relevant literature on the topic.

MATERIALS AND METHODS

A prospective study was conducted at Sri Krishna Medical College and Hospital, Muzaffarpur, Bihar, between September 2022 and May 2023, covering a period of 8 months, including the follow-up period. The study enrolled 50 patients diagnosed with choledocholithiasis. Asymptomatic cases of CBD stones detected incidentally during investigations such as Ultrasonography of the upper abdomen for chronic calculus cholecystitis, or those identified during cholecystectomy surgery, were also included. Number of cases - The study involved 50 cases conducted prospectively.

Great attention was dedicated to distinguishing surgical jaundice from medical jaundice through a comprehensive evaluation of patient history, clinical examination, and investigations.

The total of 50 cases were recruited for the study. Detailed patient particulars were collected, including chief complaints such as abdominal pain, fever, jaundice, nausea, vomiting, and their durations. Specific details about the pain, its characteristics, radiation, aggravating or relieving factors, and relation to food were carefully noted. The history of jaundice, its onset, duration, and progression (gradual deepening or fluctuating) were recorded. Information regarding fever with or without chills and rigor, nausea, vomiting, stool color, and itching were also documented. Past history, including previous attacks of biliary colic, jaundice, typical fever, and recurrent blood transfusions, were noted. Any prior surgical interventions were recorded, along with any major medical illnesses or suggestive history of diabetes mellitus, hypertension, and ischemic heart disease. Personal dietary habits and any addictions were also inquired about. In female patients, obstetrical history, such as parity, number of living children or abortion, and the use of oral contraceptive pills, were noted.

Each patient underwent a thorough and systematic clinical examination. General examination included observing the patient's built, weight, pallor, edema, jaundice, pulse, blood pressure, respiration, and temperature.

During local examination of the abdomen, the shape and movement of the abdomen with respiration, as well as the presence or absence of any lumps, were inspected. Tenderness and temperature in the right hypochondrium were palpated, and the presence of any lump or other organomegaly was recorded. Other systemic examinations, including the cardiovascular, respiratory, and nervous systems, were conducted carefully.

Follow-up assessments were carried out at the 4th postoperative week and then at 3rd postoperative months for all patients. In case of any abnormalities observed during the follow-up, patients were closely monitored with clinical, blood, and radiological investigations.

RESULTS

A total of 50 cases were recruited in the study, in which 30 cases (60%) underwent ‘T’-tube drainage and 20 cases (40%) underwent Choledochoduodenostomy.

Table 1: showing the gender distribution of cases

Sex	No of Cases	Percentage
Male	18	36
Female	32	64
Total	50	100

Out of total cases, 18 (36%) were males and 32 (64%) were females.

Table 2: showing the age distribution of choledocholithiasis and the type of surgery performed in different age group.

Age (Year)	‘T’ Tube drainage		Choledochoduodenostomy	
	No	%	No	%
<20	1	2	0	0
21-29	4	8	3	6
30-39	5	10	3	6
40-49	13	26	5	10
50-59	4	8	7	14
≥60	3	6	2	4
Total	30	60	20	40

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The incidence of choledocholithiasis was found to be more (46%) in the age group of 40-49 years. Choledochoduodenostomy was more frequently performed in older (more than 50 years) age group whereas 'T'-tube drainage was performed more commonly in relatively younger age group (less than 50 years).

Table 3: showing the relation of Cholangitis with the procedure performed

Procedure	Cholangitis (Fever)			
	Present	%	Absent	%
'T' tube drainage	10	20	20	40
Choledochoduodenostomy	8	16	12	24
Total	18	36	32	64
χ^2= 0.412, P value = 0.631				

Both the surgeries 'T'-tube drainage as well as Choledochoduodenostomy were performed more common in absence of cholangitis, but statistically Cholangitis was not found to be the important factor in decision making of procedure performed (P= 0.630).

Table 4: showing the relation of common bile duct diameter (mm) with cholangitis

CBD diameter	Cholangitis (Fever)			
	Present	%	Absent	%
<10 mm	03	06	20	40
11-15 mm	09	18	07	14
> 15mm	06	12	05	10
Total	18	36	32	64
χ^2 = 9.751, p Value= 0.007				

Cholangitis was found to be more common (15 out of 18 cases i.e 83.33%) when CBD was dilated more than 10 mm (P=0.007), whereas 20 out of 32 cases (62.5%) has shown CBD diameter less than 10 mm in absence of cholangitis.

Table 5: showing the relation of CBD diameter with the surgical procedure performed

Procedure Performed	CBD diameter (mm)		
	<10	11 –15	>15
'T' tube drainage	23	07	00
Choledochoduodenostomy	00	09(>12mm)	11
Total	23	16	11
χ^2= 33.594, p Value = <0.001			

'T' –tube was performed more commonly when CBD diameter was less than 10 mm. Choledochoduodenostomy performed only when diameter of CBD was more than 12 mm. When CBD diameter was more than 15 mm, only choledochoduodenostomy was performed.

Table 6: showing the relationship of number of stones with CBD diameter

Number of Stones	CBD diameter (mm)					
	<10 mm		11-15 mm		>15mm	
	No	%	No	%	No	%
Single	12	24	06	12	05	10
Multiple	11	22	10	20	06	12
Total	23	46	16	32	11	22
χ2 = 0.820, p Value= 0.663						

In this study, it was found that the number of stones didn't affect the common bile duct diameter. No association was seen between multiplicity of stone and CBD diameter (P =0.663).

Table 7: showing the frequency of sludge in relation to surgery performed

Procedure	Sludge			
	Present		Absent	
	No	%	No	%
'T' tube drainage	08	16	22	44
Choledochoduodenostomy	11	22	09	18
Total	19	38	31	62
χ2 = 4.089, p Value= 0.043				

In the cases of our study, most of the patients (62%) didn't has sludge. Choledochoduodenostomy was more frequently performed when sludge was present (P=0.043), whereas 'T'-tube drainage was performed when sludge was absent.

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Table 8: showing the average duration of surgery

Operation	Time (minutes)
'T' – tube drainage	78
Choledochoduodenostomy	126

Mean duration of surgery was significantly lower in 'T' tube drainage by 48 minutes.

Table 9: showing average number of days of hospital stay after the surgery

Operation	Hospital Stay (Day)
'T' tube drainage	14.4 days
Choledochoduodenostomy	10.7 days

Hospital stay was calculated from the day of surgery performed till the patient was in dischargeable condition. Average hospital stay duration was around 4 days longer for 'T'-tube drainage surgery.

Table 10: showing various postoperative complications of the surgery

Complication	'T' – tube		Choledochoduodenostomy	
	No	%	No	%
Wound infection	06	12	03	06
Residual Stones	02	04	00	00
Cholangitis	00	00	00	00
Bile leak	03	06	02	04
'T'-tube dislodgement	01	02	00	00

In our study, wound infection was more common with 'T'-tube drainage (20% Vs 15%). A total of 6 cases (4 in each 'T'-tube group and 2 in choledochoduodenostomy group) were developed bile leak in post operative period. One case of bile leak developed with 'T'-tube in situ, whereas 2 cases developed after 'T'-tube removal. One case of leak occurred due to dislodgement of upper tip of 'T'-tube outside of CBD, when 'T'-tube was in situ and was diagnosed by 'T'-tube cholangiogram. On 10th post operative day leasubsided within 2-3 days of removal of 'T'-tube. Bile leak occurred after removal of 'T'- tube was stopped within
3 days. However all of these patients were asymptomatic and treated conservatively. There were 2 cases of missed stones in 'T' – tube drainage (10%).
2 cases of bile leak occurred after choledochoduodenostomy (10%). In both cases the diameter of CBD at the time of anastomosis was 13mm and 16mm. However both patients were asymptomatic and treated conservatively and bile leak stopped within 4-5 days. There were no complications of bile collection, bile peritonitis, cholangitis, anastomotic stricture or sump syndrome.
There was no mortality noted in both the group of our study.

Follow up study

Out of 50 patients, 46 patients (92%) came for one month follow up, and 38 patients (76%) came for 3 months follow up. All the patients in both the groups didn't complaint any symptoms in the follow ups. Clinical examinations didn't revealed jaundice, tenderness and hepatomegaly. Liver function of all the patients in both the group was normal in the follow ups. Ultrasonography was not required for any of the patients.

DISCUSSION

Our research shows a 2.125-to-1 gender gap in the prevalence of choledocholithiasis. Way et al.'s finding of a 3:1 female to male ratio jibes with this data.The ratio of 2:1 to 1:1 was also reported by Kumar et al. [3].[4]However, in their analysis, Soon et al. found a male preponderance of 1.3:1.
According to our data, those between the ages of 40 and 49 are particularly at risk. Patients had a mean age of 42.92 years. Choledocholithiasis becomes more common and more commonplace as people get older. According to research by Nathanson et al., the average age of a patient diagnosed is 59.6.[5] Sgourakis stated that the ages varied widely, from 46 to 89.[6] Hermann found that while the disease's onset is often in youth, its incidence spikes between the ages of 35 and 55 and continues to rise gradually thereafter.[7] It can be done even in younger people if the indication is there and the procedure is carefully executed.Our findings suggest that regional differences in food and lifestyle may account for why choledocholithiasis is more common in middle-aged women.
When deciding on a drainage method, this factor weighs more heavily than any other.
According to L. H. Blumgart, a dilated duct is a prerequisite for the choledochoduodenostomy procedure. A duct narrower than 1.2 cm is an unequivocal Contraindication, while a duct smaller than 1.4 cm is not recommended. Therefore, a choledochoduodenostomy must meet two technical requirements: a common duct diameter of at least 1.4 cm and a stoma size of at least 2.5 cm.
When the calculus-containing common bile duct measures 1.2 cm in internal diameter and the anastomotic width is at least 2.5 cm, as Wood MD, Glidman ML, 1981 showed in his 200 cases of choledochoduodenostomy, it is an outstanding procedure' [8].

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Studying 175 consecutive cases of choledochoduodenostomy, of which 153 were for benign biliary illness, George A. Degenshein MP et al, 1974 found similar outcomes.

In our study, the common bile duct width was greater than 10 mm in 15 of 18 (83.33%) patients with cholangitis but in only 12 of 32 (43.3%) individuals without cholangitis. According to Tomizawa et al.'s research, in which 70.13 percent of (11.22.9mm) was found, this was the case.CBD's dilatory effects help doctors diagnose acute cholangitis,[9,10] CBD stones have a cholangitis sensitivity of 95%-100%.[11]

T-tube drainage is the most common and standard technique for emptying the common duct after investigation. The peritoneum is quite sensitive to the bile. It causes a severe inflammatory response, which is usually followed by extensive peritoneal adhesion; if the extravasation is significant, septic peritonitis develops, which can be deadly. These problems can be prevented by draining the shared duct. It takes about 10 days for the drain's track to be safely sealed off from the general peritoneal cavity, thus the drain should be left in place during that time (Sir Ogilvie 1957).[12]

When there are many stones in the common duct, an operative cholangiogram is a rather safe defence against residual stones. Choledochoduodenal bypass appears to prevent subsequent bile duct obstruction by any leftover stone, which, if tiny, will flow into the duodenum through the stoma with relative ease in cases when the facility of operational cholangiogram is not accessible.

Many people are against having a choledochoduodenostomy done because they worry it would cause ascending cholangitis due to food particles and bacteria from the intestines getting into the bile duct. However, there is no supporting clinical data to back up this claim. Although barium enema experiments showed instantaneous reflux of the barium into the biliary system, Madden et al. (1970) conducted a convincing experiment demonstrating that in none of the 20 animals subjected to biliary - colic anastomosis did cholangitis develop. Many writers have provided compelling evidence that cholangitis is caused by bile blockage at the stoma rather than intestinal regurgitation. Even as far back as 1923, Florcken argued that the only people who raised concerns about cholangitis were either those who had never undergone the procedure or those who had just performed a partial anastomosis. Only five patients (.4%) with recurrent cholangitis were observed in a collected series of 1,255 choledochoduodenostomy by Maddenetal.[13]

Patients undergoing surgery for CBD calculi have a mortality rate between 1% (in healthy younger patients) and 28% (in unhealthy older patients).[14]. Younger patients receiving surgery for cholangitis have a higher risk, up to 12-14%.[14]Incorporating a drainage process also raises the risk of death or serious injury.[15]

Our research showed that there were no fatalities associated with either of the surgical techniques. Complications occurred in 17 patients (34%). This may be due to the fact that majority of the patients in the research had acute cholangitis and that the patients themselves tended to be older.

The most prevalent consequence was wound infection, which was seen in both groups. In the 'T'-tube drainage group, there were 3 incidences of bile leakage, or 10%. One was caused by the upper end of the 'T-tube becoming dislodged, and the other two occurred after the 'T'-tube had been removed. However, within the next two to three days, all three patients improved, and the fistula closed. Three patients in the Choledochoduodenostomy group (15%) developed wound infections, while two patients (10%) experienced bile leaks. The patients that were treated conservatively all made good recoveries.

'T'-Tube drainage resulted in a much shorter average surgical time. In our research, we found that patients who underwent 'T'-Tube treatment stayed in the hospital for an average of 14.4 days, whereas those who got choledochoduodenostomy stayed for an average of 10.7 days.

CONCLUSION

Both surgical procedures demonstrated no mortality in this study. However, some patients experienced complications, possibly due to the higher proportion of elderly individuals in the study population, with most complications noted in patients with acute cholangitis. Wound infection emerged as the most common complication in both groups, but all patients were successfully treated conservatively.

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