

## Original Research Article

# Primary closure of common bile duct versus T-tube placement after open choledocholithotomy

Manoj Seervi, Deepak Verma\*, Nemi Chand, Sarthak Sharma

Department of Surgery, Dr. S. N. Medical College, Jodhpur, Rajasthan, India

**Received:** 29 March 2020

**Revised:** 28 April 2020

**Accepted:** 29 April 2020

### \*Correspondence:

Dr. Deepak Verma,

E-mail: [drdeepakv@ymail.com](mailto:drdeepakv@ymail.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Background:** Choledocholithiasis is primarily managed by endoscopic retrograde cholangiopancreatography (ERCP) but in certain situation particularly large and impacted common duct stone, the procedure may not succeed and this small group of patients require either open or laparoscopic common bile duct exploration followed by T-tube insertion. Usually T-Tube cholangiogram is performed on 10th postoperative day and tube is removed on 12-14<sup>th</sup> day. Alternatively, primary closure of duct after post exploratory choledochoscopy to ensure duct clearance with or without biliary stent can be done.

**Methods:** This study was performed on 25 patients of failed endoscopic extraction, subjected to open choledocholithotomy. Group A (n=7) had T-tube insertion whereas group B (n=18) had primary closure of duct after choledochotomy.

**Results:** 19 patients had calculus cholecystitis whereas 6 patients had prior cholecystectomy and later developed choledocholithiasis. 52% patients had impacted stone and 40% had large stone as a cause of ERCP failure. Postoperative pyrexia, cholangitis, septicemia, sub-hepatic bilious drainage and postoperative hospital stay was higher in T-tube group as compared to primary closure group.

**Conclusions:** Primary closure over the biliary stent after cholecystectomy and/or choledocholithotomy has less morbidity as compared to T-tube insertion and hence should be preferred choice in choledocholithiasis, provided stone free duct is ensured peroperative using choledochoscopy.

**Keywords:** Choledocholithiasis, Choledocholithotomy, Primary closure, T-tube

## INTRODUCTION

Gall stone disease is one of the most common problem affecting digestive tract and prevalence in India is around 4%.<sup>1</sup> Choledocholithiasis is associated with cholelithiasis in about 10-15% of patients.<sup>2</sup> There are different methods of extracting stones from common bile duct and endoscopic extraction is one of the commonly used procedure today. Still there are few cases which cannot be managed by this method and surgical removal is only option in such cases. Surgical extraction may be either laparoscopic or open surgical procedure. Whether open or laparoscopic, post choledocholithotomy insertion of

T-tube is common practice. T-tube placement is based on hypothesis that it provides (a) postoperative decompression of the CBD should outflow obstruction occur (b) allows radiological visualization of the CBD (c) potential route for extraction of any retained stone.<sup>3</sup> External drainage of bile through T-tube can lead to fluid and electrolyte imbalance and nutritional disturbances. It also increases chances of cholangitis and wound infection. However, it leads to prolonged hospital (>10 days) and loss of man days. Alternatively, post choledocholithotomy, common bile duct can be primarily closed with or without intraductal stent placement provided stone free ductal system can be confirmed by

rigid or flexible post-exploratory intraoperative choledochoscopy.

Aim of the study was to compare the morbidity and hospital stay in patients subjected to T-tube placement in common bile duct versus primary closure of bile duct over biliary stent placement in cases of choledocholithiasis post CBD exploration.

## METHODS

This prospective study was performed at Department of Surgery, Dr. S. N. Medical College, Jodhpur (Rajasthan) between September 2016 to September 2018 on 25 patients diagnosed as cases of cholelithiasis with choledocholithiasis and subjected to open cholecystectomy with choledocholithotomy or choledocholithotomy alone in patients who had choledocholithiasis after previous cholecystectomy. In all patients, endoscopic extraction was attempted by Department of Gastroenterology but failed. There was no exclusion criteria except the patients not approved by anesthesiologists in reference to their fitness for general anesthesia.

Patients were divided in two groups. In Group A, comprising of 7 patients, post-exploratory T-tube placement was done and in Group B (18 patients) primary closure of common bile duct after biliary stent placement was done. In both groups, intraoperative choledochoscopy was done after stone removal from duct to ensure complete clearance. Subhepatic drain was kept in both the groups. In Group A, T-tube cholangiogram was done on 9th postoperative day and tube was removed on 12-14<sup>th</sup> postoperative day. In Group B, stent was removed after three weeks. Morbidity and hospital stay was compared in between two groups. Student t test was used for statistical evaluation. Approval from ethical committee of the institute and informed consent from patients were taken.

## RESULTS

In Group A there were 4 male and 3 female whereas in Group B there were 5 male and 13 female patients. Age in both groups ranged from 26 to 72 years. Mean age in Group A was 47.7 years and 55.7 years in Group B.

**Table 1: Preoperative diagnosis.**

Preoperative diagnosis	Group A	Group B
	N (%)	N (%)
<b>Chronic calculus cholecystitis with choledocholithiasis</b>	6 (85.6)	6 (33.3)
<b>Acute calculus cholecystitis with choledocholithiasis</b>	1 (14.3)	5 (27.7)
<b>Acalculus cholecystitis with choledocholithiasis</b>	Nil	1 (5.5)
<b>Choledocholithiasis (history of cholecystectomy in past)</b>	Nil	6 (33.3)

All patients required cholecystectomy with choledocholithotomy except 6 (33.3%) patients of Group B. In these patients, cholecystectomy was already done for cholelithiasis in past and they developed choledocholithiasis subsequently.

**Table 2: Cause of failed endoscopic extraction.**

Cause of failure	No. of patients (%)
<b>Large size of stones</b>	10 (40)
<b>Large number of stones</b>	6 (24)
<b>Impacted stones</b>	13 (52)
<b>Difficult cannulation/bleeding</b>	5 (20)

Failed endoscopic retrograde cholangiopancreatography (ERCP) was due to impacted stone in 52% and large stone in 40% in patients included in the study. Procedure was abandoned in 20% patients due to difficult cannulation and attempted sphincterotomy led to bleeding and reattempt failed to cannulate duct. Nonavailability of mechanical lithotripter was main reason for inability to deal with large size stone.

**Table 3: Amount and nature of subhepatic drain output (in ml).**

Post-operative day	Group A	Group B
<b>First</b>	107.2±34.5 (Bilious)	91.6±37.6 (Bilious)
<b>Second</b>	78.6±26.7 (Bilious)	66.0±27.1 (Bilious)
<b>Third</b>	50.0±21.2 (Bilious)	42.2±13.4 (Serous)
<b>Fourth</b>	32.8±23.6 (Bilious)	12.5±1.2 (Serous)
<b>Fifth</b>	25.7±10.2 (Serous)	Nil
<b>Sixth</b>	15.9±08.3 (Serous)	Nil
<b>Seventh</b>	7.5±05.6 (Serous)	Nil
<b>Eighth</b>	Nil	Nil

Amount of subhepatic drainage in postoperative period and bilious nature of drain persisted for seven days and 4 days in T-tube group and primary closure group respectively.

**Table 4: Post-operative early and late complications.**

Complication	Group A (n=7)	Group B (n=18)
	N (%)	N (%)
<b>Post-operative pyrexia</b>	4 (57.14)	5 (27.77)
<b>Cholangitis</b>	1 (14.28)	1 (5.55)
<b>Septicemia</b>	2 (28.57)	1 (5.55)
<b>Wound infection</b>	3 (42.85)	2 (11.11)
<b>T-Tube site infection</b>	2 (28.57)	Nil
<b>Drain tube site infection</b>	3 (42.85)	2 (11.11)
<b>Bile leak after T-tube removal</b>	1 (14.28)	Nil
<b>T-Tube blockage</b>	1 (14.28)	Nil

Postoperative pyrexia, cholangitis, septicemia, drain site infection and wound infection was more common in T-tube group as compared to primary closure group. T-tube site wound infection, T-tube blockage and bile leak after T-tube removal were complication specific to Group A only. Because of primary closure and avoidance of T-tube, these complications could be completely avoided in Group B.

**Table 5: Operating time for procedures (in minutes).**

Procedure	Group A	Group B	P value
<b>Cholecystectomy with cholelithotomy and T-tube insertion (n=7)</b>	88±11.5	-	-
<b>Cholecystectomy with choledocholithotomy and primary closure (n=12).</b>	-	71.9±5.8	<0.0001
<b>Choledocholithotomy with primary closure (n=6)</b>	-	58.3±3.9	-

T-tube insertion require manipulation and time consuming and hence operating time in Group A was 88±11.5 minutes in group A whereas it was 71.9±5.8 minutes in primary closure group. In 6 patients of Group B where only choledocholithotomy was done, operating time was 58.3±3.9 minutes. The operating time difference between two group was statistically significant.

**Table 6: Hospital stay (in days).**

Group	Hospital stay	P value
<b>Group A</b>	14.14±1.06	
<b>Group B</b>	9.11±1.13	<0.0001

Patient needs to be hospitalized during T-tube in situ to avoid complications like blockage and dislodgement. They also needs T-tube cholangiogram, which is usually done at 10th postoperative day before removal, hospital stay was 14.14±1.06 days in Group A whereas it was 9.11±1.13 days in Group B, again the difference was statistically significant.

## DISCUSSION

Choledocholithiasis is associated with cholelithiasis in about 10-15 % of patients.<sup>2</sup> Ludwig Courvoisier laid the foundation of modern common bile duct exploration as early as 1890 with first successful removal of common bile duct stones and for generations, operative exploration of common bile duct at the time of cholecystectomy for common bile duct stone removal has been considered the gold standard at which all other treatment modalities were compared.<sup>4,5</sup> Halsted (1919) recommended closure of CBD after choledocholithotomy and drainage of common bile duct by a small tube into it through cystic

duct. The tube was to be left in place for 3-4 days, then clamped, if the flow of bile was uninterrupted, the tube has to be removed.<sup>6</sup>

However, residual stones was very common until Mirizzi introduced intraoperative cholangiography in 1932 and this procedure reduced the incidence of missed stones markedly and so was mortality.<sup>7,8</sup> Next improvement in the technique of common bile duct exploration was introduction of choledochoscopy in which Bakes described a speculum with a mirror and reflected light from surgeon's headlamp was used.<sup>9</sup> In 1958, commercial choledochoscope with optical system, light source and an irrigation channel enclosed in a rubber sheath was available.<sup>10</sup>

ERCP was introduced in 1968 by McCune and over the next two decades have revolutionized the diagnosis and management of diseases involving hepato-biliary tract.<sup>11</sup> Endoscopic interventions are currently established as the first line therapy for choledocholithiasis.<sup>12</sup> The advantages of ERCP make it the prominent method of treating choledocholithiasis.<sup>13</sup> However, there are situations like large stone, impacted stones or anatomical limitations of ERCP, that surgical exploration of common bile duct is required which can be done either using laparoscope (laparoscopic common bile duct exploration) or open surgery. In both situation, after exploration and removal of stone from CBD either T-tube is placed in common duct or primary closure can be done over biliary stent.

Present study was thus performed to compare the morbidity of T-tube placement over primary closure of CBD over stent placement. There were 16 female and 9 male patients with age ranging from 26 to 72 years. 12 (48 %) patients had chronic calculus cholecystitis with choledocholithiasis and 6 (24%) had acute on chronic calculus cholecystitis with choledocholithiasis. 6 (33.3%) patients of Group B had cholecystectomy done before and developed choledocholithiasis later on (Table 1).

In all these cases, endoscopic stone extraction was attempted by endoscopist but failed. Large (40%) and/or impacted stones (52%) were the main cause of the failure of endoscopic extraction. In 24% cases, common hepatic and common bile duct was completely filled with multiple stones. 20% cases had difficulty in cannulation of the ampulla or the procedure was abandoned because of bleeding during sphincterotomy (Table 2). ERCP is successful in clearing the common duct in 70% to greater than 90% of cases, depending primarily on the skill of the operator.<sup>14</sup>

Intraoperative post-exploratory rigid choledochoscopy was performed in all 25 cases. In 4 cases (16%), unsuspected calculus was detected during choledochoscopy. In three cases it was detected in lower part of common bile duct and in one case it was in upper part of detected. The stones were extracted using grasper

and then irrigation with normal saline was done in all cases. Literature has also mentioned that intraoperative choledochoscopy can improve the cost benefit of the bile duct exploration.<sup>15</sup>

In group A (N=7), appropriate size T-tube was inserted in common bile duct and choledochotomy incision was closed using 3-0 Vicryl interrupted sutures to fit T-tube snugly in duct. In group B (n=18), adequate size biliary stent was placed in the duct and interrupted 3-0 vicryl sutures were applied to achieve primary closure of duct. Abdominal drain was placed in subhepatic space. Except in 6 cases with history of cholecystectomy in past, all remaining 19 cases were subjected to cholecystectomy. Before selecting patients for primary closure, criteria for selection i.e. wall of duct should be healthy enough to hold stitches, large enough caliber to permit suture without obstruction and free passage of irrigating fluid was ensured.<sup>16</sup>

Although, the one important purpose of insertion of T-tube following choledocholithotomy is to provide decompression of duct so as to prevent leakage of bile in subhepatic space. Table 3 shows the amount and nature of subhepatic drain discharge in both groups and it is evident from the chart that the purpose of T-tube is not well served as expected. The amount was more in T-tube inserted patients and bile leak (upto 5<sup>th</sup> POD) and drainage was for longer period (upto 7<sup>th</sup> post-operative day) and hence drain could be removed on 8<sup>th</sup> day only. Whereas in Group B with primary closure of CBD, 24-hours drainage amount was significantly less and the discharge was serous from third day so the drain could be removed on 5<sup>th</sup> POD. With drain and T-tube both in-situ, patient was less mobile as compared to Group B patients.

Incidence of complication in two groups was listed in Table 4. Although post-operative pyrexia was common in both group, incidence of cholangitis (14.28% versus 5.55%) and septicemia (28.57% versus 5.55%) was more common in T-tube group as compared to Group B. Percentage of wound infection (42.85% versus 11.11%) and drain site infection (42.85% versus 11.1%) was also more common in group A. SSTI at T-tube insertion site was exclusively present in Group A. Following T-tube removal, significant bile discharge was present from site in one patient and ERCP with stenting was required. Although no obstructing calculus was seen but probably dyskinesia was the reason of persistent discharge. One patient had blockage of T-tube leading to discharge from sub-hepatic drain and required irrigation of T-tube. Although not reported in this study, other complications of T-tube drainage reported in literature are biliary sepsis, bile duct trauma during removal, bile leakage leading to biliary peritonitis, retention of fragment of tube and stricture formation, fluid and electrolyte imbalance, premature dislodgment, prolonged biliary fistula.<sup>17,18</sup>

In Group A the average operating time was 88±11.5 minutes whereas in 12 patients of group B (in whom

cholecystectomy with choledocholithotomy was done) the average time of completion of surgery was 71.9±5.8 minutes. The difference in time was statistically significant. In 6 patients of group B (cholecystectomy done previously) the average operating time was 58.3±3.9 minutes (Table 5). This indicated that T-tube insertion does take little longer for completion of procedure and therefore may be associated with certain complications like wound infection.

Prolonged hospital stay is one of the important component of morbidity of any surgical procedure. In group A, mean hospital stay was 14.14±1.06 days whereas it was 9.11±1.13 days in primary closure group. The difference was statistically significant (p<0.0001). Other studies have also observed prolonged hospital stay in T-tube insertion patients as compared to primary closure.<sup>18-22</sup>

## CONCLUSION

It is concluded from the present study that morbidity and hospital stay after Primary Closure of common bile duct after choledocholithotomy is significantly less as compared to insertion of T-Tube. Review of literature also indicates that primary closure of common bile duct is a safe and useful technique in the treatment of choledocholithiasis as with the procedure hospital stay, the risk of readmissions and morbidity is lower than when T-tube is used.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

1. Tendon R. Diseases of gall bladder and biliary tract. In: Munjal YP, Sharma SK, Agarwal AK, Singal RK, Gupta P, Sundar S, et al, eds, API textbook of medicine. 7th edn. Jaypee publishers; 2003: 641-644.
2. Ahrendt SA, Pitt HA. Biliary Tract. In: Townsend Jr. CM, Beauchamp RD, Evers BM, Mattox KL, eds. Sabiston Textbook of Surgery: the biological basis of modern surgical practice. 17<sup>th</sup> edn. Philadelphia; WB Saunders; 2004: 486-492.
3. Halstead WS. Contributions to surgery of the bile passages especially of the common bile duct. Bull John Hopkins Hosp. 1900;106:1-11.
4. Courvoisier L. Statistical contributions to the pathology and surgery of the biliary system. Leipzig: Vogel. 1890;387:57-8.
5. Beal JM. Historical perspectives of gallstone disease. Surg Gynecol Obstet. 1984;158:181-9.
6. Halstead WS. The omission of drainage of common duct surgery. J Am Med Assoc. 1919;73:1896-7.
7. Mirizzi PL. Operative cholangiography. Surg Gynecol Obstet. 1937;65:702-10.

8. Hicken NF, McAllister AJ. Operative cholangiography as an aid in reducing the incidence of over looked common bile duct stones. *Surgery*. 1964;52:753-8.
9. Bakes J. Choledochopapilloscopy. *Arch Klin Chir*. 1923;126:473-83.
10. Widegans H. Endoscopy for biliary tract. *German Med Monthly*. 1958;3:377-80.
11. McCune WS, Snorb PE, Moskovitz H. Endoscopic cannulation of the ampulla of Vater: A preliminary report. *Ann Surg*. 1968;167:752-6.
12. Kalloo AN, Kantsevov SV. Gallstones and biliary disease. Primary care. 2001;28(3):591-606.
13. Binmoeller KF, Schafer TW. Endoscopic management of bile duct stones. *J Clin Gastroenterol*. 2001;32(2):106-18.
14. Rhodes M, Sussman L, Cohen L, Lewis MP. Randomised trial of laparoscopic exploration of common bile duct versus postoperative endoscopic retrograde cholangiography for common bile duct stones. *Lancet*. 1998;351(9097):159-61.
15. Wood T, MacFadyen BV. Diagnostic and therapeutic choledochoscopy. *Seminars Laparosc Surg*. 2000;7(4):288-94.
16. Irabor DO, Oyegbile IO, Ladip JK, Adegoke PA. Where there is no t-tube: operative management of 2 patients with choledocholithiasis. *Nigerian J Surg Res*. 2002;4(1):57-61.
17. Haq A, Morris J, Goddard C, Mahmud S, Nassar AH. Delayed cholangitis resulting from a retained T-tube fragment encased within a stone. *Surg Endosc*. 2002 Apr 1;16(4):714.
18. Will VL, Gibson K, Karihaloot C, Jorgensen JO. Complication of biliary T-tube after choledochotomy. *ANZ J Surg*. 2002;72(3):177-80.
19. Keighley MR, Burdon DW, Baddeley RM. Complications of supraduodenal choledochotomy: a comparison of three methods of management. *Br J Surg*. 1976;63(10):754-8.
20. de Laspra CD, Calavia A, Lorente L, Germán M, González G, Calleja G, et al. Is T-tube necessary after choledochotomy and surgical manipulation of Oddi's sphincter? *Spanish Surg*. 2001;70(5):231-4.
21. Jameel M, Darvas B, Baker AL. Trend towards primary closure following laparoscopic exploration of the common bile duct. *Ann R Coll Surg Engl*. 2008;90:29-35.
22. Dasari BV, Tan CJ, Gurusamy KS, Martin DJ, Kirk G, McKie L, et al. Surgical versus endoscopic treatment of bile duct stones. *Cochrane Database Syst Rev*. 2013;12:CD003327.

**Cite this article as:** Seervi M, Verma D, Chand N, Sharma S. Primary closure of common bile duct versus T-tube placement after open choledocholithotomy. *Int Surg J* 2020;7:1951-5.