

## How to close open choledochotomy: primary closure, primary closure with T-tube drainage, or choledochoduodenostomy?

Bülent AYDINLI<sup>1</sup>, Gürkan ÖZTÜRK<sup>1</sup>, Sabri Selçuk ATAMANALP<sup>1</sup>, Bünyami ÖZOĞUL<sup>1</sup>,  
Şükrü ARSLAN<sup>1\*</sup>, Ercan KORKUT<sup>1</sup>, Abdullah KISAOĞLU<sup>1</sup>, Abdülmecit KANTARCI<sup>2</sup>, Rüstem Berhan PİRİMOĞLU<sup>2</sup>,  
Mehmet İlhan YILDIRGAN<sup>1</sup>, Nurhak AKSUNGUR<sup>1</sup>

<sup>1</sup>Department of General Surgery, Faculty of Medicine, Ataturk University, Erzurum, Turkey

<sup>2</sup>Department of Radiology, Faculty of Medicine, Ataturk University, Erzurum, Turkey

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**Background/aim:** Although common bile duct stones are generally treated endoscopically, surgery is required if endoscopic removal is impossible. The aim of this study was to compare the surgical options in such patients.

**Materials and methods:** A total of 282 patients with common bile duct stones underwent open choledochotomy; primary closure was applied in 48 (17.0%), primary closure with T-tube drainage in 81 (28.7%), and choledochoduodenostomy in 153 (54.3%) patients.

**Results:** Postoperative complications were seen in 8 (16.7%) patients in the primary closure, 33 (40.7%) patients in the primary closure with T-tube drainage, and 37 (24.2%) patients in the choledochoduodenostomy group. No significant differences were observed among the groups ( $P > 0.05$ ). The mean postoperative hospital stays in the primary closure, primary closure with T-tube drainage, and choledochoduodenostomy groups were 5.5, 13.5, and 8.9 days, respectively. The mean postoperative hospitalization was significantly shorter in the primary closure group than in the other groups ( $P < 0.05$ ).

**Conclusion:** Primary closure is a safe and feasible method in selected patients.

**Key words:** Primary closure, T-tube drainage, choledochoduodenostomy, endoscopic retrograde cholangiopancreatography

### 1. Introduction

Common bile duct (CBD) stones occur in approximately 10%–15% of all patients with gallbladder stones. Currently CBD stones are mostly managed endoscopically. However, there are some circumstances that make the endoscopic removal of these stones impossible, e.g., the unavailability of endoscopic intervention or experienced endoscopists. Surgical removal of CBD stones includes both open and laparoscopic approaches (1–3).

In the open approach to CBD stones, the surgical procedure includes opening of the CBD and removal of the stones and sludge. How to close the opening in the CBD is still controversial. Three classic ways of closing the opening have been described: primary closure, primary closure with T-tube drainage, and the creation of an anastomosis between the CBD and the intestines, i.e. choledochoduodenostomy. There are no clear criteria for which approach should be used under which circumstances (4,5). The aim of the present study was to compare primary closure, primary closure with T-tube

drainage, and choledochoduodenostomy in terms of benefits and patient outcomes.

### 2. Materials and methods

Two hundred and eighty-two patients with CBD stones and undergoing open choledochotomy between January 2003 and December 2012 were included in the study. Patients with pancreatitis, suppurative cholangitis, or malignancy, or those who did not undergo preoperative endoscopic retrograde cholangiopancreatography (ERCP) were excluded.

Patient records were collected retrospectively. Age, sex, symptoms, laboratory data, radiological findings, endoscopic findings, operative procedure, operative findings, postoperative course, complications, and mortality were noted. The criteria for choledochotomy were obstructive jaundice, CBD stones on ultrasound examination and magnetic resonance imaging cholangiography, and stones persisting after ERCP.

Forty-eight of these patients underwent primary closure alone, 81 underwent primary closure with T-tube drainage, and 153 received choledochoduodenostomy.

\* Correspondence: drsrukuarslan@gmail.com

The same team, under the supervision of a staff surgeon experienced in hepatobiliary surgery, decided on and performed all surgical procedures. All patients were given antibiotics before the elective open surgery. The CBD was opened through a supraduodenal vertical incision between stay sutures. The stones were extracted. The operating surgeon had to be sure that the distal part of the CBD was free from stones and sludge in this procedure. This was ensured using a flexible choledochoscope (Olympus CHF-T20) in cases with appropriate CBD diameters or if there was a free passage to the duodenum with a bougie at least 8 fr in diameter. We used side-to-side anastomosis in the choledochoduodenostomy group.

A subhepatic drain was maintained in all patients. T-tube cholangiography was performed on all T-tube-drained patients. Once CBD patency was confirmed, the T-tube was removed 3 weeks after the first postoperative day. We compared the groups in terms of postoperative complications, postoperative hospital stay, and mortality. Bile leakage is defined as any yellow bile-like fluid emerging from the subhepatic drain or following the removal of the drain, and aspiration of yellow bile-like fluid under ultrasound guidance from the subhepatic peritoneal space (300 mL).

Statistical analysis was performed using SPSS 11.0. The chi-square test and Student's t test were used for univariate analysis and to compare hospitalization times, respectively. Chi-square analysis was used to determine the factors affecting complications.  $P < 0.05$  was regarded as significant.

**3. Results**

Two hundred and eighty-two patients were included and divided into three groups based on the surgical procedure applied. The primary closure group consisted of 48 patients (17.0%), the primary closure with T-tube drainage group consisted of 81 patients (28.7%), and the choledochoduodenostomy group consisted of 153 patients (54.3%). Data for the groups are presented in Table 1.

Postoperative bile leakage, a major complication, was seen in 6 (7.4%) patients from the primary closure with T-tube drainage group and in 4 (2.6%) patients from the choledochoduodenostomy group. Another major complication, postoperative jaundice, was seen in 5 patients (6.2%,  $P = 0.002$ ) from the primary closure with T-tube drainage group. No postoperative residual stones were seen in any group. Jaundice complications were seen in 8 (16.7%), 33 (40.7%), and 37 (24.2%) patients from the primary closure, primary closure with T-tube drainage, and choledochoduodenostomy groups, respectively. There were no significant differences among the groups in terms of total complications ( $P > 0.05$ ). Complications are listed in Table 2.

The mean total hospitalization times in the primary closure, primary closure with T-tube drainage, and choledochoduodenostomy groups were 8.7, 16.5, and 11.9 days, respectively, while the mean postoperative hospital stays in those groups were 5.5, 13.5, and 8.9 days, respectively. Both the mean total and postoperative hospitalization periods were shorter in the primary closure group than in the other groups ( $P < 0.05$ ).

**Table 1.** General data of the patients.

| Characteristic                           | Primary closure     | Primary closure with T-tube drainage | Choledochoduodenostomy | Statistical analysis |
|--|---------------------|--------------------------------------|------------------------|----------------------|
| Number                                   | 48 (17.0 %)         | 81 (28.7 %)                          | 153 (54.3 %)           | -                    |
| Age (mean, years)                        | 57.6                | 56.8                                 | 59.4                   | $P > 0.05$           |
| Sex (female/male)                        | 31/17 (64.6%/35.4%) | 49/32 (60.5%/39.5%)                  | 93/60 (60.8%/39.2%)    | $P > 0.05$           |
| Obstructive jaundice                     | 35 (72.9%)          | 55 (67.9%)                           | 112 (73.2%)            | $P > 0.05$           |
| Biliary colic                            | 34 (70.8%)          | 59 (72.8%)                           | 107 (69.9%)            | $P > 0.05$           |
| Total bilirubin (mg %, range: 0.3–1.2)   | 2.9                 | 2.6                                  | 2.7                    | $P > 0.05$           |
| SGPT (u/L, range: 1–35)                  | 97.5                | 102.6                                | 96.2                   | $P > 0.05$           |
| ALP (u/L, range: 30–120)                 | 261.6               | 264.3                                | 259.1                  | $P > 0.05$           |
| GGT (u/L, range: < 38–55)                | 312.7               | 297.7                                | 306.1                  | $P > 0.05$           |
| Number of stones in the common bile duct | 2.1                 | 2.3                                  | 2.7                    | $P > 0.05$           |
| Diameter of the common bile duct (mm)    | 1.8                 | 1.7                                  | 2.1                    | $P > 0.05$           |

**Table 2.** Postoperative complications in patients.

| Complication            | Primary closure | Primary closure with T-tube drainage | Choledochoduodenostomy | Statistical analysis |
|-------------------------|-----------------|--------------------------------------|------------------------|----------------------|
| Bile leakage            | 0 (0.0%)        | 6 (7.4%)                             | 4 (2.6%)               | P > 0.05             |
| Jaundice                | 0 (0.0%)        | 5 (6.2%)                             | 0 (0.0%)               | p.0.002              |
| Residual stone          | 0 (0.0%)        | 0 (0.0%)                             | 0 (0.0%)               | P > 0.05             |
| Infection               | 3 (6.3%)        | 9 (11.1%)                            | 12 (7.8%)              | P > 0.05             |
| Pulmonary complications | 3 (6.3%)        | 7 (9.9%)                             | 11 (7.2%)              | P > 0.05             |
| Cardiac complications   | 0 (0.0%)        | 2 (2.5%)                             | 3 (2.0%)               | P > 0.05             |
| Others                  | 2 (4.2%)        | 4 (4.9%)                             | 7 (4.6%)               | P > 0.05             |
| Total                   | 8 (16.7%)       | 33 (40.7%)                           | 37 (24.2%)             | P > 0.05             |

Mortality was seen in two patients (0.7 %), one from the primary closure with T-tube drainage and one from the choledochoduodenostomy group.

#### 4. Discussion

Choledocholithiasis is treated with endoscopy. Surgical treatment is indicated when endoscopic treatment is unsuccessful (1–3). Although choledochal exploration can be performed laparoscopically, this is still problematic. Before the widespread use of laparoscopic surgery, morbidity was 15% and mortality less than 1% in patients over 65 years of age undergoing open choledochal exploration (4). The main problem in choledochal surgery is the closure of the ductus choledochus. There are several methods of closure following stone extraction. These are primary closure, primary closure with T-tube drainage, and choledochoduodenostomy (4,5).

Primary closure of the main bile duct following choledochotomy may include primary closure over the T-tube. This method is conventional and results in a complication rate of 10%; it may cause severe problems such as bile leaks in 1%–19% of the cases (5–8). In order to avoid the disadvantages of the T-tube, choledochoduodenostomy may be preferred in appropriate cases. However, various prerequisites apply for choledochoduodenostomy, the most important of which is the bile duct diameter, which should be at least 1–1.2 cm. Primary closure is the most basic method for technical and postoperative follow-up. Primary closure of the main bile duct is not a new method (9,10); however, the most important prerequisite for the procedure is a low bile duct pressure that may be achieved by a previously performed ERCP and endoscopic sphincterotomy (11). Intraoperative control of the distal CBD with a choledochoscope or dilatation bougie is important (11,12).

Comparing these three methods, there are notable advantages and disadvantages to them all. One of the most important problems, bile leakage, was seen in 7.4% of the primary closure with T-tube drainage group, compared with 2.6% in the choledochoduodenostomy group, while there was no bile leakage in patients receiving primary closure. Ambreen et al. (13) and Yamazaki et al. (14) reported bile leakage rates of 10.5% and 11.7%, respectively, in cases with T-tube drainage. Deutsch et al. (15) and De Aretxabala and Bahamondes (16) reported rates of bile leakage of about 3% in cases undergoing choledochoduodenostomy. Similarly, Ambreen et al. (13) reported bile leakage in only one patient (6.3%) with primary closure, while Yamazaki et al. (14) 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. Seale and Ledet (10) 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 intraabdominal infections. 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. 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, and increased costs. Seale and Ledet (10)

stated that the increase they observed in the incidence of thromboembolism and pancreatitis was directly related to infected bile (10). The T-tube procedure is also known to result in electrolyte loss and consequent acute renal failure in elderly patients. Another disadvantage in these patients is bile drainage lasting for at least 3 weeks, resulting in loss of productivity (17). The most important problem in choledochoduodenostomy 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 choledochoduodenostomy

is side-to-side anastomosis (18). The general morbidity of choledochoduodenostomy is 10% and the mortality is 2%–3%. Other complications include cholangitis, surgical site infections, and anastomosis leakage. The incidence of cholangitis is 0%–6% (15,16).

In conclusion, primary closure may be preferred in appropriate cases due to its few disadvantages and specific advantages. It is important to ensure that there is a free passage at the distal CBD, which has to be controlled with choledochoscope or dilatation bougie with a diameter of at least 8 fr.

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