Current assessment of choledochoduodenostomy: 130 consecutive series

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ABSTRACT

INTRODUCTION Cholelithiasis usually can be managed successfully by endoscopic sphincterotomy. Choledochoduodenostomy (CDD) is one of the surgical treatment options but its acceptance remains debated because of the risk of reflux cholangitis and sump syndrome. The aim of this study was to assess the current features and outcomes of patient undergoing CDD.

PATIENTS AND METHODS We retrospectively analysed the surgical results of consecutive 130 patients treated by CDD between 1991 and 2013 and excluded five cases with a malignant disorder. Indications for surgery included endoscopic management where stones were difficult or failed to pass and primary common bile duct stones with choledochal dilatation. Incidences of reflux cholangitis, stone recurrence, pancreatitis or sump syndrome were investigated and the data between end-to-side and side-to-side CDD were compared.

RESULTS Reflux cholangitis and stone recurrence was 1.6% (2/125) and 0% (0/125) of cases by CDD. There is no therapeutic-related pancreatitis in CDD. Sump syndrome was not also observed in side-to-side CDD.

CONCLUSIONS This study is a first comparative study between end-to-side and side-to-side CDD. The surgical outcomes for CDD treatment of choledocholithiasis were acceptable. The incidence of reflux cholangitis, stone recurrence, pancreatitis and sump syndrome was very low.

KEYWORDS

Choledochoduodenostomy – Biliary alleviation – Choledocholithiasis – Endoscopic treatment – Difficult stone

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Introduction

Gallstone disease is one of the most common digestive diseases and its prevalence shows ethnic variability, with rates of approximately 10–15% in the United States and Europe.^{1,2} Large longitudinal studies of patients with symptomatic gallstones have shown that 58–72% will have ongoing symptoms and complications.⁵ Most patients with symptomatic gallstones are recommended to undergo cholecystectomy to alleviate symptoms of pain and jaundice, and to prevent complications such as pancreatitis, cholangitis and cholecystitis.⁴ Approximately 10–18% of patients who undergo cholecystectomy for gallstones also have common bile duct stones.⁵ Common bile duct stones may be suspected preoperatively by symptoms or signs of jaundice, pancreatitis or cholangitis, deranged liver function or imaging showing duct dilatation or actual ductal stones.

At present, endoscopic sphincterotomy is widely accepted as the treatment of choice for patients with common bile duct stones.⁶ Subsequent laparoscopic cholecystectomy is indicated in patients with concomitant gallstones to prevent

biliary complications such as biliary colic, acute cholecystitis or recurrent common bile duct stones with cholangitis or biliary pancreatitis.⁷ There have been many studies on the recurrence of bile duct stones after endoscopic sphincterotomy; however, the reported frequency of stone recurrence ranged from 4% to 24% and failure of endoscopic management occurred in patients with large stones, multiple stones, impacted stones, multiple intrahepatic stones and peripapillary diverticula.^{8–11} Recurrent bile duct stones after endoscopic sphincterotomy have been suggested to be caused by inflammation of the bile duct, a bile duct diameter greater than 15 mm, papillary stenosis, peripapillary diverticula, reflux of the duodenal contents into the bile duct, parasites or foreign bodies within the bile duct.^{12,15} Endoscopic management was also required for stones that were difficult or failed to pass.

Choledochoduodenostomy (CDD) was first performed in 1888 by Riedel and the first case led to unfortunate results.¹⁴ The first successful operation was performed in 1891 by Sprengel.¹⁵ At present, CDD is indicated in patients with

recurrent stones, biliary sludge, ampullary stenosis or where endoscopic management was difficult or failed. However, its use remains debatable because of the risk of complications such as reflux cholangitis, sump syndrome and alkaline reflux gastritis. Sump syndrome is the development of cholangitis, hepatic abscess or pancreatitis after CDD, owing to stones, sludge or debris being lodged in the pool of the terminal common bile duct.¹⁶ However, the true incidence and resultant morbidity of these complications are not well defined and have not yet been thoroughly examined. The present study was conducted to evaluate the first comparative surgical outcomes of end-to-side and side-to-side CDD and the occurrence of long-term complications.

Patients and Methods

This study involved 130 consecutive patients who had undergone CDD with or without choledocholithotomy at Yamanashi University Hospital between January 1991 and December 2007 or at Tsuru Municipal Hospital between January 2008 and December 2013. The subjects comprised 60 men and 70 women of an average age of 69 ± 14 years (range 28–90 years). Of these 130 patients, five cases of malignancy were excluded (one case of bile duct cancer, two cases of gallbladder cancer and two cases of pancreatic cancer), 97 patients had primary common bile duct stones and 28 were secondary cases. Indications for CDD were the presence of common bile duct stones in which endoscopic clearance was difficult or failed, with bile duct dilatation or recurrent stones after endoscopic clearance, T-tube drainage or choledocholithotomy with cholecystectomy.

In the first 10 years of the study period, the indication for CDD was cases where endoscopic management was difficult and for primary common bile duct stones, because endoscopic sphincterotomy was not as common as it is today. All cases had a common bile duct diameter greater than 11 mm due to dilatation.¹⁷ Cases with dropped gallbladder stones were excluded by comparison of the cystic duct and stone diameter; cases likely to pass the stone through the cystic duct were excluded.

Of the 125 cases included in the study, CDD was performed by end-to-side anastomosis in 80 cases (67 for primary and 13 for secondary common bile duct stones) and by side-to-side anastomosis in 45 cases (30 for primary and 15 for secondary common bile duct stones). The bile duct was transected, a transverse incision was made in the anterior wall facing the duodenum and the stones were removed. In the end-to-side anastomosis, the bile duct was closed on the side facing the duodenum by continuous sutures using 4-0 Maxon (Ethicon). In the side-to-side anastomosis, two traction sutures (3-0 silk) were passed through the common bile duct, a 2-cm longitudinal incision was made in the ventral side of the duct and the stones were removed through the incision.

Single-layer anastomosis between the incised bile duct and the adjacent duodenum was accomplished by beginning posteriorly and positioning the knots on the inside of the anastomosis. Anastomosis of the anterior portion was also

performed using simple interrupted sutures, 3–4 cm from the anal side distal to the pylorus, using a control release atraumatic needle with 4-0 absorbable sutures. Both the anterior and posterior walls were anastomosed by one layer of interrupted synthetic absorbable sutures, 2–3 mm apart in an inside-outside-outside-inside fashion.

Diagnosis of acute cholangitis was made according to the guidelines for management of acute cholangitis and acute cholecystitis.¹⁸ Sump syndrome was defined as uncontrollable and recurrent cholangitis with subsequent hepatic abscess due to debris impaction into the bile duct.¹⁶ Biliary stricture was defined as biliary enteric anastomosis stricture manifesting symptom of cholangitis.

Follow-up of patients was performed monthly for the first 3 months, followed by every 3 months for 1 year, every 6 months for 5 years and then annually up to 10 years. Further long-term outcomes were obtained via clinical records at outpatient follow-up, emergency visits and hospital admission. This study was conducted and approved in accordance with the ethical principles outlined in the Declaration of Helsinki.

Results are expressed as mean $\pm$ standard deviation. Statistical analysis was performed with the Chi square test and Student's *t* test. Probability differences of 0.05 or less were considered to be significant.

Results

The characteristics and demographics of the 125 patients included in the study are summarised in Table 1. Mean operation times were 161 minutes (± 13 minutes) in the end-to-side group and 122 minutes (± 7.5 minutes) in the side-to-side group; the difference was not statistically significant. The amount of blood loss was 183 ml (± 61.7 ml) and 146 ml (± 37.2 ml), respectively, which was not significantly different ($P = 0.07$). Bile leakage was not observed in the end-to-side group whereas one minor bile leakage was found in the side-to-side group. This patient was managed with conservative therapy. Postoperative ileus was observed in one case in each group. Pulmonary-related complications were found in one case in each group. Mean length of hospital stay of end-to-side group was 15 days whereas that of the side-to-side group was 16 days without statistical differences. There was no mortality in either group.

Reflux cholangitis was observed in only two cases in the end-to-side group and no case was observed in the side-to-side group ($P = 0.31$). Anastomosis stricture was seen in one case in each group. Recurrent common bile duct stones and therapeutic-related pancreatitis were not observed in either group. Sump syndrome, and subsequent cholangitis and hepatic abscess, was not also observed in the side-to-side anastomosis group in the present study. There were no gastroduodenal ulcers in either CDD group. There was one femoral hernia in the side-to-side group and one cystic duct injury in the end-to-side group. This comparative study indicated that there were no statistical differences between end-to-side and side-to-side CDD.

Table 1 Demographic data of patients treated surgically by choledochoduodenostomy (CDD).			
	CDD		P-value
	End to side	Side to side	
Patients (n)	80	45	–
Male	39	22	0.08
Female	41	23	
Mean age (years ± SD)	63.6 (± 12.7)	77.2 (± 8.4)	1
Mean follow-up period (months)	98	65	0.66
Difficult EST (n):	52	45	0.11
Peripapilla diverticula	26	24	0.92
Large stone (> 15 mm)	14	12	0.76
Multiple stones	11	8	0.73
Impacted stone	1	1	0.91
Post-cholecystectomy	12	8	0.68
Recurrent (n):			
Post-EST	6	4	0.79
Post-T-tube drainage	14	4	0.18
APBS (n)	8	0	0.03
CBD diameter (mm ± SD)	14.8 ± 4.2	16 ± 5.6	0.9
ASA grade: ^a			
1	63	25	0.24
2	16	18	0.07
3	1	2	0.27
4	0	0	–
^a Grades: 1, a normal healthy patient; 2, mild systemic disease; 3, severe systemic disease; 4, severe systemic disease that is a constant threat to life. APBS, abnormal pancreatobiliary system; ASA, American Society of Anesthesiologists; CBD, common bile duct; EST, endoscopic sphincterotomy.			

Discussion

This study demonstrated that CDD was simple, effective and adequate therapy for the treatment of patients with common bile duct stones, especially in cases where endoscopic treatment was difficult, failed or stones were recurrent. Long-term complications of this procedure, such as reflux cholangitis, stone recurrence, pancreatitis, and sump syndrome, were relatively uncommon and acceptable. This result was possibly due to the fewer number of cases with anastomosis stricture and recurrent stone during long-term follow-up.

There were no differences in surgical outcome between end-to-side and side-to-side CDD in the comparative study. The side-to-side anastomosis is documented to be a major cause of sump syndrome. This syndrome is defined as cholangitis, hepatic abscess or pancreatitis after side-to-side

CDD due to the pooling of sludge or debris in the terminal common bile duct. However, appropriate diagnostic criteria have not been proposed to date. Inadequate stoma size and shape, such as kinking, results in poor biliary drainage and is a possible factor leading to sump syndrome.¹⁶ Studies have reported a prevalence of 0–9.6%^{19–21} and more recent studies have reported a prevalence of 0–5.2% (Table 2).^{16,22–54} The present study also observed a lower prevalence of this syndrome in the side-to-side group. In theory, there are some differences between end-to-side and side-to-side anastomoses. Blood supply is impaired by transection of the bile duct in end-to-side CDD in contrast to the side-to-side procedure, leading to the fear of anastomosis insufficiency and stricture. Although side-to-side CDD is more simple than end-to-side CDD, sump syndrome remains a concern due to debris pooling in the distal common bile duct. To prevent anastomosis stenosis, the anastomotic stoma should be sufficiently large or wide to ensure good biliary drainage. The large or wide CDD anastomosis may prevent complications such as reflux cholangitis and sump syndrome. However, sump syndrome develops infrequently. Endoscopic treatments, such as endoscopic sphincterotomy, should be considered for patients with sump syndrome. Management of the syndrome has been successfully accomplished by endoscopic intervention.^{55,56}

Biliary stasis has been implicated as an important factor in the formation of primary duct stones.¹⁷ The pathogenesis of the stone must be considered for treatment and alleviation of biliary stasis should be taken into account. Taken together with the present results, biliary alleviation by CDD may prevent stone formation. Biliary infection has also been implicated as an important factor in stone formation. Most duct stones are known to consist of biliary-associated components. The present study observed similar results. Biliary stasis may allow easier biliary infection and prevention may require a large anastomosis via CDD to allow easier flow of bile through the intestines. Host factors, such as choledochal dilatation, abnormal pancreatobiliary system and immune compromise also play a role in bile duct stone formation; choledochal dilatation and an abnormal pancreatobiliary system may give rise to bile flow impairment and immunocompromised hosts may easily acquire bacterial biliary infections.

Gastric and duodenal ulcers have been reported to be caused by the CDD procedure, although the mechanism remains unknown and there have been no comparative investigations.²⁰ In the present study, no CDD-related gastroduodenal ulcers were observed, as H2-inhibitors or PPI drugs were used. Gastric cancer has also been reported to be associated with CDD, possibly due to alkaline intestinal fluid reflux into the stomach, leading to stimulation of gastric oncogenes. These findings have been limited to case report series. In this era of common helicobacter pylori infection, further epidemiological investigation into CDD-related gastric malignancies are warranted to clarify these phenomena.

In our series, bile duct carcinoma was not observed in long-term follow-up period, although it has been reported that the overall incidence of bile duct carcinoma was

Table 2 Reports of surgical outcomes for choledochoduodenostomy, 1991–2015							
Study	Year	Patients (n)	Follow-up (years)	Cholangitis n (%)	Sump syndrome n (%)	Anastomosis stricture n (%)	Method ^a
Parilla <i>et al.</i> ²³	1991	172	4.6	8 (5.6)	2 (1.2)	10 (5.8)	SS
Escudero-Fabre <i>et al.</i> ²⁴	1991	71	12.1	3 (4.2)	0	NR	SS or SE
Deutsch ²⁵	1991	126	19	0	3 (2.4)	2 (1.6)	SS
Panis <i>et al.</i> ²⁶	1993	58	2.4	6 (10.3)	3 (5.2)	1 (1.7)	SS
Mihmanli <i>et al.</i> ²²	1996	24	5	0	0	0	SS
De Almeida <i>et al.</i> ²⁷	1996	125	9.3	3 (2.4)	0	0	SS
Funabiki <i>et al.</i> ²⁸	1997	78	2–20	5 (6.4)	0	5 (6.4)	ES
Uchiyama <i>et al.</i> ²⁹	2003	44	9.6	1 (2.2)	0	NR	SS or ES
Srivengadesh <i>et al.</i> ¹⁶	2003	21	10	0	0	0	SS
Leppard <i>et al.</i> ³⁰	2011	79	6.2	0	0	NR	SS
Bosanquet <i>et al.</i> ³¹	2012	68	1.2	1 (1.5)	0	NR	SS
Malik <i>et al.</i> ³²	2012	270	8.2	7 (2.6)	0	2 (0.7)	SS
Luu <i>et al.</i> ³³	2013	55	29 months	1 (1.8)	0	1 (1.8)	SS or ES
El Nakeeb <i>et al.</i> ³⁴	2015	388	58 months	0	0	1 (0.3)	SS
This study	2017	130	98 months	2 (1.6)	0	1 (0.8)	SS or ES
NR, no report; ES, end to side; SS, side to side.							

increased after biliary enteric anastomosis.³⁷ The incidence was reported to be 1.9% after choledochojunostomy (CDJ) and 7.6% after CDD. The high incidence of CDD over CDJ was supported with the speculation that the chronic inflammation by reflux of duodenal contents might stimulate the bile duct into developing a carcinoma. The incidence of bile carcinoma in our present study was low, possibly because of the lower number of cases with reflux cholangitis and anastomosis stricture during follow-up. Since there is little evidence of definite risk for biliary carcinogenesis after biliary enteric anastomosis, further accumulated clinical studies and fundamental research into the carcinogenesis are required to disclose the development of bile duct carcinoma.

The present investigation is the first study to compare end-to-side with side-to-side CDD, although this is sequential, not randomised and follow-up is probably longer with end-to-side CDD. The therapeutic trend has been changing over time, since this investigation includes long-term results for over 20 years. In other words, surgical exploration such as CDD or CDJ had been conventionally chosen for the treatment of common bile duct stones. Endoscopic treatment has been gradually acquiring popularity over surgical exploration. At present, the combination of endoscopic sphincterotomy and laparoscopic cholecystectomy is the gold standard therapy and is often used as a first choice for the treatment of cholecysto- and choledocholithiasis to minimise invasive surgery.³⁸ However, the incidence of related complications, such as pancreatitis, reflux cholangitis and stone recurrence and failed stone removal were reported to be approximately 10–20% of follow-up cases.^{12,39,40} The high incidence was attributed to the existence of a dilated

common bile duct and peripapillary diverticulum. In such recurrent or difficult cases, CDD would be the best therapeutic candidate. Accordingly, the indication of endoscopic sphincterotomy is currently thought to be a first choice in choledocholithiasis in regard to minimally invasive therapy. We consider that the indication of CDD is the cases of recurrent stone after endoscopic sphincterotomy or the cases of difficult and failed endoscopic sphincterotomy. Furthermore, CDJ is an alternative therapy to CDD difficult cases such as duodenal ulceration or scar.

Minimally invasive techniques, such as laparoscopic side-to-side CDD, have been increasingly adapted for use and have been reported to be clinically useful.^{41,42} We have now performed several cases of laparoscopic CDD, a candidate technique for minimally invasive treatment of benign biliary obstruction and observed no sump syndrome.

Conclusion

The surgical outcome of CDD for the treatment of choledocholithiasis is acceptable. The incidence of reflux cholangitis, stone recurrence and pancreatitis was low in those patients treated with CDD. Sump syndrome caused by side-to-side CDD was not observed. CDD is a simple and sufficient technique for the alleviation of biliary stasis for selected choledocholithiasis patients.

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