Surgical Management of Benign Biliary Stricture in Chronic Pancreatitis: A Single-Center Experience

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Abstract Biliary stricture in chronic pancreatitis (CP) is not uncommon. Previously, all cases were managed by surgery. Nowadays, three important modes of treatment in these patients are observation, endoscopic therapy, and surgery. In the modern era, surgery is recommended only in a subset of patients who develop biliary symptoms or those who have asymptomatic biliary stricture and require surgery for intractable abdominal pain. We want to report on our experience regarding surgical management of CP-induced benign biliary stricture. Over a period of 5 years, we have managed 340 cases of CP at our institution. Bile duct stricture was found in 62 patients. But, surgical intervention was required in 44

patients, and the remaining 18 patients were managed conservatively. Demographic data, operative procedures, postoperative complications, and follow-up parameters of these patients were collected from our prospective database. A total 44 patients were operated for biliary obstruction in the background of CP. Three patients were excluded, so the final analysis was based on 41 patients. The indication for surgery was symptomatic biliary stricture in 27 patients and asymptomatic biliary stricture with intractable abdominal pain in 14 patients. The most commonly performed operation was Frey's procedure. There was no in-hospital mortality. Thirty-five patients were well at a mean follow-up of 24.4 months (range 3 to 54 months). Surgery is still the best option for CP-induced benign biliary stricture, and Frey's procedure is a versatile operation unless you suspect malignancy as the cause of biliary obstruction.

Keywords Chronic pancreatitis · Biliary stricture · Frey's procedure · Jaundice

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Introduction

The common bile duct (CBD) and the ventral portion of the pancreas have a close relationship as both develop from the same anlage. In about 80 to 85 % of people, the lower CBD traverses the pancreatic head, and in 15 to 20 % cases, it is adjacent to the posterior surface of the pancreatic head [1]. Thus, the lower bile duct may be involved in neoplastic as well as inflammatory processes of the pancreatic head. The stricture of the lower common bile duct in chronic pancreatitis is not rare. The reported incidence ranges from 3 to 46 % [2–9]. But symptomatic stricture develops in about 10 % of cases [10]. CBD stricture in chronic pancreatitis may be due to edema, pseudocyst formation, and encasement of the bile duct by fibrous processes. A stricture due to pseudocyst and edema usually resolves after resolution of acute episodes or

after drainage of a pseudocyst, but a fixed stricture remains unaltered. Management of such stricture is a matter of controversy. Previously, surgical drainage of the bile duct was the only recommended treatment to prevent both the acute development of cholangitis and late development of secondary biliary cirrhosis. But the reported low incidence of cholangitis and secondary biliary cirrhosis in biliary stricture related to chronic pancreatitis has prompted others to advocate a less aggressive approach to these patients [2, 11–13]. A less aggressive approach includes observation with periodic evaluation using liver function tests, cholangiography, and liver biopsies. Once the patient develops symptoms related to biliary obstruction, some form of biliary drainage is necessary. Options for biliary drainage include endoscopic stenting and operative bypass. With the proliferation of endoscopic procedures, a large proportion of these patients are managed by endoscopic biliary stenting. But, stricture resolution was observed in the long term in 12 to 38 % of patients [14–18]. In the long run, two thirds of the patients require surgical intervention for persisting stricture after stent removal. Repeated stent changing or use of metallic stent for this benign disease is associated with numerous hospital admissions and substantial morbidity. Currently, stenting is at best a temporizing procedure particularly for cholangitis. On the other hand, surgery offers long-term relief of symptoms related to biliary obstruction. So, surgery is the best option in good-risk patients, keeping endoscopic stenting for patients with serious comorbid conditions or those unwilling to undergo surgery. In the present study, we report on our experience in chronic pancreatitis-related CBD stricture managed by surgery.

Materials and Methods

Over a period of 5 years (from August 2007 to October 2012), 44 patients underwent surgery for biliary obstruction related to chronic pancreatitis at our institution. Relevant clinical, biochemical, radiological, and endoscopic features were extracted from our prospective database. Indications for surgery, postoperative complications, and follow-up of patients were noted. Diagnosis of biliary stricture induced by chronic pancreatitis was made on the basis of clinical history, liver function tests (LFT), serum CA 19–9, CT scan of the abdomen (Fig. 1), and cholangiography (magnetic resonance cholangiopancreatography (MRCP) or endoscopic retrograde cholangiopancreatography (ERCP) as necessary) findings. Indications for biliary surgery were (1) symptomatic biliary stricture, (2) planned pancreatic procedure for pain and a previous history of cholangitis, (3) significantly raised alkaline phosphatase level, (4) and upstream dilation of biliary tree with a known stricture. Patients with either choledocholithiasis or pancreatic cancer as the possible cause of biliary obstruction were excluded. When there was any mass lesion, we tried to obtain a

Fig. 1 CT scan of the abdomen showing features of chronic pancreatitis with dilated bile duct

tissue biopsy preoperatively either by CT or endoscopic ultrasound (EUS)-guided fine-needle aspiration (FNA). We routinely performed Frey's procedure for CBD stricture induced by chronic pancreatitis (Fig. 2). CBD will be visible or palpable to varying degrees after the head of the pancreas has been cored out, crossing the posterior aspect of the cavity. It is critical to be sure that any pancreatic tissue that might be restricting the bile duct is cautiously excised. For this purpose, we use scissor rather than cautery, so that the plane along the bile duct is not obscured by charred tissue.

We did intraoperative cholangiography through the cystic duct stump before and after head coring. If there is relief of obstruction after head coring, we do not do any form of biliary drainage. If the obstruction is not relieved after head coring, we did choledochojejunostomy using the same Roux loop used for pancreaticojejunostomy or opening of the bile duct into the cored-out cavity of the pancreatic head. We opened the CBD in the cored-out cavity only when CBD is inadvertently entered during division of fibrous tissue. Whipple's operation was performed if there was a suspicion of malignancy. We followed

Fig. 2 Operative photograph showing Frey's procedure (head coring)

the patients at 3- to 6-month interval with clinical examination, LFT, and radiological tests when necessary.

Results

Over a period of 5 years, we have managed 340 cases of chronic pancreatitis at our institution. Of these, 101 patients (29.70 %) had undergone surgery. Biliary obstruction was found in 62 (18.23 %) patients. Of these 62 patients, 44 patients (43.56 % of all patients undergoing surgery for CP) required surgery. The remaining 18 patients were followed up regularly, as they had no biliary symptoms or chronic pancreatitis-related complications. Three patients were excluded from our study. Two patients were associated with CBD stone, and one patient was associated with pancreatic cancer. So, the final analysis is based on 41 cases. There were 27 males and 14 females with a mean age of 45 years (range 18 to 65 years). All patients had long-standing chronic pancreatitis (mean 8 years). Twenty-two patients had a long history of alcohol abuse. Two patients had a history of lateral pancreaticojejunostomy for control of pain. The presenting sign and symptoms (Table 1) were abdominal pain, jaundice, weight loss, and fever. Serum alkaline phosphatase was raised (range 250 to 2,618 U/L) in 29 (70.73 %) cases. Serum bilirubin was raised (range 3.5 to 11.5 mg/dL) in 22 (53.65 %) cases. Preoperative imaging showed dilated CBD in all cases (range 10 to 25 mm). The head of the pancreas was bulky with dense calcification in 23 cases. Inflammatory mass was found in 13 cases. In the first seven cases of head mass, we obtained tissue biopsy with CT-guided FNA, as our institution do not have EUS at that time. In the remaining six cases, we performed EUS-guided FNA. There was no evidence of malignancy in any of the cases. Pseudocyst was found in four cases. Associated portal hypertension was found in four cases. Ten patients underwent preoperative biliary stenting, and seven of them had repeated placement of stents. Symptomatic biliary obstruction was found in 27 (7.94 % of all cases of CP) patients, and in 14 patients (34.14 % of all cases of biliary obstruction undergoing surgery), the indication for surgery was intractable pain of pancreatic origin with documented biliary stricture, though the patients had no biliary symptoms. The

most commonly performed operation was Frey's procedure. Other operative procedures were opening of CBD in the cored-out cavity of the pancreatic head, hepaticojunostomy, Whipple's operation, and choledochoduodenostomy (Table 2). There were no inhospital deaths. Eight patients developed wound infections, and five of these patients had preoperative biliary stenting. One patient developed biliary leak, and one patient developed pancreatojejunal anastomotic leak. Both these patients recovered well with conservative treatments. Liver biopsies were obtained in all cases. Only one patient (3 %) showed features of secondary biliary cirrhosis. This patient had persistently raised serum alkaline phosphatase level (though markedly diminished than the preoperative value) in the follow-up period despite patent biliary–enteric anastomosis. Average hospital stay was 8 days (range 6 to 18 days). The mean follow-up period was 24.87 months (range 3 to 54-months). One patient (uncontrolled diabetes due to poor compliance) died in follow-up due to renal failure 9 months after surgery. Two patients developed recurrent abdominal pain, requiring hospitalization twice. Two patients developed abdominal pain and jaundice after Frey's procedure. One of them was treated with endoscopic biliary stenting (plastic stent). The stent was removed after 3 months, and the patient remained asymptomatic for 19 months after the stent removal. The other patient was treated with choledochojunostomy using the same loop of jejunum used for pancreaticojejunostomy at the time of Frey's procedure. One patient developed significant malnutrition. The remaining 35 patients had no pancreatic or biliary problems.

Discussion

Biliary strictures as a consequence of CP have long been recognized. After pseudocyst formation, bile duct stricture is the second most common complication in CP. It is most commonly found in chronic pancreatitis with inflammatory head mass or when there is dense calcification in the pancreatic head. Every second patient with an inflammatory head mass presents with biliary obstruction. The overall incidence of biliary obstruction in CP varies from 2.7 to 45.6 %. This broad range is probably due to differences of criteria used for

Table 1 Presenting signs and symptoms ($n=41$)

	Number	Percentage
Pain	39	95.12
Jaundice	22	53.65
Fever	05	12.19
Weight loss	13	31.70
Hepatomegaly	18	43.90
Palpable gall bladder	03	07.31
Abdominal mass	05	12.19

Table 2 Operative procedures ($n=41$)

	Number	Percentage
Frey's procedure alone	25	60.97
Frey's procedure + choledochojunostomy	09	21.95
Frey's procedure + opening of the bile duct in the cored-out head of the pancreas	04	09.75
Frey's procedure + choledochoduodenostomy	01	02.43
Whipple's operation	02	04.87

patient selection. The incidence of biliary obstruction in patients that required surgery for chronic pancreatitis rose to 35 % with a range of 15–60 % [19]. In our study, the incidence of biliary stricture is 18 % of all cases of CP and 44 % of all patients undergoing surgery for CP, which is comparable to other studies [13, 20–23].

The anatomical relationship between the distal end of the common bile duct and the head of the pancreas is the main factor responsible for bile duct obstruction in patients with CP. The length of the intrapancreatic portion of the common bile duct ranges from 1.5 to 6.0 cm (average 3.0 cm) and accounts for the variable stricture lengths encountered in clinical practice [24]. Extrahepatic biliary obstruction in CP can be due to choledocholithiasis, pancreatic malignancy, pseudocyst, or fibrosis. The transient jaundice commonly seen in acute exacerbation of CP is most likely due to edema, and it resolves with the resolution of acute episode. A pseudocyst, particularly located in the head of pancreas, may compress and obstruct the bile duct. But obstructive jaundice solely due to compression by the pseudocyst is rare. Biliary obstruction in CP is more often caused by irreversible fibrosis than by a pseudocyst, so it is unwise to assume that decompression of a pseudocyst will relieve the symptoms. An operative cholangiography is imperative after drainage of the pseudocyst to ensure adequate flow of bile in the duodenum. In our study, four patients had a pseudocyst in the head region. We did Frey's procedure in all four cases, and the pseudocyst was drained in the cored-out cavity of the pancreatic head. Operative cholangiography showed free flow of contrast in the duodenum. The other two possibilities of biliary obstruction like pancreatic malignancy and choledocholithiasis should be borne in mind. In our study, three patients were excluded from the final analysis for the same causes.

The clinical course of CBD stricture varies and is characterized by exacerbations and remissions. The earliest and most reliable sign of biliary obstruction is elevation of serum alkaline phosphatase with or without increased serum bilirubin. An elevated alkaline phosphatase level will be found in 63 to 100 % of patients with a biliary stricture [19]. Similarly, in our patients, alkaline phosphatase was raised in 71 % of cases. Alkaline phosphatase may be markedly raised, but the height of elevation has little relation with the severity of obstruction. Similarly, jaundice is not a uniform feature. Elevated serum bilirubin has been reported in 38 to 100 % of patients [19]. In our patients, raised serum bilirubin was found in 54 % of patients. Cholangitis occurs in about 10 % of cases [19, 25] and varies from subclinical episodes to overt sepsis. Life-threatening cholangitis is seldom the first manifestation of obstruction. Secondary biliary cirrhosis is a well-discussed topic in biliary stricture due to CP. Frey et al. [25] found that the average incidence of biliary cirrhosis was 7.3 %, but other authors [6, 22, 26] have not found this complication. In our study, only one patient (3 %) had secondary biliary cirrhosis.

Noninvasive imaging of the hepatobiliary tree is important in evaluating a patient with presumed biliary tract obstruction. Ultrasonography will demonstrate bile duct obstruction in 80 % of cases, but a CT scan is usually required for better delineation of parenchymal and ductal morphological changes of the pancreas, including the presence of a pancreatic mass and pseudocyst. The definitive evaluation of biliary obstruction can be done by cholangiography. ERCP or MRCP can outline both the pancreatic duct and bile duct. ERCP is more important when endoscopic stenting and brush cytology are required. Biliary stricture in CP has some characteristic features: (1) obstruction is seldom complete; (2) long segment stricture with gradual tapering of the intrapancreatic portion of CBD over a distance of 16 to 57 mm (mean 40.7 mm); (3) the proximal dilated bile duct often appears as "bent knee" deformity superior to the pancreas, and an hourglass- or funnel-shaped narrowing localized at the upper border of the pancreas can also be seen; (4) bilirubin level rarely rises above 10 mg/dL; and (5) jaundice wax and wanes. All these features are quite helpful for distinguishing benign stricture from obstruction seen in pancreatic cancer. In rare cases where malignancy is suspected and CT scan or MRI fails to delineate any mass, EUS is recommended. Serum CA 19.9 has a supportive role. In our patients, pancreatic protocol CT scan was the imaging modality of choice.

Management of biliary obstruction in CP is determined by two factors: (1) whether the patient has biliary symptoms and (2) whether the biliary obstruction is an isolated phenomenon or a part of more generalized problems such as intractable pancreatic pain, a pseudocyst, or suspected malignancy. If the patient is asymptomatic, he or she can be managed conservatively and monitored by 6-monthly liver function tests and biliary ultrasound. As there is no reliable means for predicting progression to secondary biliary cirrhosis, Yadegar and coworkers [2] have recommended serial liver biopsy at a 6-month interval. However, the low risk of developing biliary cirrhosis in these patients does not justify routine or repeated liver biopsies. Similarly, routine stent placement for asymptomatic patient is strongly discouraged.

Table 3 Indication for biliary drainage in chronic pancreatitis (Frey et al. [24])

1. Symptomatic cholangitis
2. Biliary cirrhosis (biopsy proven)
3. CBD stone in association with common bile duct stricture
4. Persistent jaundice for over a month
5. Progression of CBD stricture based on radiological assessment of increased dilatation of common and intrahepatic bile duct
6. Persistently elevated alkaline phosphatase (>3 times the normal levels >1 month)
7. Inability to rule out cancer of the pancreas

Biliary drainage is indicated when the patients have symptomatic biliary stricture. Biliary drainage can be achieved by ERCP with stenting, percutaneous transhepatic biliary drainage, or surgery. Although, traditionally, surgical biliary bypass has been used as the standard approach for managing CP with bile duct strictures with good long-term success, there is a significant surgical morbidity in frequently debilitated patients with alcoholic CP and associated liver diseases. Deviere and colleagues [14] were the first to report on the endoscopic treatment of biliary stricture in CP. Nowadays, endoscopic therapy has been used as an alternative to surgery. Plastic biliary stents are useful for short-term treatment of CP-induced biliary stricture in the setting of jaundice and cholangitis and may be used as a long-term basis in poor surgical candidates. Unfortunately, long-term success rates are as low as 10 % in some studies [17, 27]. Patients with calcification of the pancreatic head have the poorest response to endoscopic therapy, with as few as 7.7 % of patients achieving clinical success at 1 year when single stents are used [17]. Balloon dilation of the stricture followed by placement of multiple stents is superior to single-stent changes [28]. If the stricture is still present with serial placement of multiple stents every 3 months for 1 year, surgery is indicated as definitive therapy. Self-expandable metallic stents designed for permanent placement was evaluated in the setting of benign biliary stricture with CP by Cantu et al. [29]. Initial success was 100 %, but at long-term follow-up (ranging 22 to 50 months), up to 62 % of stents were occluded. Stent patency rate dropped from 100 % at 12 months to 37 % at 30 months. In such patients, subsequent options are surgery or to repeat endoscopic procedures for stent-in-stent placement. To overcome the complications of stent blockage and repeat endoscopy, fully covered removable metal stents are used. Mahajan et al. [30] have shown complete resolution of stricture in 11 of 17 (66 %) patients and no recurrence of symptoms 3.8 months after stent removal. In short, endotherapy in the treatment of biliary strictures is a good option for high-risk surgical patients and for those who prefer a less invasive approach [31]. It may be useful as “temporary bridge” to surgery in selected patients. However, more data on long-term outcomes and preferably randomized trial with good sample size will be necessary before advocating this therapy as routine.

Surgery is still the best therapy for three reasons: (1) successful endoscopic drainage of biliary obstruction has no influence on pain pattern in CP, so for a patient with intractable pain of pancreatic origin and biliary obstruction, surgery is the only option; (2) after failure of endoscopic therapy, surgery is “the treatment” to relieve the obstruction; and (3) long-term success rate of surgery (failure rate <3 %) is much higher than that in endoscopic stenting. So, we think that surgery should be offered to all good-risk patients with symptomatic biliary obstruction. The indications for surgical intervention for biliary obstruction in CP described by Frey et al. [25] are listed in Table 3.

We have full agreement with these proposed indications except for persistently raised serum alkaline phosphatase for more than 1 month. We think that at least 1 year of follow-up is essential to follow the course of disease progression. Another important indication is planned pancreatic procedure with a diagnosed biliary stricture irrespective of biliary symptoms. This was the indication for surgery in 14 patients of our series.

Multiple surgical approaches are available for the treatment of biliary stricture due to CP. Ideally; surgical therapy in patients with biliary obstruction has to address both the obstructed duct and the inflammatory process in the head of the pancreas. In patients with biliary obstruction, Frey’s or Beger’s procedure is the treatment of choice unless malignancy is the cause of biliary obstruction. Both the procedures are suited to deal with the morphological changes including in the bile duct and the head of the pancreas. Additional procedure may be required if intraoperative cholangiography shows inadequate relief of obstruction after head coring. Roux-en-Y hepaticojejunostomy is preferred in this regard. We do not prefer choledochoduodenostomy, though one of our patients had undergone choledochoduodenostomy. Whipple’s operation is preferred when you suspect malignancy. We performed Whipple’s operation in three cases. One patient was excluded from the final analysis because of malignancy. Procedures encouraging a bilio-enteric bypass alone will not suffice to achieve long-lasting pain relief, since the resection of the underlying pain-induced inflammatory process is not performed. We prefer Frey’s procedure over Beger’s procedure for two reasons: (1) it does not require a division in the neck of the pancreas which is a tedious job in the midst of severe inflammation and fibrosis, because there is an increased risk of bleeding due to portal vein injury; and (2) single anastomosis is required. We performed Frey’s procedure with the idea that the pancreatic head is the “pace maker” for pancreatic pain. It provides relief of biliary obstruction as well as long-term control of pain in the majority of cases. That is why 25 patients in our series were treated by Frey’s procedure alone. In 14 cases, we had to do additional procedures along with the Frey procedure. To the best of our knowledge, Frey’s procedure is one of the versatile procedures for the treatment of chronic pancreatitis and its complications, except malignancy.

Conflict of Interest We have no competing interest regarding this manuscript.

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