

Binding pancreaticogastrostomy anastomosis in central pancreatectomy

A single center experience

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Abstract

A growing number of central pancreatectomies are performed. However, reconstruction of pancreaticoenteral digestive continuity after central pancreatectomy remains debated. This study evaluates the short-term outcomes of binding pancreaticogastrostomy anastomosis in central pancreatectomy.

We have reviewed our experience with 52 patients who underwent binding pancreaticogastrostomy following central pancreatectomy from February 2009 to March 2015. Indication includes 6 noninvasive intraductal papillary mucinous neoplasms, 11 neuroendocrine tumors, 12 solid pseudopapillary tumor, 9 serous cystadenoma, 6 mucinous cystadenoma, and 8 focal pancreatic traumas.

The mortality rate was nil while the morbidity rate was 34.6%. Eighteen patients experienced complications including 6 pancreatic fistulas, 2 postpancreatectomy hemorrhages, 4 delayed gastric emptying, 1 hypostatic pneumonia, and 5 pancreatitis. The median postoperative length of hospital stay was 12 days (10 days for patients without fistula). None of the 52 patients were found to have pancreatic endocrine or exocrine insufficiency or recurrence of tumors.

Central pancreatectomy with binding pancreaticogastrostomy is a useful and practicable surgical procedure for benign or borderline lesions of the pancreatic neck or proximal body.

Abbreviations: BPG = binding pancreaticogastrostomy, BPJ = binding pancreaticojejunostomy, CHA = common hepatic artery, CP = central pancreatectomy, DGE = delayed gastric emptying, DP = distal pancreatectomy, IPMN = intraductal papillary mucinous neoplasms, ISGPS = International Study Group of Pancreatic Surgery, PD = pancreaticoduodenectomy, PF = pancreatic fistula, PG = pancreaticogastrostomy, PJ = pancreaticojejunostomy, POD = postoperative day, PPH = postpancreatectomy hemorrhage, PV = portal vein, SMV = superior mesenteric vein.

Keywords: binding pancreaticogastrostomy, central pancreatectomy, pancreatic fistula

1. Introduction

Owing to the dramatic improvements in diagnoses, operative techniques, and perioperative medical care, central pancreatectomy (CP), also known as middle pancreatectomy, has been increasingly performed in selected patients to resect benign or

borderline lesions of the pancreatic neck or proximal body.^[1,2] As an alternative to pancreaticoduodenectomy (PD) and distal pancreatectomy (DP), CP has advantages over the conventional techniques in that this procedure avoids intrinsic morbidity brought by PD or DP, obviates excessive loss of normal pancreatic parenchyma and thus, long-term exocrine and endocrine function of the pancreas may be maximally preserved, and allows for preservation of adjacent tissues, such as duodenum, spleen, and extrahepatic bile duct, and therefore, their functions.^[2–5]

Despite these advantages, CP continues to be associated with considerable morbidity. Particularly, CP patients are reported to be at a high risk of postoperative pancreatic fistula (PF),^[2,3,6] which might be explained by management of both proximal and distal pancreatic remnants. Furthermore, the distal remnant was usually found to be a soft texture with a small pancreatic duct,^[3,6] which was considered to be risk factors for PF. Unfortunately, neither pancreaticojejunostomy (PJ) or pancreaticogastrostomy (PG) can lower the high frequency of PF after CP. Therefore, reconstruction of pancreaticoenteral continuity following CP has been debated.

Recently, Peng et al described a novel reconstruction method called binding pancreaticogastrostomy (BPG) which may effectively reduce the incidence of PF after PD. The rationale is that BPG can provide a water-tight closure for the anastomosis.^[7–9] In the present study, we first describe our experience with applying BPG to CP as a single center, evaluate its operative outcome and propose a decline in incidence of PF by using BPG.

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2. Patients and methods

2.1. Patients

Between February 2009 and March 2015, 55 patients underwent CP at the Department of Hepatopancreatobiliary surgery, the Second Affiliated Hospital of Harbin Medical University. The patients receiving CP should match the following criteria: the tumors should be <5 cm in diameter and/or deeply located in the neck/body of gland, histologically benign or low-grade malignant tumors without vascular invasion, or patients with traumatic rupture of neck/body of pancreas. BPG was performed in 52 patients and Roux-en-Y end-to-end PJ was performed in 3 patients who were excluded in this study. The included 52 patients consisted of 21 women and 31 men with a median age of 55 years. Six resections were performed for noninvasive intraductal papillary mucinous neoplasms (IPMN) (5 IPMN-adenomas, 1 carcinoma in situ), 11 were performed for neuroendocrine tumors (9 nonfunctional, 2 insulinoma), 12 were performed for solid pseudopapillary tumor, 9 were performed for serous cystadenoma, 6 were performed for mucinous cystadenoma, and the remaining 8 were focal trauma of pancreatic midportion. No patient was preoperatively diagnosed with diabetes mellitus and diarrhea. The clinicopathological characteristics of the patient cohort are presented in detail in Table 1. All of the lesions were located in the mid-section of the pancreas and were proven or suspected to be benign or borderline whereas a final decision to proceed was made by the surgeon according to an assessment of anatomy and pathology intraoperatively. All study participants provided written consent prior to study enrollment. All procedures performed in this study were in accordance with the ethical standards of the Institutional Ethics Committee of Second Affiliated Hospital of Harbin Medical University.

2.2. The CP procedure

The exploration and resection stages in this study bear little difference from the majority of previous reports.^[3–5] After general anesthesia, a midline abdominal incision was used. By separating the gastrocolic ligament, the lesser sac was entered with gastro-epiploic vessels preserved. Thereafter, the anterior aspect of the pancreas was exposed. Intraoperative ultrasonography, if necessary, was performed to localize the tumor, and to determine the relationship between the tumor and its surrounding structures. The superior mesenteric vein (SMV) was identified and dissection was undertaken from the posterior surface of the pancreas. And the

Table 1

Clinicopathological characteristics of the patient cohort.

Variable	BPG (n=52)
Age, y	55 (34–79)
Male/female gender	31/21
BMI	23.9 (21.4–28.9)
Size of tumor, cm	3 (2.0–5.0)
Pathology	
Noninvasive intraductal papillary mucinous neoplasms	6
Adenoma	5
Carcinoma in situ	1
Neuroendocrine tumors	11
Nonfunctioning	9
Insulinoma	2
Solid pseudopapillary tumor	12
Serous cystadenoma	9
Mucinous cystadenoma	6
Focal pancreatic trauma	8

BMI=body mass index, BPG=binding pancreaticogastrostomy.

pancreas was then elevated off the SMV with a piece of rubber tape placed behind the pancreas. After identification, the common hepatic artery (CHA) and portal vein (PV) were dissected from the superior border of the pancreas. Then with careful procedure posterior along the spleno-mesenteric axis, incarceration and ligation of small venous branch tributaries was achieved. Pancreatic transection, including the lesion, was carried out with an adequate negative margin of both cut ends. All the specimens were sent to frozen pathologic analysis insuring diagnosis excluding the 8 pancreatic trauma cases. The proximal stump was closed by interrupted sutures after the proximal main pancreatic duct was ligated. After identification of the distal main pancreatic duct, a stent was implanted and fixed. A few stay sutures were used on the distal pancreatic stump for hemostasis as well as guide lines by which the distal pancreatic remnant could be pulled into gastric cavity for next step of reconstruction.

2.3. Binding pancreaticogastrostomy procedures

The reconstruction began with a mobilization of distal pancreatic stump to the caudal for 3 to 4 cm. After evaluating the size and position of distal pancreatic stump, a purse-string suture was preset around the sero-muscular layer of the posterior gastric wall (Fig. 1). After that, a small gastrostomy was performed in the area

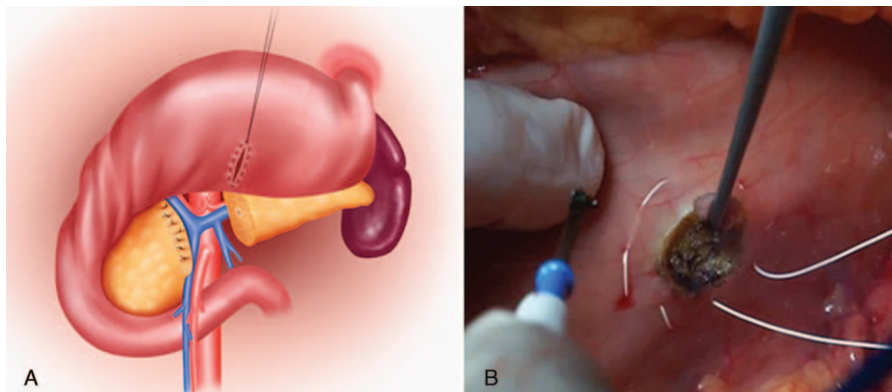


Figure 1. (A, B) Incision was made on posterior gastric wall and a purse-string suture was preset.

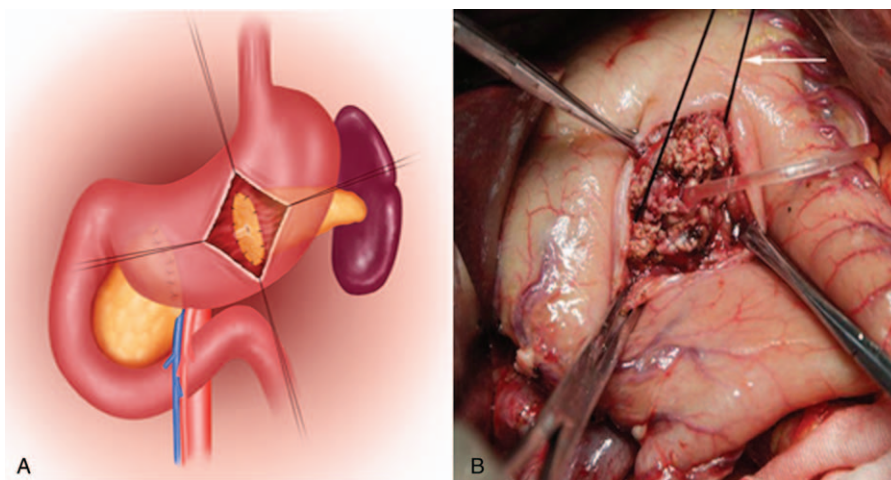


Figure 2. (A, B) The distal pancreatic remnant was pulled into the gastric cavity. The arrow indicates the guide lines.

with a size equivalent to accommodate the distal pancreatic stump. Iodine water was poured into the gastric cavity for disinfection. An incision was made at the anterior gastric wall with an electric scalpel stanching bleeding around it. The guide lines were sent from the posterior gastric wall to the anterior by forceps and with that the pancreas remnant was pulled into the gastric cavity carefully insuring the stent was not fallen off or folded (Fig. 2). The purse-string, as the outer binding,^[7] was tied just enough for anastomosis and the endogastric mucosa and pancreatic capsule were interrupted sutured. The guide lines were removed and at last the incision on the anterior gastric wall was closed with a closure device and a running suture (Fig. 3). Closed suction drains were placed in the region of the PG anastomosis and the cephalic pancreatic remnant.

2.4. Definition of postoperative complications

Somatostatin was routinely used while still variable among patients due to changes in the patient’s condition and at the individual surgeon’s discretion. PF was defined as a drain output of any measurable volume of fluid with an amylase level >3 times the upper limit of institutional normal serum amylase activity,

associated with a clinically relevant change in management of postoperative PF.^[10] Postpancreatectomy hemorrhage (PPH) was defined by 3 parameters: time of onset, location, and severity of hemorrhage according to the International Study Group of Pancreatic Surgery (ISGPS).^[11] Delayed gastric emptying (DGE) was defined as the inability to return to a standard diet by the end of the first postoperative week.^[12] Others complications, including hypostatic pneumonia and pancreatitis, were classified according to the Claviene-Dindo classification.^[13]

2.5. Statistical analysis

Continuous data were expressed as median values with range. For categorical variables, Pearson Chi-square test or Fisher exact test was used. *P* <.05 was considered statistically significant. Data were analyzed using IBM SPSS 22.0 software (version 22.0; SPSS, Chicago, IL).

3. Results

The perioperative data are listed in Table 2. The length of the resected pancreatic parenchyma in the 8 patients who

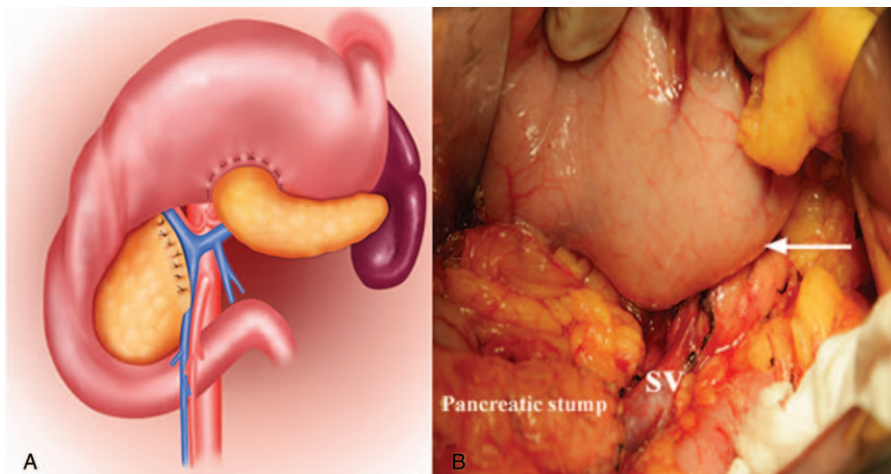


Figure 3. (A, B) Binding pancreaticogastrostomy (BPG) was completed. The white arrow indicates BPG. SV=splenic vein.

Table 2
Perioperative course and postoperative complications.

Variable	BPG (n = 52)
Operative time, min	210 (135–310)
Blood loss volume, mL	280 (50–470)
Blood transfusion, %	0 (0)
Drain duration, d	10 (5–25)
Without fistula, d	7 (5–11)
With fistula, d	18 (12–25)
Amylase level of drainage fluid on POD 1, IU/L	1581 (325–5257)
Amylase level of drainage fluid on POD 3, IU/L	235 (68–3543)
Length of postoperative hospital stay, d	12 (6–27)
Without fistula, d	10 (6–12)
With fistula, d	19 (13–27)
Patients with complications, %	18 (34.6)
PF, %	6 (11.5)
Grade B, %	6 (11.5)
Grade C, %	0 (0)
PPH (Grade B and C), %	2 (3.8)
DGE (Grade B), %	4 (7.7)
Hypostatic pneumonia (Grade II), %	1 (1.9)
Pancreatitis (Grade II), %	5 (9.6)

BPG = binding pancreaticogastrostomy, DGE = delayed gastric emptying, PF = pancreatic fistula, POD = postoperative day, PPH = postpancreatectomy hemorrhage.

experienced pancreatic trauma was 43 mm (ranging from 28–55 mm) on average. The median duration of intervention was 210 minutes with a blood loss median volume of 280 mL. No patient required blood transfusion. Peripancreatic drains were employed for a median duration of 10 days (7 days for patients without fistula). The median amylase level of drainage fluid on postoperative day (POD) 1 and 3 was 1581 and 235 IU/L, respectively. The median postoperative length of hospital stay was 12 days (10 days for patients without fistula). The mortality rate was nil while the morbidity rate was 34.6%. PF occurred in 6 patients. Table 3 showed the postoperative course of patients with PF. Drain fluid cultures were positive in 4 cases, and antibiotic therapy was established. Four patients underwent percutaneous drainage insertion due to the rapid development of an infected peripancreatic fluid collection. None of these 6 patients developed a persistent pancreatic leak requiring reoperation. A comparison between the patients with and without PF was performed to determine the potential risk factors for PF after BPG. However, no significant difference was found between the 2 groups (Supplementary Table 1, <http://links.lww.com/MD/B931>). In this study, 2 patients experienced PPHs (early and late, respectively). One patient received a second operation 4 hours postoperatively to make a suture at ruptured vessel of the anastomosis and the other patient was given an endoscopy for hemostasis at day 8 as a result of poor function of blood

coagulation caused by hepatic cirrhosis. Other complications included a Grade A DGE in 5 patients and a hypostatic pneumonia in 1 patient. Both were complicated by postoperative fistula and healed during hospitalization. In none of the 52 patients was significant evidence of pancreatic endocrine or exocrine insufficiency found, nor a recurrence of tumors with mean follow-up of 24 months (ranging 2–46 months).

4. Discussion

Significant advances in diagnoses, surgical techniques, and medical care over the past 2 decades have made CP no longer a strange and novel operative technique to pancreatic surgeons. Many previous reports have demonstrated CP is a safe technique for resecting benign and low malignant lesions located at the neck or proximal body of the pancreas with careful patients' selection.^[2–5]

In contrast with conventional surgical resections, namely PD and DP, CP avoids excessive loss of pancreatic parenchyma, thereby reducing the risk of pancreatic exocrine and endocrine insufficiency and the potential infective and thrombotic complications of splenectomy. From the literature, satisfactory endocrine and exocrine functions were retained after CP.^[1–6] In our study, no patient exhibited significant evidence of endocrine and exocrine dysfunction although 4 lesion sizes were >4 cm. On the other hand, CP is reported to be associated with a considerable and extremely variable PF rate, which prolongs hospitalization and results in reductions in quality of life, though not a largely significant one. The patency is largely attributed to management of both proximal and distal transected pancreatic remnant surfaces combined with a soft gland and normal-caliber pancreatic duct.^[14] We hypothesize, particularly, that the distal pancreatic remnant anastomosis plays a crucial role in PF formation because the distal gland is usually found to be soft based on our experience, which was also observed by other surgeons and the pancreatic juice trend of the distal remnant is inevitably from left to right.^[3,6] Therefore, in the present study, we put emphasis on the reconstruction of the distal pancreatic remnant. Reconstruction of the distal pancreatic remnant after CP can be achieved either through PJ or PG. To date, with regard to mortality and morbidity, 3 large randomized controlled trials failed to demonstrate which method was superior to the other.^[15–17] Whereas a recent multicenter randomized trial revealed that PG was more efficient than PJ in reducing PF for patients undergoing PD.^[18] In particular, PG has conceivable advantages over PJ.^[19–22] PG appears to be a better physiologic reconstruction for reestablishing pancreaticoenteral continuity after CP. When performing PG, natural position is easier to achieve and lesser tension anastomosis can be carried out due to the close and direct anatomical relationship between the distal pancreatic

Table 3
Characteristics of patients developing pancreatic fistula.

Case no.	AVD POD 1, U/L	AVD POD 3, U/L	Grading of PF (ISGPF)	PF management	Drain fluid culture
1	1131	2468	Grade B	Conservative, drain removed on POD 24	Negative
2	4813	3543	Grade B	Percutaneous drain insertion, POD 20	<i>E. coli</i>
3	5257	3543	Grade B	Percutaneous drain insertion, POD 17	<i>E. fecalis</i>
4	3280	2379	Grade B	Percutaneous drain insertion, POD 13	<i>E. coli</i>
5	2380	875	Grade B	Conservative, drain removed on POD 26	Negative
6	3513	2831	Grade B	Percutaneous drain insertion, POD 14	<i>E. coli</i>

AVD = amylase value in drain, ISGPF = International Study Group of pancreatic fistula, PF = pancreatic fistula, POD = postoperative day.

Table 4**Main published series of central pancreatectomy with pancreaticogastrostomy.**

Series	Year	N	Median follow-up, mo	Morbidity N, %	Operative time, min	Pancreatic fistula N, %
Sauvanet ^[6]	2002	25	26	NA*	NA	7 (28%)
Efron ^[19]	2004	14	12	10 (71%)	229	5 (36%)
Goldstein ^[20]	2004	12	18	3 (25%)	226	0
Allendorf ^[26]	2007	26	33	9 (31%)	226	2 (8%)
Adham ^[21]	2008	44	55	23 (46%)	201*	4 (8%)
Sudo ^[22]	2010	19	71	10 (53%)	215	9 (47%)
Present study	2013	52	24	18 (34.6%)	210	6 (11.5%)

NA = not available.

* The data was with 6 pancreaticojejunostomies.

remnant and the stomach. Besides, there is only a single anastomosis to be dealt with resulting in exclusion of small bowel dissection for a Roux-en-Y loop and thus, operative time is spared. It is suggested that a rich blood supply of the posterior stomach is very beneficial for anastomosis. In addition, activation of proteolytic enzymes is avoided due to the acidic environment in gastric cavity making the pancreatoenteric anastomosis free of digestive damage.^[23,24]

BPG, regarded as a modification of either PG or binding pancreaticojejunostomy (BPJ), was first described by Peng and colleagues.^[7,8] BPG also shares the aforementioned advantages of PG. We, as a single center, first introduce this reconstruction method after CP and evaluate its clinical outcome. Its rationale, the same as BPJ, lies in the realization of a water-tight closure for the anastomosis which has been demonstrated to be safe and effective at decreasing the rate of PF.^[7-9,25] Our BPG procedure is not exactly the same as those in previous studies. The endogastric mucosa and pancreatic capsule were oversewn with a few sutures for fixation inside the stomach and the inner binding was not adopted.^[7,9] From our point of view, on one hand, suture for fixation is more reliable and without it a tighter outer binding which abates blood supply of anastomosis might be inevitable. On the other hand, there are only a few needle holes on pancreas exposing them to intragastric lumina rather than to the outer lumina and the outer binding could prevent potential leakage from them by providing a no gap anastomosis. Furthermore, since BPG is an open PG, better vision of surgical region is available and as a consequent, a more accurate anastomosis can be conducted.^[24]

In the majority of reports, various modifications of PJ have been largely described while PG was rarely used. To date, there are only 6 relatively large series featuring PG after CP with the number of cases ranging from 12 to 44 (Table 4). The PF rate ranges from 0% to 47%.^[6,19-22,26] In our series the PF rate is 11.5% (6 patients) and the result appeared fairly low. This is probably because the classification of PF used in this study was different from the previous studies. Two of the 6 PF cases suffered pancreatic trauma, possibly resulting in problematic occlusion of proximal pancreatic remnant, emphasizing the need for a comprehensive preoperative evaluation.

We accepted the limitations of our study. One is that it did not have clear criteria for the application of resection type and may be associated with a selection bias. Another limitation was small number of cases which perhaps due to a relatively low disease incidence. Therefore, a multicenter clinical controlled study with a larger sample size is required in future study.

5. Conclusion

CP with BPG is a useful and practicable surgical procedure for benign or borderline lesions of the pancreatic neck or proximal body. This reconstruction method might be an alternative consideration when performing CP.

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