

Pancreaticogastrostomy: A Safe and Effective Reconstruction Method After Pancreaticoduodenectomy: A Short Observational Study

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ABSTRACT:

Background: Pancreaticoduodenal resection is usually performed in patients with a localised small carcinoma in the head of the pancreas, at the lower end of the common bile duct or at the ampulla and occasionally for chronic pancreatitis. The mortality following pancreaticoduodenal resection has fallen and is now below 5% [1-6]. However, leakage from the anastomosis between pancreas and the jejunum has been and remains, one of the most worrying complications of the operation. The data from papers published in the last 8 years show that the incidence of pancreatic leak is 14% and the mortality of this complication 24% [3,4,6-16]. Pancreaticogastrostomy is a potentially safer alternative to pancreaticojejunostomy in the reconstruction following Whipple's operation. **Aim:** The aim of the study was to observe pancreaticogastrostomy is a potentially safer alternative to pancreaticojejunostomy after pancreaticoduodenectomy. **Methods:** This prospective observational study was conducted at the Department of Surgery in Shaheed Suhrawardy Medical College Hospital, for One year (August 2021 to July 2022). Patients with a localised small carcinoma in the head of the pancreas, at the lower end of the common bile duct or at the ampulla, and occasionally for chronic pancreatitis admitted in the department of surgery were approached for inclusion in the study. Total 41 patients were selected according to inclusion and exclusion criteria. Informed written consent was taken from each patient. All patients underwent pancreaticogastrostomy. Detail clinical and demographic history was taken along with thorough physical examination relevant investigations. All patients were evaluated preoperatively and post operatively at discharge, 1 month and 3 months. Outcome was assessed post operatively. Collected data were checked and analysed in SPSS 23. **Results:** Two patients died within 30 days of the operation (mortality 4.9%), one from perioperative haemorrhage and another from septicaemia due to a biliary infection, which may have resulted from preoperative transhepatic biliary drainage. Both operations were carried out for carcinoma of the head of the pancreas. One patient developed a biliary leak which closed in 6 days. A postoperative pancreatic leak occurred in one patient with carcinoma of the ampulla; the fistula closed after 5 mdays, and did not delay his discharge from hospital. This patient remains well 36 months after operation, although he has now developed mild diabetes. One other patient developed diabetes mellitus postoperatively. This woman had evidence of obstructive pancreatitis at operation. She died 6 months later of recurrent carcinoma of the head of the pancreas. One patient with chronic pancreatitis has uncontrolled steatorrhea, with up to four bowel movements a day. Four other patients take regular pancreatic supplements together with H2 receptor antagonists in order to maintain normal defaecation. There has been no case of stomal ulceration. None of the patients were lost to follow-up. The median survival for patients operated on for carcinoma of the head of the pancreas was 13 months, and for patients with carcinoma of the bile duct, 14 months. Median survival of patients with ampullary carcinoma was 38 months. **Conclusion:** Seventy two percent of patients had good outcome after Pancreaticogastrostomy (PG). Significant relief in symptoms of pain were noted after PG. Further larger study is recommended to validate this findings.

Key Words:

Pancreaticoduodenectomy,
Pancreaticogastrostomy

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Introduction

Pancreaticoduodenectomy has become increasingly accepted as a safe and appropriate operation for selected patients with malignant and benign diseases of the pancreas and periampullary region. The operative mortality rate after pancreaticoduodenectomy is 4% or less at major surgical centers¹⁻⁵. Postoperative sepsis, hemorrhage and cardiovascular events are responsible for the majority of deaths after pancreaticoduodenectomy. Although the mortality rate after pancreaticoduodenectomy has decreased in recent years, the incidence of postoperative morbidity occasionally approaches 50%¹⁻⁸. In most series, the three leading causes of morbidity after pancreaticoduodenectomy are delayed gastric emptying, wound infection and pancreatic fistula resulting from a pancreatic anastomotic leak^{1,2,1-18}. Failure of a pancreatic-enteric anastomosis to heal after pancreaticoduodenectomy can be a source of considerable morbidity and can contribute to mortality. The incidence of pancreatic anastomotic leak ranges from 5% to 25% in most series. Because pancreatic fistula has been such a common problem after pancreaticoduodenectomy, various techniques of managing the pancreatic remnant (body and tail of the pancreas) have been studied¹². Simple suture ligation of the pancreatic duct without enteric anastomosis was popular in past decades¹³ but has been largely abandoned due to an external fistula rate of more than 50%¹⁴. Pancreatic ductal occlusion with such substances as neoprene or prolamine has been proposed as a means of reducing fistula rates, with some reported success¹⁵⁻¹⁶. Various modifications of a pancreaticojejunal anastomosis have been tested, including site of jejunum used (end vs. side), type of anastomosis (invagination vs. duct-to-mucosa), use of an isolated Roux-en-Y limb, and use of fibrin glue and pancreatic duct stenting¹⁷⁻²². No universal agreement has been reached regarding one particular variation of pancreaticojejunostomy being safer and less prone to fistula formation. A recently repopularized option for enteric drainage of the pancreatic remnant is pancreaticogastrostomy, a technique first reported on experiments in dogs in 1934²³ and used clinically for 50 years²⁴⁻²⁵. Reported results of pancreaticogastrostomy have been favorable, with very low rates of pancreatic fistula and mortality²⁶⁻²⁹.

Materials and Method

This is a cross sectional study done at Suhrawardy Medi-

cal College and Hospital over a period of one year (August 2021 to July 2022) amongst the admitted patient in Department of Surgery. A total of 41 subjects (n=41) were chosen for purposive sampling. After inclusion and assessment, all patients were interviewed by the research team for base line data like age, sex, socioeconomic status, BMI and co-morbid disease. Subjects were investigated for anesthetic fitness as well as to identify comorbidities. All patients underwent pancreaticogastrostomy. Detail clinical and demographic history was taken along with thorough physical examination relevant investigations. All patients were evaluated preoperatively and post operatively at discharge, 1 month and 3 months. Outcome was assessed post operatively. All information were recorded in separate case record form.

Results

There were 30 females and 11 males included in this study, with a median age of 60 years (range 26 to 77 years) (Table 1). The histopathological diagnoses were as follows: 20 pancreatic adenocarcinomas, five ampullary adenocarcinomas, three cholangiocarcinomas, two chronic pancreatitis, two neoplastic pancreatic cysts, two pancreatic cystic lesions, two neuroendocrine tumors, two duodenal gastrointestinal stromal tumor, one ampullary tubulovillous adenoma with high grade dysplasia, one intraductal tubular carcinoma, and one adenocarcinoma of the distal, extrahepatic common bile duct (Table 1). The median size of the tumors was 30 mm (range, 8e130 mm). Positive resection margins (R1) were observed in three (6.8%) of the specimens whereas 44 (93.6%) were of negative resection margins (R0). The classic Whipple's resection was performed in 41 (80.85%) patients, and two (4.25%) patients underwent PPPD (Table 2). In another three (12.76%) cases, classic Whipple's resection was combined with other procedures such as wedge segmentectomy for neuroendocrine liver metastasis, left hepatectomy, and total abdominal hysterectomy. One (2.12%) patient underwent PPPD with salpingo-oophorectomy. The median operative time was 351 minutes (range, 243e553 minutes). The median bloodloss was 563.8 mL (range, 200e5000 mL); 20 (42.55%) out of 41 patients received perioperative blood transfusion, with the median amount transfused being 2 units of packed red blood cells.

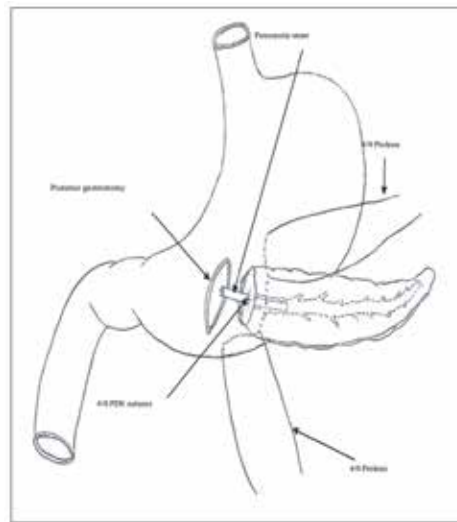


Figure 1: Schematic drawing shows the technique of pancreaticogastrostomy. The pancreatic stent was secured with a 4/0 polydioxanone (PDS) suture. A series of 4/0 Prolene sutures was passed through the pancreatic parenchyma, away from the cutting edge, to anchor the pancreatic stump to the posterior wall of the stomach. An incision was made at the posterior gas-trostomy, next to the pancreatic stump.

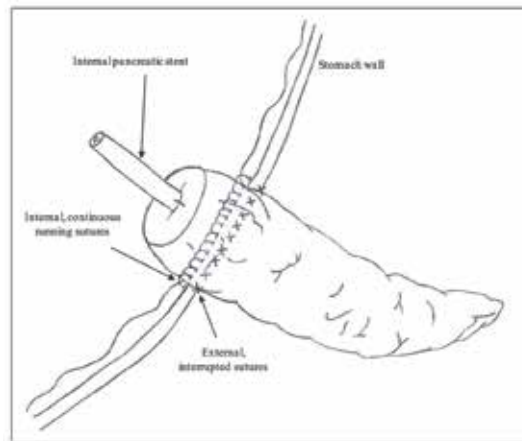


Figure 2 Schematic drawing shows the pancreatic stump protruding the stomach lumen. The pancreatic stump was sutured to the seromuscular layer of the stomach with 4/0 polydioxanone (PDS) sutures, in a continuous running fashion. The external part of the pancreas was sutured to the posterior wall of the stomach with 4/0 Prolene sutures, in an interrupted, full-thickness fashion



The median fluid amylase concentrations were 578 U/L from the left abdominal drain near the hepaticojejunostomy anastomosis (range, 3e54,879 U/L) and 232.5 U/L (range, 3e7617 U/L) from the right abdominal drain near the PG anastomosis on POD 3. On POD 5, the median amylase concentration for the left abdominal drain was 116 U/L (range, 5e24,043 U/L), and for the right abdominal drain it was 68 U/L (range, 6e1672 U/L). Meanwhile, the median fluid volumes were 140 mL (range, 3e1200 mL) for the left abdominal drain and 79.5 mL (range, 1e1400 mL) for the right abdominal drain on POD 3. On POD 5, the median drain volumes were 102.5 mL (range, 2e1280 mL; left abdomen) and 110 mL (range, 5e1002 mL; right abdomen).

The overall postoperative morbidity was 44.68%. According to the Clavien Dindo classification of surgical complications, nine were Grade I, one was Grade II, nine were Grade IIIa, two were Grade IIIb, and two were Grade IIIb, two were Grade V.

There were two (4.25%) postoperative mortalities. Surgical complications (Table 3) included bile leak, delayed gastric emptying, chylous ascites, intra-abdominal fluid collection, gastric outlet obstruction and dehiscence of gastrostomy, liver abscess, liver abscess and narrowed hepatico jejunal anastomosis, PG ulcer, upper gastrointestinal bleeding, and wound infection. According to the ISGPF classification system, there were 24 patients with Grade A POPF (nonclinical significant) and none of the patients had Grade B/C POPF (clinically significant). All patients with POPF recovered uneventfully. The median length of stay was 12 days (range, 6-35 days). The most frequent complication was chylous ascites, which was treated with laparotomy or conservatively with total parenteral nutrition (Table 3). One patient with bile leak was treated with exploratory laparotomy and hepaticojejunostomy was redone. Two patients with DGE were treated with the insertion of nasojejunal feeding tube and were conservatively managed. Intra-abdominal fluid collection, which occurred in four cases, were successfully treated with ultrasound-guided drainage and antibiotics. Two cases with gastric outlet obstruction and dehiscence of gastrostomy were treated with relaparotomy. A case with liver abscess was treated with percutaneous drainage and antibiotics. One case that was complicated with liver abscess and narrowed hepaticojejunal anastomosis was treated with abscess drainage, percutaneous transhepatic biliary stenting. Two patients with

upper gastrointestinal bleeding from gastrojejunal stromal ulcers were treated with adrenaline injection and hemoclip application. Lastly, one case with wound infection was treated with wound dressing. All patients with complications recovered uneventfully.

The two cases of postoperative mortalities in this series involved portal vein injury and had no correlation with the PG reconstructive technique. The first case involved portal vein tear close to the hepatic bifurcation and was injured during hilar lymphadenectomy. The injury was repaired, but the patient subsequently succumbed to postoperative liver failure and ensuing multiple-organ failure on POD 6. The second case involved resection of a large tumor with elective portal vein resection and reconstruction using saphenous vein graft. Postoperative ischemic hepatitis was observed with poor portal flow and hepatic artery thrombosis. The patient gradually deteriorated with sepsis and multiorgan failure and died on POD 8.

Table 1: Patients' demographic data and histopathological diagnoses.

Variable	Patients (n=47)
Sex (M/F)	17/30
Age (y)	60 (20-77)
Histopathological diagnoses	
Pancreatic adenocarcinoma	18
Ampullary adenocarcinoma	8
Cholangiocarcinoma	6
Chronic Pancreatitis	3
Neoplastic Pancreatic Cysts	3
Pancreatic Cystic lesions	2
Neuroendocrine tumor	2
Duodenal gastrointestinal stromal tumor	2
Ampullary tubulovillous adenoma with high grade dysplasia	1
Intraductal tubular carcinoma	1
Adenocarcinoma of the distal, extrahepatic common bile duct	1
Tumor Size (mm)	30 (8-130)
Surgical resections	
Positive resection margin(R1)	3 (6.8%)
Negative resection margin (R0)	4 (93.6%)

Table 2: Operative Details.

Patients (n=41)	
Type of Surgery	
Classic Wihipple’s	41
Classic Wihipple’s + wedge segmentectomy	1
Classic Wihipple’s + left hepatectomy	1
Classic Wihipple’s + TAHBSO	1
PPPD	2
PPPD + salpingo-oophorectomy	1
Operative Time (min)	351 (243-553)
Blood Loss (mL)	563.8 (200-500)
Perioperative blood transfusion	20/47 (42.55%)
No. of packed red blood cell units	2

PPPD = pylorus-preserving pancreaticoduodenectomy; TAHBSO = total abdominal hysterectomy bilateral salpingo-oophorectomy;

Table 3: Postoperative outcome and interventions.

Postoperative morbidity	44.68%
Calvien-Dindo	
Grade I	9
Grade II	1
Grade IIIa	9
Grade IIIb	2
Grade IV	0
Grade V	2
Postoperative mortality	2 (4.25%)
Surgical complication	
Bile leak	1
Delayed gastric emptying	2
Chylous ascites	7
Intra-abdominal fluid collection	4
Gastric outlet obstruction and dehiscence of gastrostomy	2
Liver abscess	1
Liver abscess and narrowed hepaticojejunal anastomosis	1
Upper gastrointestinal bleeding from gastrojejunal stromal ulcers	2
Wound infection	1
POPF	
Gread A	24 (51.06%)
Gread B/C	0
Interventions	
Laparotomy	1
Conservatively with total parenteral nutrition	6
Exploratory laparotomy repair of bile leak and redo hepaticojejunostomy	1
Insertion of nasojejunal feeding tube and conservatively managed	2
Ultrasound-guided drainage and antibiotics	4
Relaparotomy	2
Percutaneous drainage and antibiotics	1
Abscess drainage, PTBD and stenting	1
OGDS	2
Wound Dressing	1
Length of stay (d)	10 (6-35)

OGDS = esophagogastricduodenoscopy; POPF =post-operative pancreatic fistula; PTBD = percutaneous transhepatic biliary drainage

Discussion

As PD becomes a more standardized surgical procedure, controversy regarding the reconstructive method for pancreaticeenteric anastomosis continues to persist. Although PG was first reported by Waugh and Clagett30 in 1946, PJ is still the most commonly performed procedure in comparison to PG. PG has been reestablished as an alternative secure reconstructive method in the past decade. It is favored by several surgeons lately because of its many theoretical advantages compared to PJ. First, pancreatic enzymatic secretions are deactivated by the acidic gastric fluid and the deficiency of enterokinase, which is necessitated for converting trypsinogen to trypsin and consequently activating other proteolytic enzymes, may help in preventing the autodigestion of the pancreatic anastomosis. Moreover, the alkaline pancreatic secretions may assist in preventing marginal ulceration. The close proximity between the posterior gastric wall and the pancreatic remnant permits for the possibility of less tension on the pancreatic anastomosis. The nasogastric decompression also allows for the continuous stomach emptying, thus reducing the tension on the anastomosis. Lastly, PG decreases the anatomoses amount in a single loop of retained jejunum and averts the creation of a long jejunal limb between the biliary and pancreatic anastomoses, wherein an accumulation of both pancreatic and biliary secretions could induce more pressure, which could potentially lead to tension at both anastomoses.^{31,32} Even so, pancreatic surgeons continue to be challenged in managing the pancreatic remnant after PD, thus, many modified techniques have been used in order to further decrease the occurrence rate of POPF.

In this study, PG is the reconstructive method of choice after PD. Many authors endorsed this practice. Guerrini et al16 presented a lower fistula rate (15.1%) after PG compared to after PJ (22.1%). We reported a newly modified PG technique utilizing two-layer anastomoses (internal continuous and external interrupted), which were performed using 4/0 PDS sutures, with a short internal stenting of the pancreatic duct. In comparison to other modified PG techniques, this method of reconstruction was beneficial because the full-thickness bites of sutures on the stomach wall and the pancreatic parenchy-

ma were more secure irrespective of the thickness and consistency of the pancreatic parenchyma. In other words, cheese-wire or cut-through of the sutures were less likely to occur. Furthermore, the internal, short pancreatic stent diverted the pancreatic juice away from the PG anastomosis, thus lessening the risk of autodigestion and dehiscence on the anastomosis.

POPF refers to a drain output of any measurable volume of fluid on or after POD 3 with an amylase content greater than three times the serum amylase activity based on ISPGF.¹³ POPF was identified based on both drainage amylase concentration and volume on POD 3 and POD 5. Out of 41 patients, only 24 patients were diagnosed with Grade A, but none of the patients were unwell clinically and no patient required any specific intervention. None of the patients were diagnosed with Grade B/C POPF. Grade A POPF is also known as a “transient fistula” or “chemical leakage,” which has no clinical impact. Various reports have analyzed the utilization of particular concentrations of drain amylase during the postoperative period as a predictor of POPF with diverging results, in spite of the international consensus.¹³ For instance, drain amylase greater than 5000 U/L on POD 1 or more than 200 mL/d output with amylase greater than five times the serum amylase concentration on POD 5 have been proposed as clinically useful predictors of POPF.^{33,34} Although the data in our study aligned with these proposed predictors, no clinical evidence for clinical POPF (Grade B/C) was observed. Accordingly, there are limitations in using the fistula classification.^{35,36} This is because amylase-rich drainage cannot be solely used in identifying clinical POPF.³⁷ From the results obtained, both left and right abdominal drainage concentrations and volumes decreased on POD 5 from POD.

Additionally, in some cases, the surgical drainage volume increased owing to the resumption of normal diet, which in turn induced exocrine stimulation causing more pancreatic juice to move through the leaking pancreatic anastomosis. Thus, measurement of surgical drainage volume alone might be useful, but it was insufficient to identify clinical POPF. Therefore, the severity of POPF was further determined and graded by the clinical outcomes of patients.³⁴ Because there are differences in the description of POPF, it is conceived that the well-defined Claviene Dindo classification of surgical complications^{25,26} has more merit in scoring postoperative complications. The rate of severe postoperative

complication was 27.7% in this study, which was similar to the rates (16.7-27.1%) in other studies.³⁸⁻⁴⁰ Patient-related risk factors such as age,⁴¹ sex,⁴² duration of jaundice, clearance of creatinine, and intraoperative blood loss⁴³ were not taken into account because they have been shown equivocally to have no association with POPF.

Limitations

This work has several limitations. Unavailability of important data⁴⁴ and the small sample size. Future prospective, large-volume trials are crucial to corroborate these preliminary results and elucidate the advantages of this modified technique.

Conclusion

In conclusion, the acceptable morbidity and low mortality rates in this series demonstrated that this modified PG anastomotic technique was safe and reliable in comparison with other PG or PJ methods.

Conflicts of interest

Not reported

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