

# Pancreatogastrostomy as a Salvage Procedure to Treat Severe Postoperative Pancreatic Fistula After Pancreatoduodenectomy

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**Hypothesis:** Postoperative pancreatic fistula (POPF) is one of the most severe surgical complications of pancreatoduodenectomy (PD) with pancreaticojejunostomy (PJ) reconstruction. Recently, POPF has been classified as grade A, B, or C. Relaparotomy is mandatory for POPF associated with sepsis or hemorrhage (grade C). Peripancreatic drainage and completion pancreatectomy are the procedures most commonly used, but associated morbidity and mortality remain high. We hypothesized that the results of pancreatogastrostomy (PG) for treatment of grade C POPF following PD with PJ in the rare patients for whom relaparotomy is necessary would be similar to the results in a historical series of similar patients who underwent completion pancreatectomy.

**Design:** Case series.

**Setting:** Academic research.

**Patients:** Between June 1, 1988, and June 30, 2005, 403 patients underwent PD (85 with PJ and 318 with PG). During the same period, 12 patients were treated for grade C POPF, which occurred only after PD with PJ.

**Interventions:** All 12 patients with grade C POPF required relaparotomy. Eight patients underwent completion pancreatectomy (group A), and 4 patients underwent salvage telescoped PG with preservation of the pancreatic remnant (group B).

**Main Outcome Measures:** Postoperative mortality and morbidity.

**Results:** Mortality was 50% (4 of 8 patients) in group A and 0% (0 of 4 patients) in group B. Specific and general complications and the length of hospital stay were similar in both groups. One patient in group B developed grade B POPF, which was managed nonsurgically. Postoperative diabetes mellitus occurred in all patients in group A and in 1 patient in group B.

**Conclusion:** In selected patients, salvage PG can be considered a safe and efficient alternative to completion pancreatectomy for the treatment of grade C POPF after PD with PJ.

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**P**OSTOPERATIVE PANCREATIC fistula (POPF) remains the most feared complication after pancreatoduodenectomy (PD), occurring in 3% to 36% of patients.<sup>1,2</sup> The mortality associated with POPF is still unacceptably high.<sup>3-7</sup>

## See Invited Critique at end of article

The treatment of POPF remains controversial, with some in favor of conservative management and some advocating early reoperation.<sup>6,8-14</sup> In large-volume centers specializing in pancreatic surgery, most POPFs are managed conservatively with adequate multidisciplinary expertise (interventional radiologists and nutritionists).<sup>13,15-18</sup>

However, relaparotomy remains mandatory in patients developing generalized peritonitis, septic shock, or hemorrhage.<sup>5,6,12,19</sup> In such patients, the treatment of choice is peripancreatic drainage or completion pancreatectomy. However, both procedures are associated with high mortality and morbidity rates.<sup>6,8,11,12,14</sup>

A consensus conference recently established a new definition of POPF<sup>20</sup> that considers not only the output and the day of diagnosis of the POPF but also its clinical effect. The severity of POPF is graded as A, B, or C, with grade C being the most severe.<sup>20</sup>

The use of telescoped pancreatogastrostomy (PG) reconstruction after PD significantly reduces the rate of POPF (<3%)<sup>15</sup> compared with the use of pancreaticojejunostomy (PJ). Since the introduction of PG after PD, we have not ob-

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**Table. Patients and Operative Characteristics**

Patient No./ Sex/Age, y	Referral	Relaparotomy			Appearance of Pancreas	Surgical Procedure	Postoperative Diabetes Mellitus	Outcome
		1st	2nd	3rd				
<b>Group A</b>								
1/M/66	No	Yes	Yes <sup>a</sup>	No	Edematous	CP and splenectomy	Yes	Alive
2/M/71	No	Yes	No	No	Edematous	CP and splenectomy	Yes	Dead
3/M/44	No	Yes	Yes <sup>b</sup>	No	1st Edematous, 2nd necrotizing pancreatitis	1st Refashion gastrojejunostomy, 2nd CP and splenectomy	Yes	Alive
4/F/68	No	Yes	No	No	Edematous	CP	Yes	Alive
5/M/63	No	Yes	No	No	Edematous	CP	Yes	Dead
6/F/78	No	Yes	Yes <sup>c</sup>	Yes <sup>c</sup>	Edematous	CP	Yes	Dead
7/F/78	No	Yes	Yes <sup>c</sup>	No	Edematous	CP	Yes	Alive
8/M/69	No	Yes	Yes <sup>d</sup>	Yes <sup>c</sup>	Edematous	CP and splenectomy	Yes	Dead
<b>Group B</b>								
9/F/74	Yes	Yes	No	No	Edematous	PG	No	Alive
10/F/52	No	Yes	No	No	Edematous	PG	Yes	Alive
11/M/44	Yes	Yes	Yes <sup>c</sup>	No	Edematous	PG	No	Alive
12/M/64	Yes	Yes	No	No	Edematous	PG	No	Alive

Abbreviations: CP, completion pancreatectomy; PG, pancreatogastrostomy.

<sup>a</sup>For incisional hernia.

<sup>b</sup>For persistent grade C postoperative pancreatic fistula; in this patient no relaparotomy was required after the CP.

<sup>c</sup>For biliary fistula.

<sup>d</sup>For occlusion.

served grade C POPF, and any grade A or grade B POPF was successfully managed nonsurgically. Therefore, we decided to treat grade C POPF after PJ with surgical conversion to PG as an alternative to total pancreatectomy.

The primary objective of the present study is to report the results of PG for treatment of grade C POPF following PD with PJ in the rare patients for whom relaparotomy is necessary. The secondary objective is to compare these results with a historical series of similar patients who underwent completion pancreatectomy.

## METHODS

### STUDY SAMPLE

Between June 1, 1988, and June 30, 2005, 403 patients underwent PD (85 with PJ and 318 with PG) at our institution. During the same period, 12 patients were treated for grade C POPF occurring after PD with PJ (**Table**). Three had their initial PD performed in another hospital. All 12 patients required urgent relaparotomy; their mean age was 63 years (age range, 44-78 years). Pancreatoduodenectomy with PJ was performed for adenocarcinoma of the pancreas (n=4), endocrine tumor (n=2), annular pancreas (n=1), metastasis of renal tumor (n=1), adenocarcinoma of the ampulla (n=1), and other diseases (n=3). The study population was divided into 2 groups according to the type of surgical procedure performed at the time of relaparotomy. Group A patients (n=8) underwent completion pancreatectomy for grade C POPF at the time of the first (n=7) or second (n=1) relaparotomy and were operated on before 1997. Group B patients (n=4) underwent salvage PG after surgical exploration for grade C POPF.

### DEFINITION OF POPF

According to Bassi et al,<sup>20</sup> POPF was defined as an output from the abdominal drainage of any measurable volume of fluid on

or after postoperative day 3, with an amylase content greater than 3 times the serum amylase level. Postoperative pancreatic fistula was graded as A, B, or C according to the severity of associated morbidity.<sup>20</sup> Patients with grade C POPF are defined as those who failed treatment with the use of percutaneous drainage, parenteral nutrition, antibiotics, and somatostatin. These patients are usually severely ill.

### DEFINITION OF OPERATIVE MORTALITY AND MORBIDITY

Operative mortality included intraoperative death and in-hospital death. Only major complications were considered. Complications were defined as major when they resulted in organ failure, relaparotomy, radiologic or endoscopic intervention, or red blood cell transfusion for any kind of postoperative bleeding. Complications related to the technical aspect of the operation were defined as specific (ie, biliary leak), while medical complications (ie, pulmonary embolism) and worsening of preexisting comorbidities were defined as general complications.

### INDICATIONS AND SURGICAL TECHNIQUE

The indications for relaparotomy in patients with grade C POPF were (1) generalized peritonitis, (2) hemorrhage, and (3) worsening of the patient's condition despite optimal medical treatment (total parenteral nutrition, antibiotics, and somatostatin) or minimally invasive drainage. In group A (historical group), the decision to perform completion pancreatectomy was made before surgery. In group B, the decision to perform salvage PG instead of completion pancreatectomy was made during surgery according to the following 2 criteria: (1) the presence of a viable pancreatic remnant and (2) the presence of major dehiscence of the PJ. Any attempt to isolate a bowel loop to perform a new PJ was considered hazardous, and the presence of a viable pancreatic remnant was a prerequisite to successful PG. A telescoped

2-layer PG was performed according to the method described by Delcore et al.<sup>21</sup> Briefly, after taking down the PJ, the necrotic portion of the pancreatic stump (usually 2-3 cm) was debrided, and the pancreatic remnant was sufficiently mobilized to be telescoped into the gastric lumen. The anastomosis was secured with 2 layers of adsorbable sutures.

## STATISTICAL ANALYSIS

Values are expressed as means.  $\chi^2$ , Fisher exact, and Mann-Whitney tests were used.  $P < .05$  was considered statistically significant. All analyses were performed using commercially available statistical software (StatView; Abacus Concepts, Inc, Berkeley, California).

## RESULTS

### SURGICAL FINDINGS AND PROCEDURES

#### Group A

The median age in group A patients ( $n=8$ ) was 68.5 years (age range, 44-78 years). The indications for relaparotomy were generalized peritonitis in 5 patients, massive hemorrhage in 1 patient, worsening of the patient's condition despite optimal medical treatment in 1 patient, and worsening of the patient's condition despite optimal medical treatment and percutaneous drainage in 1 patient. The median Acute Physiology and Chronic Health Evaluation (APACHE) II score was 18 (range, 11-22). At relaparotomy, generalized peritonitis and acute pancreatitis of the pancreatic remnant were found in 7 patients. All of these patients underwent completion pancreatectomy and drainage of the abdominal cavity using multiple drains. In 4 patients, additional splenectomy was performed. At the first relaparotomy in the last patient, necrosis of the gastrojejunal anastomosis was found; the pancreatic remnant appeared mildly edematous at that time. Therefore, simple refashioning of the gastrojejunal anastomosis and peripancreatic drainage were performed. However, the condition of the patient rapidly deteriorated in the early postoperative period, and a second relaparotomy was necessary. At this time, severe necrotizing pancreatitis of the pancreatic remnant associated with necrosis of the transverse colon was found. Therefore, completion pancreatectomy and transverse colon resection with colostomy were performed. The details of patients requiring second and third relaparotomies are summarized in the Table. The pathology report showed complete pancreatic necrosis in 1 patient. In the remaining 7 patients, pathology reports showed viable pancreas with acute pancreatitis. All 4 patients who survived this complication required insulin treatment for diabetes mellitus.

#### Group B

The median age in group B patients ( $n=4$ ) was 58 years (age range, 44-74 years). The indications for relaparotomy were generalized peritonitis in 3 patients and failure of optimal medical treatment and percutaneous drainage in 1 patient. The median APACHE II score was 14

(range, 8-18). At relaparotomy, generalized peritonitis due to dehiscence of the PJ was found in 3 patients. The pancreatic remnant appeared edematous with necrosis at the site of the stump, requiring resection of a few centimeters of pancreatic parenchyma before performing PG. The abdominal cavity was drained using multiple drains. In 1 patient, multiple large abdominal and retroperitoneal areas of steatonecrosis were found due to ongoing acute pancreatitis induced by dehiscence of the PJ. The body and tail of the pancreas were viable, allowing for PG. One patient developed postoperative diabetes mellitus, which required oral treatment only.

### POSTOPERATIVE MORTALITY

Postoperative mortality was 50% (4 of 8 patients) in group A. The cause of death was multiorgan failure in all patients. No mortality occurred among the 4 patients in group B.

### POSTOPERATIVE MORBIDITY

Among the total cohort, 17 postoperative complications were noted in 10 of 12 patients (83%), including 4 minor complications that were not further considered. Among these, 6 patients developed 1 complication, 2 patients had 2 complications, 1 patient had 3 complications, and 1 patient had 4 complications. Specific complications occurred in 7 of 12 patients (58%); these included 4 (2 biliary leaks, 1 intestinal occlusion, and 1 incisional hernia) in group A and 3 (1 biliary leak, 1 pancreatic fistula, and 1 abdominal wall hematoma) in group B ( $P=.58$ ). General complications occurred in 6 of 12 patients (50%); these included 5 (4 multiorgan failures and 1 ischemic stroke) in group A and 1 pulmonary embolism in group B ( $P=.55$ ). After completion pancreatectomy, 6 relaparotomies (for biliary peritonitis in 4 patients, incisional hernia in 1 patient, and intestinal occlusion in 1 patient) were required in 5 patients in group A, while only 1 relaparotomy for biliary peritonitis was required in group B (Table). Completion pancreatectomy was performed in group A at a median of 8 days (range, 2-22 days) after initial PD, while PG was performed in group B at a median of 10 days (range, 4-15 days) after initial operation. The mean postoperative lengths of hospital stay were 32 days in group A and 29 days in group B ( $P=.74$ ). In group B, 1 patient developed postoperative diabetes mellitus, and 1 patient developed grade B POPF, which was treated nonsurgically. In group A, all 4 patients developed postoperative diabetes mellitus.

## COMMENT

This study showed that in selected patients PG can be successfully performed as a salvage procedure to treat life-threatening POPF following PD with PJ. Pancreatogastrostomy also represents a safe alternative to completion pancreatectomy.

The management of POPF depends on the severity of the clinical findings. Most POPFs heal spontaneously fol-

lowing conservative treatment with or without percutaneous drainage.<sup>13,15,22,23</sup> However, in POPF associated with peritonitis or sepsis after failure of conservative treatment (grade C), urgent relaparotomy becomes necessary and is considered lifesaving.<sup>6,9-14</sup> In such cases, most authors have proposed completion pancreatectomy as a salvage procedure.<sup>6,8,11-14</sup> However, this operation is associated with high perioperative mortality ranging between 75% and 100%<sup>6,8,11-14</sup> and with severe morbidity (brittle diabetes). Schlitt et al<sup>8</sup> described 29 relaparotomies for grade C POPF after PD. Ten patients underwent completion pancreatectomy, which resulted in 8 postoperative deaths. The authors described 4 other patients in whom PG was used to treat grade C POPF occurring after PD with PJ. The outcomes for these 4 patients were not reported. In the present study, PG for grade C POPF did not carry any mortality among 4 patients, whereas the mortality for completion pancreatectomy was 50% (4 of 8 patients). Although not statistically significant, the present results underline the safety and feasibility of PG for preservation of the high-risk pancreatic remnant as demonstrated by previous experimental<sup>24</sup> and clinical<sup>15,21,25,26</sup> studies. This favorable result can be explained by the following characteristics of PG: (1) the anatomic position of the pancreas, which makes PG easy even in the presence of peritonitis; (2) the incomplete activation of pancreatic enzymes due to the absence of enterokinase in the stomach; and (3) the possibility to easily drain the pancreatic juice by continuous nasogastric suction. Moreover, POPF after PD with PG has a mild clinical course because of the absence of bile and biliary peritonitis, which is commonly seen with POPF after PJ.

Some authors propose surgical peripancreatic drainage as a safer alternative to completion pancreatectomy for less severe POPF.<sup>27</sup> However, in POPF associated with disruption of the PJ anastomosis, simple peripancreatic drainage might not be effective. In the present series, 1 patient in group B was initially treated with peripancreatic drainage only. The condition of this patient rapidly deteriorated as a consequence of worsening peritonitis, and he required a second relaparotomy for completion pancreatectomy.

The overall major morbidity in the total cohort was 83% (10 of 12 patients), similar to rates previously reported,<sup>6,8,11,12,14</sup> suggesting that treatment of grade C POPF is still a challenge. Such patients should be referred to centers with a high volume of pancreatic surgery. One patient in group B developed grade B POPF, which was successfully treated with bowel rest, total parenteral nutrition, and somatostatin. It has been demonstrated that PG minimizes the need for relaparotomy after elective PD.<sup>15,25,26</sup> The experience of our patient in group B suggests that salvage PG can at least reduce the severity of grade C POPF.

Completion pancreatectomy-associated type 1 diabetes mellitus and pancreatic exocrine insufficiency constitute lifelong morbidities for patients following PD, requiring frequent hospitalizations.<sup>6,11,12,14</sup> Moreover, early mortality from hypoglycemia has been reported.<sup>14</sup> In the present study, salvage PG reduced the incidence of postoperative diabetes mellitus. Moreover, the single patient in group B who developed

postoperative diabetes has not required lifelong insulin treatment.

Studies<sup>28,29</sup> demonstrate that pancreatic surgery can be performed safely in older patients with outcomes similar to those in younger patients. However, older patients have less physiological reserve and are at higher risk of death in case of postoperative morbidity. Older age may have contributed to the higher mortality encountered in group A in our study. Patients in group A were older than those in group B, but the difference was not statistically significant ( $P=.27$ ).

Patient selection may have introduced bias in the present study. The following 2 questions arise: (1) Were the 2 groups comparable for disease severity? (2) Could salvage PG instead of completion pancreatectomy have been performed in the group A patients? The APACHE II scores were similar in both groups. Moreover, the clinical status of the patients was not considered in the decision to perform completion pancreatectomy or salvage PG. In group A, completion pancreatectomy was considered to be the best available treatment at that time. In group B, the availability of a viable pancreatic remnant in the presence of a PJ leakage led the surgeon to perform PG.

The indications for relaparotomy were the same in both groups, namely, peritonitis, hemorrhage, and worsening of the clinical condition after failure of conservative treatment. In both groups, the delays between initial PD and relaparotomy for POPF were similar. Therefore, group B did not represent an "earlier" intervention group. Finally, postoperative morbidity was high in both groups, underlining the fact that all patients were already severely ill at the time of relaparotomy.

To answer the second question about the possibility of performing PG in group A patients, we retrospectively reviewed all intraoperative and pathology reports. We concluded that the pancreatic remnant could have been used to perform PG in at least 7 of 8 patients who underwent completion pancreatectomy in group A. However, PG was not considered a therapeutic option at that time.

The results of the present study demonstrate that salvage PG can be performed safely even in cases of grade C POPF if the pancreatic remnant after debridement is sufficiently large to allow for telescoped PG. Findings in the present study encourage us to pursue PG as a viable alternative to completion pancreatectomy for severe POPF after PD. However, our results should be interpreted with caution because of the small sample size and the retrospective nature of the study.

In conclusion, most POPFs can be managed conservatively. When urgent relaparotomy is necessary for the treatment of grade C POPF, PG should be considered an efficient salvage procedure with minimal morbidity in selected patients with a viable pancreatic remnant.

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