



## Interventional pancreaticojejunostomy after pancreatoduodenectomy

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### Abstract

**Background:** Leakage from the pancreaticoenteric anastomosis after pancreatoduodenectomy (PD) is closely associated with intra-abdominal hemorrhage with ensuing high mortality.

**Methods:** Interventional pancreaticojejunostomy was performed in 10 patients with external drainage of pancreatic juice after two-staged PD or leakage from pancreaticojejunostomy after PD. The jejunum was punctured using a 22-gauge needle into the pancreatic fistula during endoscopic observation of the jejunal lumen, followed by the insertion of two 0.35-inch guidewires into the jejunum and pancreatic fistula. Finally, a stenting tube was placed between the jejunum and pancreatic fistula.

**Results:** No severe complications developed. Oral intake was instituted the following day in 8 of 10 patients, and on the 7th day in the remaining two patients.

**Conclusion:** This interventional procedure is considered to be safe and easy to perform, and in the future, it may permit a reduction in the number of second laparotomies in pancreatic fistula.

**Key words:** Pancreatoduodenectomy — Pancreaticojejunostomy — Intervention

Despite decreased morbidity and mortality rates after pancreatoduodenectomy (PD) performed at specialized high-volume centers [1], leakage from pancreaticoenteric anastomoses after PD remains associated with intra-abdominal hemorrhage and subsequent high mortality rates [2, 10, 11]. If leakage from the pancreaticoenteric anastomosis occurs, the pancreatic juice must be drained externally to avoid intra-abdominal hemorrhage. In addition, two-stage PD, including exteriorization of

pancreatic juice and second-look pancreaticojejunostomy, is recommended for high-risk patients [5, 8, 9]. We have devised and successfully performed interventional pancreaticojejunostomy in patients with external drainage of pancreatic juice after PD.

### Method

#### Patients

The present study represents a retrospective examination of ten patients (8 men, 2 women; mean age = 72.4 years; range = 61–81 years) with external drainage of pancreatic juice after PD (Table 1). Underlying pathology was bile duct cancer ( $n = 8$ ), cancer of the ampulla of Vater ( $n = 1$ ), and local recurrence and liver metastasis from colon cancer ( $n = 1$ ). PD without pancreaticojejunostomy and external drainage of pancreatic juice was performed in three cases because two patients required concomitant major hepatectomy and one patient displayed severe liver dysfunction. In five patients leakage from the pancreaticojejunostomy occurred after conventional PD, but pancreatic juice was completely drained via a drainage tube located posterior to the anastomosis. The remaining two patients underwent hemostasis and external drainage of pancreatic juice under laparotomy because of intra-abdominal hemorrhage from the common hepatic artery caused by leakage from the pancreaticojejunostomy.

#### Interventional procedure

The endoscope was passed to the Roux limb of the jejunum through gastrojejunostomy. A 22-gauge needle, of the type typically used for percutaneous transhepatic biliary drainage, was inserted into the pancreatic fistula, and needle penetration of the jejunal wall was performed under endoscopic observation of the jejunal lumen (Fig. 1). The metallic part of the needle was withdrawn, leaving the Teflon catheter in the jejunum, and a 0.18-in. guidewire was inserted through the Teflon catheter into the Roux limb of the jejunum. The fistulojejunostomy was dilated using a 10-Fr dilator (Medico's Hirata, Osaka, Japan) passed over the wire (Fig. 2), and a 0.35-in. guidewire was placed into the jejunal lumen. A second 0.35-in. guidewire was inserted into the pancreatic fistula (Fig. 3). Finally, each end of a 10-Fr stenting tube with multiple side holes (Create Medic, Yokohama, Japan) was inserted into the pancreatic fistula and jejunum using the two guidewires under fluoroscopy (Fig. 4).

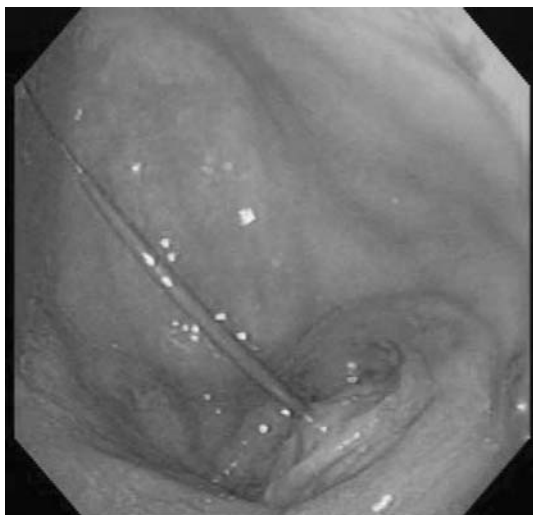
**Table 1.** Characteristics of patients who underwent interventional pancreaticojejunostomy

Patient No.	Diagnosis	Initial operation <sup>a</sup>	Pancreatic leak	Postoperative hemorrhage	Second operation
1	Bile duct cancer	2S-PD			
2	Bile duct cancer	PD	(+)	(+)	(+)
3	Bile duct cancer	PpPD	(+)		
4	Cancer of ampulla of Vater	PpPD	(+)		
5	Bile duct cancer	PpPD	(+)		
6	Bile duct cancer	PpPD	(+)		
7	Recurrence of colon cancer	2S-HPD			
8	Bile duct cancer	PpPD	(+)	(+)	(+)
9	Bile duct cancer	2S-HPD			
10	Bile duct cancer	PpPD	(+)		

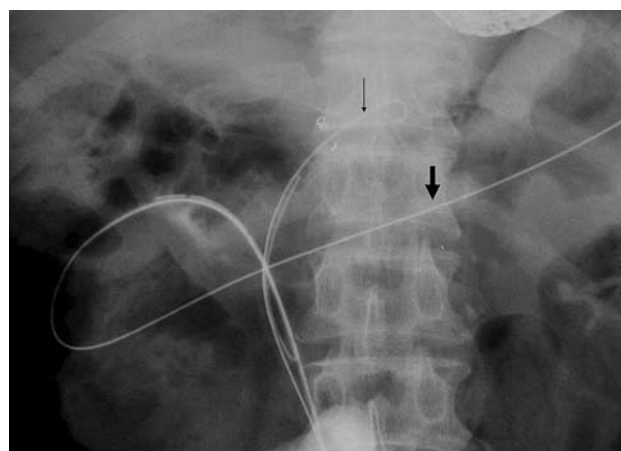
<sup>a</sup> 2S-(H) PD = two-staged (hepato-) pancreatoduodenectomy without pancreaticojejunostomy and external drainage of pancreatic juice; PpPD = pylorus-preserving Pda hemostasis and external drainage of pancreatic juice under laparotomy



**Fig. 1.** Needle penetration of the jejunum during endoscopic observation of the jejunal lumen.



**Fig. 2.** The fistulojejunostomy was dilated during endoscopic observation of the jejunal lumen.



**Fig. 3.** Two 0.35-in. guidewires were inserted into the pancreatic fistula (thin arrow) and the jejunal lumen (thick arrow).

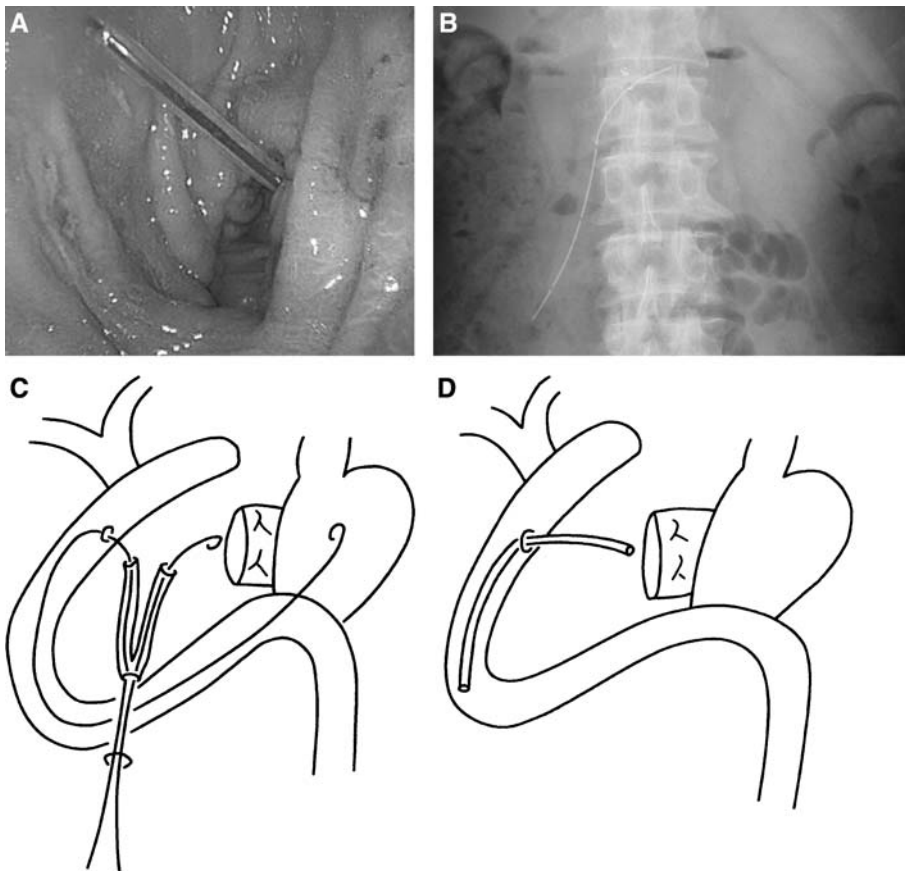
three patients. In one patient the stenting tube was dislocated on day 14 after the interventional procedure and the pancreaticojejunostomy was closed. The stenting tube was thus reinserted. In another patient, external leakage of pancreatic juice lasted about one month but resolved spontaneously. The remaining patient developed localized peritonitis but recovered with conservative treatment. In all nine patients except one, pancreatic juice leakage stopped within two days without any problems. Oral intake was initiated on the following day in eight of ten patients and on the seventh day after the interventional procedure in the remaining two patients who developed external leakage of pancreatic juice and localized peritonitis. The median length of hospital stay was 3.6 days (range = 2–14 days). No patients developed acute pancreatitis or new diabetes mellitus, although two patients displayed diabetes mellitus preoperatively. Although two patients died due to cancer recurrence, the remaining eight cases are recovering satisfactorily after a mean followup of 15.4 months (range = 7 months to 3 years).

## Results

No serious complications occurred during or after procedures in all patients. Minor complications occurred in

## Discussion

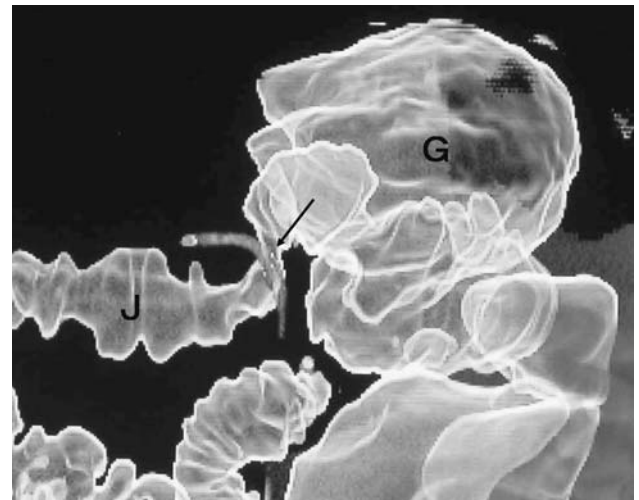
Pancreatic anastomotic leakage is closely associated with intra-abdominal hemorrhage and high mortality



**Fig. 4.** A 10-Fr stenting tube was placed between the jejunum and pancreatic fistula under endoscopic observation (A) and fluoroscopy (B). Diagrams show insertion of a stenting tube into the pancreatic fistula and jejunum by using the two guidewires (C, D).

rates [2, 10, 11]. In particular, a small pancreatic duct, large intraoperative blood loss [7], age greater than 65 years, and jaundice [6] represent risk factors for pancreatic juice leakage after PD. As a result, two-stage PD was introduced in an attempt to allow safe performance of PD in high-risk patients such as those requiring concomitant major hepatectomy or resection of other organs, those displaying liver cirrhosis, and those with a soft and fragile pancreas [5, 8, 9]. Although two-stage PD is reportedly associated with no mortality and seems remarkably safe, a second laparotomy may be somewhat problematic, particularly for patients in poor condition. Recent advances in interventional radiology have allowed the development of variant procedures such as endoscopic ultrasonography-guided bilioduodenal anastomosis [3]. We modified these interventional procedures and devised interventional pancreaticojejunostomy for patients with external drainage of pancreatic juice. In the five cases who underwent intentional external drainage of pancreatic juice, interventional pancreaticojejunostomy was easily performed because the pancreatic duct tube was placed at a point close to the jejunum and the end of the tube was brought out of the abdominal cavity at the first operation.

The other big problem for patients with pancreatic anastomotic leakage is sepsis. In the presence of fever or leukocytosis, an infected intra-abdominal fluid collection should be drained by surgical or interventional techniques. In most cases with a pancreatic anastomotic leakage, a pancreatic fistula may be resolved by con-



**Fig. 5.** Three-dimensional images reconstructed from computed tomography showing the remnant stomach (G), jejunum (J), and the tube (arrow) which is placed into the pancreatic fistula.

servative management with an intraoperatively placed drain or percutaneous drainage if sepsis can be controlled [4]. However, we have experienced five cases in which a pancreatic fistula did not close spontaneously though sepsis was controlled. Our interventional procedure should be performed only when sepsis is controlled and a pancreatic fistula does not close conservatively. In our experience pancreatic fistulas with

a mixture of enteric and pancreatic juice closed spontaneously, while pure pancreatic leaks did not close in five patients. Therefore, we performed our interventional procedure only for pure pancreatic leaks. These five patients underwent computed tomography during pancreatic fistulography. Next, three-dimensional fistulograms were reconstructed to verify relationships between pancreatic fistula and the jejunum because three-dimensional images are useful for the interventional procedure (Fig. 5). In addition, endoscopic observation of the jejunal lumen is important to confirm secure introduction of the needle into the jejunal lumen. The main problem with this procedure may be the increased risk of bleeding. However, enhanced computed tomography before the procedure greatly reduces the risk of vascular perforation during puncture insertion. We performed interventional pancreaticojejunostomy without serious complications such as bleeding or jejunal perforation. In addition, oral intake was started on the following day in eight of ten patients who underwent this procedure. Interventional pancreaticojejunostomy is an easy and safe procedure, but further evaluation of this procedure is warranted.

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