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Case Report

Pancreaticogastrostomy Prevents Postoperative Pancreatic Fistula of Portal Annular Pancreas During Pancreaticoduodenectomy

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Portal annular pancreas (PAP) is an asymptomatic congenital pancreatic anomaly in which the uncinate process of the pancreas extends and fuses to the dorsal surface of the body of the pancreas by surrounding the portal vein and or the superior mesenteric vein. During pancreaticoduonectomy (PD), the presence of PAP significantly increased risk for postoperative pancreatic fistula (POPF) because specific management of 2 pancreatic resection planes with 1 or 2 pancreatic ducts is required for pancreatico-intestinal reconstruction. To reduce the risk of POPF, a shift of the resection plain to the left for 1 anastomosis is recommended. We report a case of PAP that was successfully performed PD with pancreaticogastrostomy (PG). PG was conducted with invagination of the 2 resected pancreatic planes together into the stomach to minimize resected volume of the pancreas. A 78-year-old male patient with PAP underwent PD due to a duodenal adenocarcinoma. Intraoperatively, the uncinate process extended extensively behind the portal vein and fused with the dorsal surface of the pancreatic body above the splenic vein. For pancreatico-intestinal reconstruction, PG was performed with invagination of the 2 resected pancreatic planes together into the stomach. The postoperative course was uneventful, and he was discharged on postoperative day 12. Endocrine and exocrine function of the pancreas were maintained well at 10 months after surgery. PG is one of the useful choices for patients with PAP to prevent POPF while maintaining the pancreatic endocrine and exocrine function after PD.

Key words: Portal annular pancreas – Pancreaticoduodenectomy – Postoperative pancreatic fistula – Pancreaticogastrostomy

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Fig. 1 Preoperative CT scan findings of the portal annular pancreas. The portal vein (arrow) was surrounded annularly by pancreatic parenchyma (arrow heads).

Portal annular pancreas (PAP) is an asymptomatic congenital pancreatic anomaly in which the uncinate process of the pancreas extends and fuses to the dorsal surface of the body of the pancreas by surrounding the portal vein and or the superior mesenteric vein. Although the overall prevalence of PAP has been reported from 1.1% to 3.4% in computed tomography (CT) imaging studies,[1,2] PAP is an unattended pancreatic variant probably due to minimal clinical significance. However, during pancreaticoduonectomy (PD), the presence of PAP significantly increased risk of postoperative pancreatic fistula (POPF) because a specific management of 2 pancreatic resection planes with 1 or 2 pancreatic ducts is required for pancreatico-intestinal reconstruction.

Here, we report a patient with PAP who underwent PD due to a duodenal adenocarcinoma, and we discuss the technical issues during PD.

Case Report

A 78-year-old man presented with upper abdominal discomfort. Upper gastrointestinal endoscopy revealed a large tumor in the duodenum. A duodenal adenocarcinoma was diagnosed by endoscopic biopsy. He was referred to our hospital for PD. Preoperative CT revealed that the uncinate process of the pancreas extended and fused to the dorsal surface of the pancreatic body by surrounding the portal vein, and a PAP was diagnosed (Fig. 1). The pancreatic duct was not identified in the retroportal pancreas. Intraoperative findings were compatible with CT. The uncinate process extended

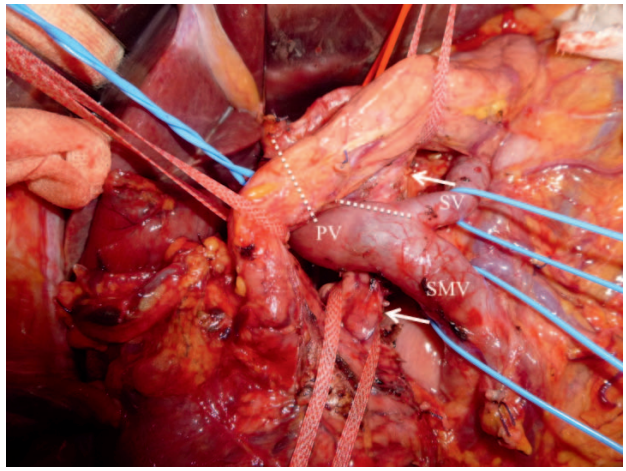

Fig. 2 Intraoperative findings of the portal annular pancreas. The uncinate process (arrow) extended behind the portal vein (PV) and fused with the dorsal surface of the pancreatic body. The fusion was superior to the splenic vein. The pancreatic transection lines were showed along the dotted line. Superior mesenteric vein = SMV; splenic vein = SV.

extensively behind the portal vein, and fused with the dorsal surface of the pancreatic body above the splenic vein (Fig. 2). The pancreas was divided above and below the portal vein using scalpel. The pancreatic duct was identified on the resected plane of the anteportal pancreas, but not retroportal pancreas. For pancreatico-intestinal reconstruction, we performed pancreaticogastrostomy (PG) with invagination of the 2 resected pancreatic planes together into the stomach (Fig. 3). Histologically, the resected specimen revealed an adenocarcinoma of the duodenum. The postoperative course

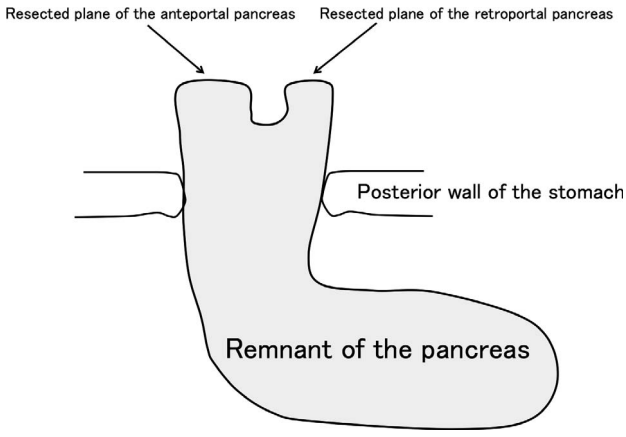

Fig. 3 Pancreaticogastrostomy (PG) was performed with invagination of the 2 resected pancreatic planes together into the stomach.

was uneventful, and he was discharged on postoperative day 12. Endocrine and exocrine function of the pancreas were maintained well at 10 months after surgery.

Discussion

During pancreatic surgery, the presence of PAP significantly affects the procedure, especially pancreatico-intestinal reconstruction for the substantially increased risk for POPF. It is because of an aberrant pancreatic fusion and pancreatic duct, which are sometimes not discovered intraoperatively. Surgeons should consider how to manage the 2 resected pancreatic planes (anteportal and retroportal planes) for pancreatico-intestinal reconstruction at the time of PD. In fact, a high POPF rate of 46.7% (12 PDs and 3 distal pancreatectomies) in patients with PAP has been reported.[2]

PAP has been classified depending on the location of the main pancreatic duct (MPD) in relation to the portal vein[3] or in accordance with its relation to the portal conference.[1] Joseph *et al*[3] proposed as follows: type 1 is the fusion of the ventral bud of the pancreas with the body and retroportal MPD; type 2 is type 1 associated with pancreas divisum; and type 3 is the portal vein encasement by the uncinate process with a normal anteportal MPD. And Karasaki *et al*,[1] each type can be subdivided depending on the relation to the portal confluence (suprasplenic, infrasplenic, and mixed type). In accordance with the PAP classification, our case indicated type 3 and suprasplenic type. It is very important to confirm anatomy of the PAP especially pancreatic ductal system pre- and intraoperatively.

According to previous reports,[2,4] POPF after PD occurred in 4 (30.7%) of 13 patients with PAP. At present, PG and pancreaticojejunostomy (PJ) are the 2 most widely employed techniques for restoration of pancreatic drainage into gastrointestinal tract after PD. To avoid technical difficulties of PJ of 2 resection planes and jejunum with 1 or 2 pancreatic ducts to mucosa anastomosis, and to reduce the risk of POPF, some authors recommended a shift of the resection plain to the left for 1 anastomosis.[2,5] In our case, we performed PG with invagination of 2 pancreatic planes into the stomach, and the postoperative course was uneventful. The key operative consideration is ensuring adequate drainage of all remaining pancreatic tissue. As recent studies showed that the resection volume of the pancreas is a significant risk factor for postoperative diabetes after pancreatectomy,[6–8] the pancreatic endocrine and exocrine function could be preserved with minimum resected volume of the pancreas. To our knowledge, this is the first report to describe the efficacy of PG with PAP to reduce POPF while maintaining the pancreatic endocrine and exocrine function after PD. The shift of the resection plain to the left may result in pancreatic insufficiency of endocrine and exocrine pancreas. However, as recent advances in insulin formulations, such as long- and short-acting insulin preparations, allow better glucose control,[9] and high-quality pancreatic enzyme formulations are available to improve exocrine pancreatic insufficiency after pancreatectomy,[10] the shift of the resection plain to the left for 1 anastomosis is also good option to reduce the risk of POPF.

Although a recent multicenter randomized control trail and meta-analysis showed that PG reduced the incidence of POPF after PD compared with PJ,[11,12] the best method to restore pancreatic digestive continuity is still debated.[13] As PG offers an easier-to-learn technique suited for less experienced surgeons,[11] we performed PG. However, intraabdominal positions of stomach, normal pancreas, and annular pancreas are varied. Some cases of PAP could not be treated with the present PG on the viewpoints of the individual gastric and annular pancreatic position.

Although the patient did not have steatorrhea requiring insulin, the main pancreatic duct dilatation and atrophic changes of the remnant pancreas was seen on CT scan at 9 months after surgery. These morphologic changes occur more often in PG than PJ possibly because of the gastric mucosa overhealing and covering the anastomosis.[14] In this case, another potential reason for the postoperative main pancreatic duct dilatation and parenchymal atrophic changes may be due to the ischemia of the rest of the retroportal pancreas. The dorsal pancreatic artery and the inferior pancreaticoduodenal artery, which feed the retroportal pancreas, were dissected for the lymph node dissection at the time of surgery.

In conclusion, it is important to confirm pancreatic ductal system integrity preoperatively and intraoperatively when recognizing this anomaly to perform PD safely. Decision of the pancreatic resection line and duct management is one of the most crucial points of this situation. We suggest that PG is one of the useful choices for the patients with PAP when performing PD.

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References

1. Karasaki H, Mizukami Y, Ishizaki A, Goto J, Yoshikawa D, Kino S *et al*. Portal annular pancreas, a notable pancreatic malformation: frequency, morphology, and implications for pancreatic surgery. *Surgery* 2009;**146**(3):515–518
2. Harnoss JM, Harnoss JC, Diener MK, Contin P, Ulrich AB, Büchler MW *et al*. Portal annular pancreas: a systematic review of a clinical challenge. *Pancreas* 2014;**43**(7):981–986
3. Joseph P, Raju RS, Vyas FL, Eapen A, Sitaram V. Portal annular pancreas. A rare variant and a new classification. *JOP* 2010; **11**(5):453–455
4. Pardiwala KH, Maker AV. Operative management of portal annular pancreas during pancreaticoduodenectomy. *Surgery* 2016;**159**(3):972–974
5. Matsumoto I, Shinzeki M, Fukumoto T, Ku Y. An extremely rare portal annular pancreas for pancreaticoduodenectomy with a special note on the pancreatic duct management in the dorsal pancreas. *Surgery* 2013;**153**(3):434–436
6. Shirakawa S, Matsumoto I, Toyama H, Shinzeki M, Ajiki T, Fukumoto T *et al*. Pancreatic volumetric assessment as a predictor of new-onset diabetes following distal pancreatectomy. *J Gastrointest Surg* 2012;**16**(12):2212–2219
7. Kwon JH, Kim SC, Shim IK, Song KB, Lee JH, Hwang DW *et al*. Factors affecting the development of diabetes mellitus after pancreatic resection. *Pancreas* 2015;**44**(8):1296–1303
8. Kang JS, Jang JY, Kang MJ, Kim E, Jung W, Chang J *et al*. Endocrine function impairment after distal pancreatectomy: incidence and related factors. *World J Surg* 2016;**40**(2):440–446
9. Fullerton B, Jeitler K, Seitz M, Horvath K, Berghold A, Siebenhofer A. Intensive glucose control versus conventional glucose control for type 1 diabetes mellitus. *Cochrane Database Syst Rev* 2014;**14**(2):CD009122
10. Sikkens EC, Cahen DL, van Eijck C, Kuipers EJ, Bruno MJ. The daily practice of pancreatic enzyme replacement therapy after pancreatic surgery: a northern European survey: enzyme replacement after surgery. *J Gastrointest Surg* 2012;**16**(8):1487–1492
11. Topal B, Fieuws S, Aerts R, Weerts J, Feryn T, Roeyen G *et al*. Pancreaticojejunostomy versus pancreaticogastrostomy reconstruction after pancreaticoduodenectomy for pancreatic or periampullary tumours: a multicentre randomised trial. *Lancet Oncol* 2013;**14**(7):655–652
12. Xiong JJ, Tan CL, Szatmary P, Huang W, Ke NW, Hu WM *et al*. Meta-analysis of pancreaticogastrostomy versus pancreaticojejunostomy after pancreaticoduodenectomy. *Br J Surg* 2014; **101**(10):1196–1208
13. Keck T, Wellner UF, Bahra M, Klein F, Sick O, Niedergethmann M *et al*. Pancreatogastrostomy versus pancreatojejunostomy for RECOnstruction after PANCreatoduodenectomy (RECOPANC, DRKS 00000767): perioperative and long-term results of a multicenter randomized controlled trial. *Ann Surg* 2016; 263(3):440–449
14. Hirono S, Murakami Y, Tani M, Kawai M, Okada K, Uemura K *et al*. Identification of risk factors for pancreatic exocrine insufficiency after pancreaticoduodenectomy using a 13C-labeled mixed triglyceride breath test. *World J Surg* 2015;**39**(2):516–525