



Single Purse-String Duct to Mucosa Pancreaticogastrostomy: A Safe, Easy, and Useful Technique after Pancreaticoduodenectomy

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Pancreatic fistula (PF), hemorrhage, and intra-abdominal abscess are major complications after pancreaticoduodenectomy (PD), which is a complex, high-risk surgical procedure but has been the standard of care for patients with malignancies of the pancreatic head, ampulla of Vater, duodenum, and distal common bile duct since reported by Whipple and colleagues¹ in 1935. Among these common complications, PF is the most frequent, results in mortality, and is associated with other morbidities, including intra-abdominal hemorrhage and sepsis. Contemporary series report rates of PF after PD that vary from 0% to >30%.^{2,3} There are several risk factors that contribute to PF and pancreaticoenteric anastomotic failure is the most important.

Pancreaticojejunostomy (PJ) is the preferred anastomosis after PD and has been used commonly for the past several decades, but complications result in 40% to 50% of patients, even in recent studies.⁴⁻⁶ Pancreaticogastrostomy (PG) anastomosis was first reported by Waugh and Clagett⁷ in 1946, but was used less frequently, until several randomized trials and meta-analyses were published that suggested PG was associated with a lower incidence of anastomotic failure and PF than PJ.⁸⁻¹¹ In China, PG has become more widely used since 2009, when Peng and colleagues¹² successfully performed binding PG with encouraging results. But the majority of cases adopted the invagination method, with the pancreatic stump inserted into the stomach lumen, but has a risk for pancreatic stump bleeding caused by acid corrosion. We developed a modification technique—the single purse-string duct

to mucosa PG. Here we present our preliminary results in 75 patients.

MATERIALS AND METHODS

Study population

Data were collected prospectively on 75 consecutive patients (43 men and 32 women; mean age 65.3 years [range 38.9 to 81.1 years]) who underwent PD from January 2010 to May 2014 using the single-string duct to mucosa PG for tumors located at the pancreatic head and periampullary region. The technique was performed by the same surgeon, who had performed a minimum of 100 PD operations. Demographic and clinical characteristics of these patients are presented in [Table 1](#).

Surgical procedures

The surgical procedure for PD was performed with an abdominal midline incision, up to the xiphoid and down to 3 cm below the umbilical. Peng's multifunctional operative dissector^{13,14}—which combines cutting, separating, aspirating, and coagulating—was the instrument used through the whole process. Lymphadenectomy was routinely performed in patients with malignant tumor.

After assessing resectability, the stomach was divided using 2 linear stapling devices in the mid-antrum, and no pylorus-preserving technique was used. Transection of the pancreas is generally performed at the pancreatic neck or body, or at least a 2-cm surgical margin from the tumor; using Peng's multifunctional operative dissector, the pancreatic duct was. A frozen section as obtained to detect the presence of tumor invasion if the surgical margin was not enough. The pancreatic distal stump was then separated from the splenic vein and artery about 3 cm to facilitate the PG anastomosis. The size of the main pancreatic duct (MPD) and texture of the remnant pancreatic stump were assessed during the procedure. A silicone tube equal in diameter to the MPD was then inserted into the MPD as a stent to prevent occlusion of the pancreatic duct, and the pancreatic parenchyma beside the MPD was transfixed with 3-0 Vicryl stay sutures, one needle on each side without cutting. The sutures were

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Abbreviations and Acronyms

DGE	= delayed gastric emptying
MPD	= main pancreatic duct
PD	= pancreaticoduodenectomy
PF	= pancreatic fistula
PG	= pancreaticogastrostomy
PJ	= pancreaticojejunostomy
POD	= postoperative day

used to pull the pancreatic duct and silicone stent into the stomach.

To better understand the technique of single purse-string duct to mucosa PG, we divided it into 3 steps:

1. At an appropriate place on the posterior wall of the stomach opposite the pancreatic stump, a 2- to 3-cm diameter seromuscular layer was excised, around which a single purse-string suture of 2-0 polydioxanone was placed (Fig. 1). The size of this excision was equal to the size of the pancreatic stump, if the excision was too large, then the purse-string would be difficult to tie, if it was too small, then the pancreatic stump would not be easy to insert.
2. An incision about 3 to 5 cm was made in the anterior gastric wall, and the gastric lumen was washed using 0.5% povidone-iodine diluted with physiological saline. After that, a small hole (2 to 5 mm) was made in the mucosa of the posterior gastric wall

Table 1. Demographic and Clinical Characteristics of Patients (n = 75) Who Underwent Single Purse-String Duct to Mucosa Pancreaticogastrostomy

Characteristics	
Age, y, mean (range)	65.3 (38.9–81.1)
Sex, n (%)	
Male	43 (57.3)
Female	32 (42.7)
Primary tumor, n (%)	
Cancer of pancreatic head	39 (52.0)
Cancer of ampulla of Vater	14 (18.7)
Cancer of distal bile duct	12 (16.0)
IPMN	5 (6.7)
Cancer of duodenum	4 (5.3)
Endocrine cell carcinoma	1 (1.3)
Tumor size, mm, mean (range)	28 (17–69)
Preoperative serum total bilirubin level, $\mu\text{mol/L}$, mean (range)	51.3 (3.9–389)
Perioperative biliary drainage, n (%)	
Yes	17 (22.7)
No	58 (77.3)

IPMN, intraductal papillary mucinous neoplasm.

adjacent to the position of the pancreatic duct, through which the pancreatic duct with silicone stent was pulled into the gastric lumen by gently pulling the sutures (Fig. 2). The gastric mucosa and pancreatic parenchyma beside the pancreatic duct were transfixed (about 1.5 cm distant to the pancreatic cut surface) with interrupted absorbable 3-0 Vicryl stay sutures, 4 needles on each side (Fig. 3). If the MPD diameter is >3 mm, it was sutured continuously with the gastric mucosa by 5-0 Prolene (Ethicon), otherwise, the MPD would not be sutured with the gastric mucosa, they will grow together along the silicone stent.

3. Subsequently, the purse-string suture was tied to create a water-tight closure (Fig. 4), but with minimal tension to avoid pancreatic duct occlusion.

Additional reconstruction of digestive tract was achieved by an end to side hepatodochojunostomy and end to side gastrojejunostomy. The hepatodochojunostomy was carried out by continuous suture with nonabsorbable 5-0 Prolene (Ethicon) suture, and the gastrojejunostomy was done anterior the transverse colon. After completion of all 3 anastomoses, a nasogastric tube was placed in all of the patients to decompress the stomach, followed by a nasojejunal feeding tube in 39 patients, and 2 abdominal drains without suction were placed close to the PG, the right one behind the hepatodochojunostomy with its head extended to the PG through the foramen of Winslow, and the left one behind the PG through the lesser sac.

Duration of operation, estimated blood loss, blood transfusion, and mean time for PG anastomosis (from the incision of the posterior gastric wall to completion of tying the purse-string suture) were measured during the operation.

Postoperative management

After operation, all patients were administered somatostatin intravenously at a dosage of 3 mg every 8 hours from postoperative days (PODs) 1 to 7, and a proton pump inhibitor was administered in the postoperative period, 40 mg/d intravenously also from PODs 1 to 7, then 40 mg orally until discharge. Parenteral nutrition was started on the first day after surgery, enteral nutrition was given through the nasojejunal feeding tube on POD 1 with 250 to 500 mL of water and progressively increased to a standardized elemental diet of 1,000 to 1,500 mL from PODs 2 to 7, both parenteral and enteral nutrition continued until oral feeding could be resumed.

The nasogastric tube was removed once the aspirate has reduced to <200 mL/d and patient resumed passing flatus. Removal of the nasojejunal feeding tube waited until oral intake resumed, usually on PODs 5 to 7; the

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