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Triple-layer duct-to-mucosa pancreaticojejunostomy with resection of jejunal serosa decreased pancreatic fistula after pancreaticoduodenectomy

An-Ping Su, MD, Yi Zhang, MD, Neng-Wen Ke, MD, Hui-Min Lu, MD, Bo-Le Tian, MD, Wei-Ming Hu, MD, and Zhao-Da Zhang, MD*

Department of Hepatobiliarypancreatic Surgery, West China Hospital, Sichuan University, Chengdu, Sichuan Province, China

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ABSTRACT

Background: Pancreatic fistula (PF) is one of the most common complications after pancreaticoduodenectomy (PD). We described a new method of pancreaticojejunostomy (PJ) developed by combining triple-layer duct-to-mucosa PJ with resection of jejunal serosa, which was named as modified layer-to-layer PJ (MLLPJ). The aim of the present study was to observe whether the new technique would effectively reduce the PF rate in comparison with two-layer duct-to-mucosa PJ (TLPJ).

Methods: Data on 184 consecutive patients who underwent the two methods of PJ after standard PD between January 1, 2010 and January 31, 2013 were collected retrospectively from a prospective database. The primary endpoint was the PF rate. The risk factors of PF were investigated by using univariate and multivariate analyses.

Results: A total of 88 patients received TLPJ and 96 underwent MLLPJ. Rate of PF for the entire cohort was 8.2%. There were 11 fistulas (12.5%) in the TLPJ group and four fistulas (4.2%) in the MLLPJ group ($P = 0.039$). Body mass index, pancreatic texture, pancreatic duct diameter, and methods of PJ anastomosis had significant effects on the formation of PF on univariate analysis. Multivariate analysis showed that pancreatic duct diameter ≤ 3 mm and TLPJ were the significant risk factors of PF.

Conclusions: MLLPJ effectively reduces the PF rate after PD in comparison with TLPJ. Results confirm increased PF rates in patients with pancreatic duct diameter ≤ 3 mm compared with pancreatic duct diameter > 3 mm.

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1. Introduction

The safety of pancreaticoduodenectomy (PD) has improved significantly in recent years, and the mortality rates associated with this procedure are relatively low [1,2]. However, the incidence of postoperative morbidity remains as high as 30%–65%, even in many large specialized centers [3,4]. Pancreatic fistula (PF) is one of the most common postoperative complications after PD, the incidence of which ranges from 2.5%–25% depending on

the definition used [5]. Therefore, some authors have named the pancreaticoenteric anastomosis the Achilles heel of pancreatic surgery [6]. PF with subsequent delayed gastric emptying, intra-abdominal abscess, peritonitis, sepsis, and hemorrhage has a profound impact on the patient's physical and emotional well being, which prolongs the hospital stay, adds substantially to the hospital costs, and in some cases leads to death [7].

The primary cause of PF after PD is the dehiscence of the pancreaticojejunostomy (PJ). How to construct a firm,

* Corresponding author. Zhao-Da Zhang, MD, Department of Hepatobiliarypancreatic Surgery, West China Hospital, Sichuan University, Chengdu 610041, Sichuan Province, China. Tel./fax: +86 28 85422475.

E-mail address: zhaodazhang@yeah.net (Z.-D. Zhang).

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tension-free, and visceral PJ with good blood supply, therefore, is the key point in preventing PF. Numerous surgical strategies have been used to connect the pancreatic stump with the jejunum, such as two-layer duct-to-mucosa anastomosis and invagination anastomosis [8,9]. Although two-layer duct-to-mucosa PJ (TLPJ) has been advocated to reduce the risk of PF after PD, no consensus has been reached regarding the PJ that is safest and least prone to fistula formation [9–11]. Other surgical strategies advocated to strengthen the tightness and avoid shear forces of PJ are two-layer duct-to-mucosa anastomosis with resection of jejunal serosa (layer-to-layer PJ) and triple-layer duct-to-mucosa anastomosis [12–14]. No PF was noted with layer-to-layer PJ [12,13], and PF only occurred in one patient (1.96%) with triple-layer duct-to-mucosa PJ [14], which was obviously lower compared with other series. However, there was no control group in each study. Because the two methods seemed to be effective to decrease the incidence of PF after PD, how about combining them together? Actually, triple-layer duct-to-mucosa PJ with resection of jejunal serosa, which was named as modified layer-to-layer PJ (MLLPJ), was performed in our institution from September 2007 and good results were achieved. To obtain reliable evidence, this nonrandomized and single institution trial was designed. The aim of the present study was to observe whether MLLPJ can effectively decrease the PF rate in comparison with TLPJ after PD.

2. Methods

2.1. Patients

A retrospective review from a prospective database was carried out. One hundred eighty-four consecutive patients who had undergone standard PD at the Department of Pancreatic Surgery of West China Hospital between January 1, 2010 and January 31, 2013 were enrolled in the study. MLLPJ was performed until June 30, 2011, and TLPJ was performed after July 1, 2011. The study was approved by the medical ethics committee of West China Hospital, Sichuan University. Appropriate informed consent was obtained from each patient, and they also agreed to follow-up meetings at least 3 mo after surgery.

2.2. Surgical procedures

Standard PD with hemigastrectomy was performed on each patient. The hemigastrectomy line was determined as previously described [15]. The resected specimen included pylorus, distant antrum of stomach, gallbladder, distal common bile duct, pancreatic head, duodenum, and 10 cm of the proximal jejunum. In patients with malignant disease, lymph nodes around the head of the pancreas, the common hepatic artery, the hepatoduodenal ligament, and the right side of the superior mesenteric artery were dissected. The pancreas was sharply transected with a scalpel. The remnant pancreatic stump was sutured at the bleeding point with 4-0 polydioxanone (PDS) (Johnson & Johnson Co) and any oozing points were coagulated by electrocautery. After the specimen was removed, child reconstruction was performed in the

following sequence: end-to-side duct-to-mucosal PJ (TLPJ or MLLPJ), end-to-side single-layer choledochojejunostomy (CJ), and end-to-side gastrojejunostomy (GJ). In all patients, biliopancreatic reconstruction was performed by using a loop of jejunum brought up through the transverse mesocolon by the retrocolic route.

In the TLPJ group (Fig. 1A), the first posterior layer was constructed by use of 4–6 interrupted 4-0 PDS sutures between the pancreatic capsular parenchyma of the stump and the seromuscular layer of the jejunum. A small incision was then made on the antimesenteric border of the jejunum opposite to the pancreatic duct. The second layer was performed between the pancreatic duct and all layers of the jejunal wall by use of 5–6 interrupted 4-0 or 5-0 PDS sutures. A 5 or 6 French plastic feeding tube, used as an internal stent, was inserted in the main pancreatic duct and jejunal lumen after the posterior side of the second layer was completed. The anterior two layers of the PJ were anastomosed in the reverse order and in the same manner.

In the MLLPJ group (Fig. 1B), before the reconstruction, the jejunal serosa was resected a little smaller than the size of the pancreatic stump at the anastomotic point (Fig. 2A). If there was any bleeding, it was stopped by applying direct pressure to the wound. The first posterior layer was constructed by use of 3–5 interrupted 4-0 PDS sutures between the posterior capsule of the pancreatic remnant (0.5–1 cm distant to pancreatic stump) and the serosa of the jejunum (Fig. 2B). The second posterior layer is between the jejunal seromuscular layer and the pancreatic capsular parenchyma of the stump (the edges of the resected jejunal serosa and pancreatic stump) (Fig. 2C), which was done using 4–6 interrupted 4-0 PDS sutures, tied securely and with the knots cut short to avoid the sutures cutting through the pancreatic parenchyma and making any dead space. Then a small incision was made as mentioned in the TLPJ group. The dorsal parts of the pancreatic duct and jejunal mucosa were sutured with 2–3 interrupted 4-0 or 5-0 PDS sutures (Fig. 2D). An internal stent was then placed from the pancreatic duct to the lumen of the jejunum as in the TLPJ group. The anterior three layers of the PJ were anastomosed in the reverse order and in the same manner (Fig. 3).

In both groups, once the PJ was completed, the same loop was used to reconstruct the CJ and GJ. A one-layer CJ was constructed using interrupted 4-0 PDS sutures without a stent. GJ was performed with a gastrointestinal circular stapler (25 mm; Johnson & Johnson Co) in an antecolic fashion. A nasogastric tube was placed into the afferent jejunal limb of the anastomosis. Two abdominal drains were placed around the pancreatic and biliary anastomosis.

2.3. Perioperative management

Perioperative management was standardized. All patients underwent bowel preparation with drinking Fleet phosphosoda (Fleet, Lynchburg, VA) 1 d before surgery. All patients were given prophylactic antibiotics and underwent a nasogastric tube placement 30 min before surgery. Intraoperative blood transfusion was conducted if hemoglobin was <70 g/L during surgery. For postoperative management, proton pump inhibitors, prophylactic antibiotics, and somatostatin analogs

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