Polypropylene mesh-reinforced pancreaticojejunostomy for periampullar neoplasm

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Abstract

AIM: To evaluate the effect of polypropylene mesh-reinforced pancreatojejunostomy on pancreatic leakage.

METHODS: Seventeen consecutive patients with periampullar malignancy received polypropylene mesh-reinforced pancreatoduodenectomy and the Child's method was used to rebuild the alimentary tract.

RESULTS: The mean time of polypropylene mesh-reinforced pancreatojejunostomy was 22 min. Anastomosis could endure 30-500 cm H₂O pressure during operation. All patients recovered without pancreatic leakage.

CONCLUSION: Polypropylene mesh-reinforced pancreatojejunostomy is a feasible and reliable procedure to prevent pancreatic leakage.

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Key words: Pancreatic leakage; Pancreatojejunoanastomosis; Pancreatodudenectomy

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INTRODUCTION

Pancreatic anastomotic leakage is a common lethal complication of pancreaticojejunostomy. The incidence of pancreatic anastomosis leakage depends on multiple factors, among which the anastomotic method is the key factor. Different anastomotic methods in pancreaticojejunostomy have been reported in the literature, but none of them is able to prevent pancreatic leakage. Recently, we designed a new anastomotic method: polypropylene mesh-reinforced pancreaticojejunostomy (MRP), by which the sheath of jejunum is bound to the pancreatic remnant wrapped by a strip of mesh. We have applied this method in 17 consecutive periampullar neoplasm patients, and none of them developed pancreatic leakage.

MATERIALS AND METHODS

Clinical data

Nine male and eight female patients with periampullar malignancy, aged 38-72 years, were included in this study, including 6 patients with carcinoma of the pancreatic head, 6 with distal common bile duct cancer, 3 with ampullar carcinoma and 2 with duodenal carcinoma. All the patients received polypropylene mesh-reinforced pancreatoduodenectomy and the Child's method was used to rebuild the alimentary tract. Initial polypropylene MRP was performed on 16 patients, the other patient received end-to-end invagination anastomosis during the first operation but developed pancreatic leakage after operation. On the 8th postoperative day, the patient developed massive intraabdominal bleeding and received the second laparotomy along with polypropylene MRP.

Technique

The pancreas was transected with a scalpel on the scheduled line. Hemostasis was secured by suture ligatures with 4-0 polypropylene stitches (Ethicon, Somerville, NJ) or electrocautery. A 3.0 cm cut end of the pancreatic remnant was isolated. A 1.0 cm wide polypropylene mesh (Ethicon, Somerville, NJ) strip was tightly wrapped over the pancreatic stump about 1.0 cm from the cut margin with a few stitches. The mesh was fixed if it could not be moved with force. If the main pancreatic duct was identified, a stent tube was inserted into the main pancreatic duct and fixed with suturing thread (Figure 1A).

Then, the pancreatic stump and the free margin of jejunum were brought together. A posterior row of continuous running sutures using a 3-0 polypropylene stitch was placed between the inner edge of the mesh and jejunum. The sutures were passed carefully through the
mesh, pancreatic capsule and full thickness of jejunum. We began at the farthest point on the cranial side of the pancreatic stump and the caudal side was ligated with six to eight sutures (Figure 1B). After the posterior sutures were completed, they were gently pulled to invaginate the pancreatic stump into the jejunum (Figure 1C). The opposite end of the pancreatic duct stent tube was traversed through sites where bilioenteric anastomosis was performed. Finally, the continuous sutures were extended anteriorly using the same stitch. The sutures were tied after the tightness of the suture line was confirmed. As a result, the jejunal stump invaginated the pancreatic stump of about 2.0 cm (Figure 1D). Care was taken to cover the entire mesh in the jejunal lumen. A urinary catheter was inserted into the jejunum, and saline solution was injected to test for a watertight closure. The seromuscular surface of jejunum 1.0 cm from the margin was anchored to the superior and inferior peritoneal attachments of the pancreatic body to minimize the tension. Biliary anastomosis was constructed in an end-to-side fashion 15 cm distal from the pancreaticojejunostomy. Then a Jackson-Pratt drainage tube was placed near the anastomosis. Pancreatic leakage was defined as the persistent amylase-rich (more than three times the serum concentration) drainage output exceeding 50 mL/d[1-2]. Prophylactic octreotide was not used.

RESULTS
The mean operative time for polypropylene MRP was 22 min (ranged 10-25 min). No pancreatic leakage was observed under the pressure of 20 cmH2O during operation. The abdominal drainage output was less than 50 mL in 14 patients, and the amylase content in drainage was within normal range (ranged 46-98 IU/L). The abdominal drainage was removed 4-5 d after the operation, and the patients recovered well and were discharged on the 10th postoperative day. Two patients had a high volume of abdominal drainage during the first 3 postoperative days, but the amylase content in the abdominal drainage was within normal range. The abdominal drainage was removed on the 7th postoperative day and the patients recovered well. A 55-year old male patient received pancreaticojejunectomy for distal common bile duct with an end-to-end invagination anastomosis. The pancreas was soft and fragile. The abdominal drainage output was >100 mL/d after operation and the amylase content was >2000 IU/L. Pancreatic anastomotic leakage was identified. The patient had no fever or abdominal pain and received conservative therapy initially. On the 8th postoperative day, fresh blood was drained from the abdominal drainage tube and the patient received the second laparotomy. During the operation, laceration of pancreatic tissue was found on the suture of anastomosis with massive fluid collection. The bleeding came from the splenic artery involved in the fluid collection. After the bleeding was stopped, the pancreas was found to be edematous and fragile. In order to make a direct suture on the pancreas, we decided to perform polypropylene MRP. The patient recovered well after the second operation without pancreatic leakage. All patients were followed up in the outpatient clinic and no adverse events occurred.

DISCUSSION
Since Whipple introduced pancreaticoduodenectomy, it has become a standard procedure for malignant and
benign disorders of the pancreatic head and periampullary region\(^\text{[1-3]}\). Although the mortality from the surgical procedure has come down considerably during the past three decades\(^\text{[4]}\), it is still higher than that of other radical procedures for abdominal malignancy\(^\text{[7-9]}\). Pancreatic anastomotic leakage is still the most important determinant of its morbidity, with an incidence of 2%-14\(^\%\)\(^\text{[10,11]}\) and mortality of 28\(^\%\)\(^\text{[12,13]}\). The etiology of pancreatic anastomotic leakage covers several aspects, including quality of pancreatic tissue, size of major pancreatic duct, exocrine status of the patient, general condition and nutritional status of the patient, skill of the surgeon and method of pancreaticojejunostomy\(^\text{[14-16]}\). Among them, method of pancreaticojejunostomy seems to be the key factor\(^\text{[17]}\). Different methods for pancreaticojejunostomy have been reported in the literature\(^\text{[18]}\), including end-to-side anastomosis, duct-to-mucosa anastomosis, or end-to-end or end-to-side invagination anastomosis. The suturing techniques for anastomosis include running or interrupted suture, single layer or double layers suture\(^\text{[19-21]}\). But all these methods cannot absolutely prevent the leakage, the incidence of leakage of the most widely applied end-to-side invagination anastomosis is still as high as 11\(^\%\)\(^\text{[22]}\). No consensus on the choice of anastomotic technique has been reached, and currently each technique finds its application among different groups of surgeons\(^\text{[23]}\).

It is well known that the incidence of pancreatic leakage is higher in patients with a soft and normal pancreatic parenchyma because it is prone to develop parenchymal laceration from shear forces applied during tying of the sutures, especially while performing suturing on the posterior wall of the pancreas. In patients with normal pancreatic parenchyma, the incidence of leakage is 12% to 28\(^\%\), compared with 5% to 9\(^\%\) in those considered to have pancreatic fibrosis\(^\text{[24]}\). The efferent loop filled with bile and pancreatic juice also increases the shear force\(^\text{[25]}\). Some retrospective or prospective studies also suggested that technical modifications may reduce the leakage rate\(^\text{[26-28]}\), suggesting that if the pancreas is soft with a narrow duct, it would be more secure when the pancreaticojejunal anastomosis is intraluminal into the jejunum by invaginating the pancreatic stump.

Polypropylene mesh-reinforced pancreaticojejunostomy was developed based on the binding pancreaticojejunostomy described by Peng et al\(^\text{[29]}\), who reported a widely invaginated end-to-end anastomosis with ablated jejunal mucosa. Our procedure with single layer continuous sutures is less complicated than the binding pancreaticojejunostomy. The success of this technique may be due to the following four aspects. First, the mesh forms a safe “clothing” around the remnant pancreas for anchoring sutures, thus preventing the possibility of parenchymal laceration and bleeding from the sutures in soft pancreatic parenchyma caused by the suture. We identified the advantages of a new technique in the case where a secondary polypropylene MRP was received for leakage from the first operation site. During the second operation, the pancreatic parenchyma was severely edematous and fragile, making the direct suture impossible. However, it was easy and convenient to perform polypropylene MRP on this patient, and no leakage occurred postoperatively. Second, since the shape of the pancreatic stump can be modified and reduced by the mesh, it is more convenient to make an invagination. Third, the posterior single layer continuous sutures are simple and require less time. Fourth, it is very convenient to perform polypropylene MRP under different conditions and the time required is less than single end-to-end invagination. The mesh in the anastomosis can promote fibroblast attachment and enhance the anastomotic healing process\(^\text{[30,31]}\), however, it still needs further confirmation.

An ideal pancreaticojejunal anastomosis should be safe and convenient. Moreover, laparoscopy is more and more widely applied by general surgeons, and the convenience of a surgical procedure should be considered. The use of polypropylene MRP ensures a tight seal for any type of pancreatic stump regardless of the pancreas consistency, thus a more secure and reliable anastomosis can be obtained. The preliminary results are very encouraging. However, an appropriate prospective study in randomized patients is needed. Up to date, we have not observed any adverse effect of polypropylene MRP, but a long follow-up time is needed to confirm it.

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