Binding Pancreaticojejunostomy: How I Do It

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12.1 Introduction

Pancreatic leakage after pancreaticoduodenectomy (PD) is the main complication which contributes to prolonged hospitalization and increased costs significantly, even causing death. The incidence of pancreatic leakage of conventional pancreaticojejunostomy ranged from 9.9 to 28.5%, and the mortality due to pancreatic fistula was as high as 20–50% [1]. The efforts have been made to minimize the occurrence of this complication after PD. Bundles of techniques have been proposed for the reconstruction of pancreatic digestive tract continuity, while the best procedure is still controversial.

The leakage from a pancreatic digestive anastomosis can be developed at a site where the needle inadvertently penetrates the pancreatic ductule, or a suture cuts the fragile pancreatic parenchyma on suturing or on tying the knot. The minor leak of pancreatic juice gradually leads to a gross anastomotic leakage as a consequence of autodigestion around the anastomosis. Based on this hypothesis, we designed a novel technique of pancreatic digestive reconstruction, which was reported as intraseromuscular sheath pancreaticojejunostomy for the first time in 1996 [2]. Because of the substitution of suture with binding, this surgical technique has been named as binding pancreaticojejunostomy (BPJ) finally. [3, 4] Till 2003, 227 consecutive patients underwent using this technique; none of the cases developed a pancreatic anastomotic leak [5].

With the increasing of clinical applications and the development of surgical technique of binding pancreatic digestive reconstruction, we simplified the surgical procedure in 2002 [6, 7]. In 2003, the reliability of BPJ was verified by animal experiment [8]. In 2004, we evaluated the advantage of BPJ and the appropriate degree of tightness of binding from the view of tolerance pressure of the anastomotic stoma [9]. Considering to the disadvantage of BPJ, in 2009 we developed binding pancreaticogastrostomy [10]. In 2011, binding pancreatic duct-to-mucosa anastomosis [11] and end-to-side BPG was developed [12], respectively. Therefore a series of binding pancreatic digestive reconstructions have been developed, and the application is expanded depending on the characteristics of the pancreas, even in the laparoscopic surgery, while the rate of pancreatic anastomotic leak remains low [13, 14].

From 1996 up to now, a total of 172 publications have been searched via the Wanfang Data (Chinese database), Web of Science, and PubMed using the term "binding pancreaticojejunostomy," including Chinese and English.

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12.2 Surgical Procedure [4, 5, 15, 16]

12.2.1 Preparation of the Jejunum for Binding Anastomosis

The stump of the jejunum is everted for 3 cm; this can be achieved by suturing the jejunal cut edge to a site at the jejunum 6 cm from the edge (Fig. 12.1). Two such sutures are done and tied knots loosely, rendering 3 cm of the jejunum everted with its mucosa exposed, which then is destroyed by electric coagulation or by 10% carbolic acid and rinsed immediately with 75% alcohol and normal saline (Figs. 12.2 and 12.3).

12.2.2 Preparation of the Pancreatic Stump

The residual end of the pancreas is isolated for a length of 3 cm; usually two to three small branches of splenic vein (SV) between the pancreas and the splenic vein were divided and ligated. After the adequate isolation, the isolated pancreatic remnant can be lifted upward; thus the splenic artery and vein can be seen and separated by a small area of pancreas which is the point for fixing the posterior cut edge of the jejunum.

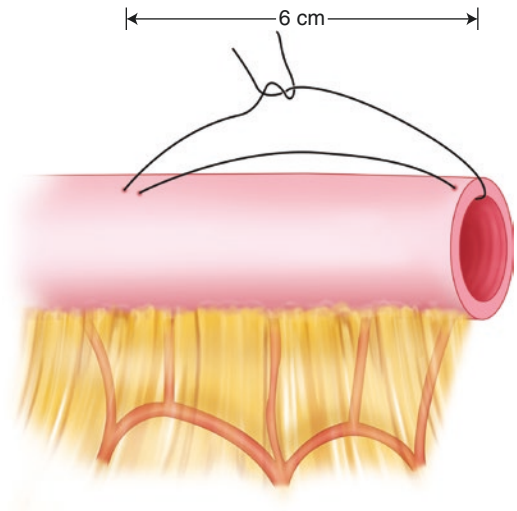

Fig. 12.1 The cut end of the jejunum is prepared for eversion

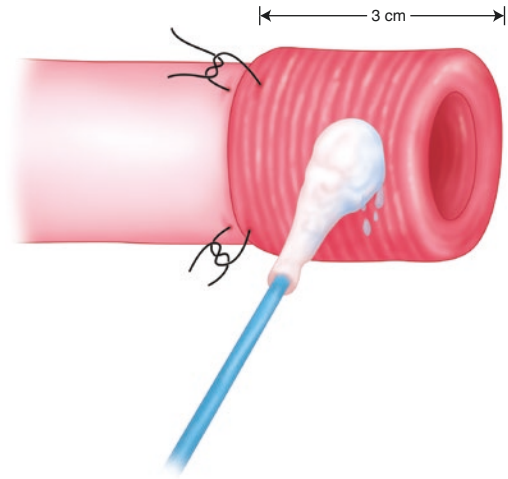

Fig. 12.2 The everted mucosa is daubed with 10% carbolic acid and rinsed immediately with 75% alcohol and normal saline

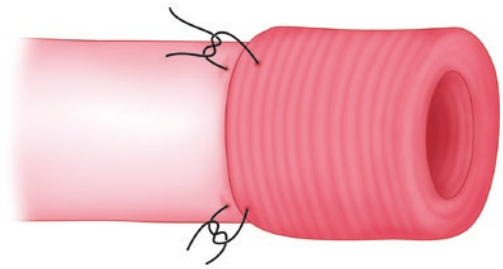

Fig. 12.3 A rim of intact mucosa is left for anastomosis

12.2.3 Two Stumps Sutured

The end of the residual pancreas and everted jejunum are brought together and sutured continuously or intermittently in a circular fashion; care is taken to suture the mucosa only and to avoid penetrating the muscular and serosa layers of the jejunum. The anterior or posterior lip of the pancreatic duct should be involved in the anterior or posterior row of sutures, respectively, whenever possible (Fig. 12.4).

12.2.4 Intussusceptions

The two sutures on the everted jejunum are removed before the everted jejunum stump is restored to its normal position, so as to wrap over the residual end of the pancreas. The cut end of the jejunum by a few stitches is fixed onto the pancreas. Special attention is paid to the posterior fixing point as mentioned above.

12.2.5 Binding

At 1.5–2 cm from the cut edge of the jejunum, a 3-0 absorbable tie is looped around the jejunum circumferentially together with the intussuscepted pancreas (Fig. 12.5). The tip of a hemostatic clamp can be passed underneath the binding ligature to verify the tightness. The blood supply to the jejunum distal beyond the binding ligature is ensured by preserving several vessels for that segment of jejunum. The thread for making the binding ligature is placed through a hole at the jejunal mesentery between the last two groups of vessels near the cut edge.

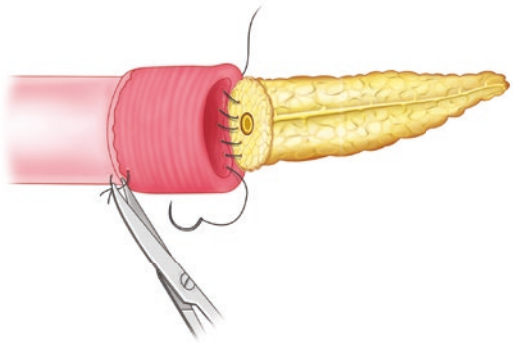

Fig. 12.4 Mucosa and muscularis mucosa of the jejunum are sutured to the cut end of the pancreas

12.2.6 Jejunostomy

When the anastomosis was finished, a catheter is inserted into the jejunum through the site where choledochojejunostomy is intended to be constructed, for injection of saline to test for a watertight closure. Jejunostomy through the defunctionalized loop with a catheter left in about 12 cm distal to the choledochojejunostomy is performed for decompression or X-ray study postoperatively.

12.2.7 Drainage

A Jackson-Pratt drainage tube is placed near the pancreatic digestive anastomosis. The volume and amylase content of the drainage fluid are measured on day 1 and 3 after operation. The definition of pancreatic leakage was used according to the International Study Group for Pancreatic Fistula (ISGPF), pancreatic fistula is defined as output via an operatively placed drain

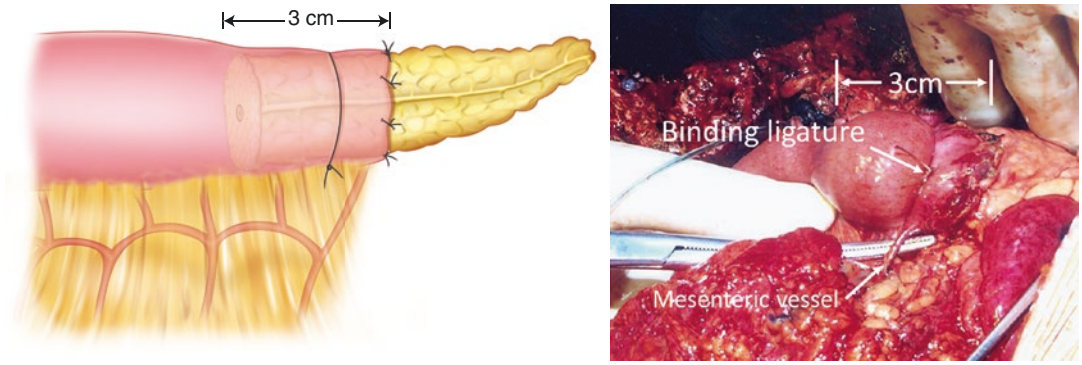

Fig. 12.5 The remnants of the pancreas in the lumen of the jejunum are looped and ligated together

(or a subsequently placed percutaneous drain) of any measureable volume of drain fluid on or after postoperative day 3, with an amylase content greater than 3 times the upper normal serum value [1].

12.3 Comment

Pancreaticojejunostomy anastomotic leak rate of 0% was reported at the initial series with BPJ technique [16]. Strictly speaking, pancreaticojejunostomy anastomotic leak rate should be referred to the grade B or grade C pancreatic fistula depending on the ISGPF. The mechanism of BPJ including (1) the sutures of jejuna is only limited to the jejunal mucosa, not different from traditional reconstruction which the whole layer of jejunal was sutured; thus, no possibility of needle hole leakage can be developed; this is called the first line of defense. (2) The jejunum mucosa which secretory function was destroyed is wrapped over the residual end of the pancreas; this close contact could accelerate the healing between the jejunum and the pancreas. Once the leakage was presented, like a circular defense line, a binding ligature can prevent the pancreatic juice from leaking on the gap between these two organs. (3) Beyond the binding ligature, one branch of mesenteric vessel to the jejunal cut end should be preserved so there would be enough blood supply for the anastomosis site. The 3 cm of remnant pancreas usually was isolated, the blood supply of the cut end of pancreas was also guaranteed, and the abundant blood supply for the jejunal and the remnant pancreas is the prerequisite of healing for pancreaticojejunostomy. [17] These three principles are the main mechanisms for BPJ compared with the traditional pancreaticojejunostomy.

One of the tricks of BPJ is how to define the tightness of the binding ligature by different surgeons. If the tie is too loose, the pancreatic juice is easy to leak from anastomosis site. If the tie is too tight, inadequate blood supply to the distal pancreas will be developed and easy to compress the pancreatic duct by tight ligature. Depending on the results of our previous animal study, the anastomosis for a watertight seal could be tested by instilling saline dyed with methylene blue at a pressure of 40 cmH_2O [9]. A dent of 1–2 mm can be preserved in the jejunum under the ligature, so the tip of a vascular clamp should be able to pass; close contact between the jejunum and the remnant pancreas can be developed, and ischemic necrosis due to being too tight was avoided. The results of animal experiments showed that no structure pancreatic duct can be formed by this level of tightness of binding ligature [18, 19].

In 2010, a French prospective study conducted by Bue reported a rate of pancreatic fistula of 8.9% including 45 sequential patients with soft pancreas and non-dilated main pancreatic duct using BPJ technique, which is lower than previously published by the same institution (17.6%) [20]. In addition, it is one of the lowest ever published when soft pancreatic parenchyma and non-dilated main pancreatic duct are involved. However, in the situation in which the diameter of cut edge of remnant pancreas and jejunum is not matched, it may be considered as a contraindication for BPJ. In 2011, Yang et al. from China reported a meta-analysis of randomized controlled trials with regard to the methods of reconstruction of pancreatic digestive continuity after PD [21]. In 2014, a Korean research group reported a lower rate of pancreatic fistula using BPJ than that of conventional pancreaticojejunostomy [22]. The results were not associated with the texture of the pancreatic parenchyma or dilatation of the pancreatic ducts. The above study supports and reproduces the excellent results of Peng's BPJ. In addition, BPJ is also a suitable procedure for patients without pancreatic duct dilatation.

Though none of the anastomosis techniques could be suitable to all kinds of pancreatic remnants and to avoid pancreatic fistula in the past 100 years' history of pancreatic digestive tract reconstruction. As a new technique, BPJ successfully decreased the rate of pancreatic anastomosis fistula. It is verified as a safe procedure for pancreatic anastomosis, especially in case of soft texture of the remnant pancreas. Similarly, like traditional pancreaticojejunostomy, expertise in surgical procedure, operation volume, and other management parameters are also important

factors for BPJ. In China, the practice by broad hospitals including teaching hospitals as well as primary hospitals provides the reliable results using BPJ [23, 24]. We concluded that BPJ is an easy technique for manipulation and popularization.

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