Inter-Anastomosis Drainage Tube Between the Pancreas and Jejunum: A Novel Technique for Preventing Pancreatic Fistula after Pancreaticoduodenectomy

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Pancreatic fistula (PF) after pancreaticoduodenectomy (PD) remains an unsolved surgical problem,[1,2] encountered at an unacceptably high rate (18.7% to 31.4%).[3,4] Once a PF has occurred, patients are constrained by the risk of lethal ruptured aneurysms[5] and prolonged hospital stays requiring intensive medical support and high expenditures.[6,7] Conventional approaches for preventing PF have focused mainly on stopping the outflow from 2 possible leak sources, including an insufficient main pancreatic duct (MPD) anastomosis and oozing from small openings of branched ducts at the parenchymal stump.[8] Even after more than 100 years of technical innovations and modifications,[9-13] pancreatic surgeons might have to accept that a substantial degree of PF is unavoidable, particularly when the normal soft pancreas is involved.[2] As long as forthcoming modifications to PD are based on the conventional methodology, it is unlikely that dramatic improvement in the prevention of PF will be achieved.

When we reconsider the mechanisms of PF genesis (Fig. 1), the initial step is most likely the collection of undesired outflowing pancreatic juice in the anastomotic space between the pancreatic stump and the jejunal serosal wall. Subsequently, the juice leaks into the extraperitoneal cavity (* in Fig. 1), establishing a PF. Conventional countermeasures for these pancreatic juice outflows have included placement of external peritoneal drainage tubes near the anastomotic site. Our original notion for preventing PF after PD was to eliminate the undesired pancreatic juice deposited at the anastomotic space, rather than stopping the outflow (Fig. 1).

We present here our preliminary experiences with a novel add-on method for Blumgart-type pancreatic anastomosis after PD, namely, the inter-anastomosis drainage (IAD) method, which involves simple placement of a single-suction drainage tube into the space between the pancreas and the jejunum during initial PD.

OPERATIVE PROCEDURES

The IAD method was performed by adapting a suction drainage tube (10 Fr BLAKE, Ethicon, code 2226) and placing the tip of the tube between the space between the cut pancreas margin and the jejunal wall via a transjejunal lumen root (Fig. 1). The channel part of the tube was originally in the shape of a "+" sign with 4 flaps; it was arranged into a thin and flat "I" shape by removing the anterior and posterior flaps. The length was adjusted to the width of the pancreatic parenchyma, usually 2.5 to 3.5 cm (Fig. 2). The IAD tube was placed so that the

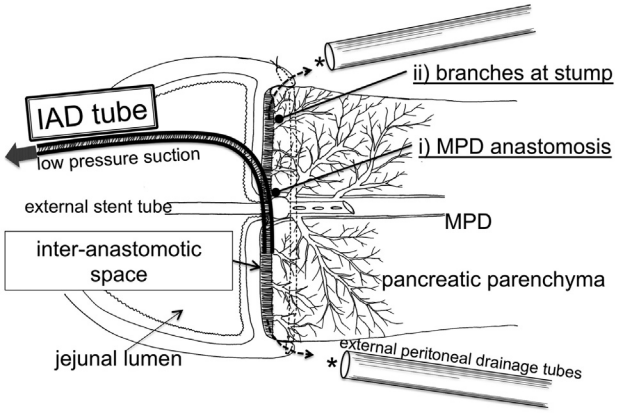

Figure 1. Transectional view of pancreaticojejunostomy. When undesirable pancreatic juice deposits at the inter-anastomotic space leakage into the extra-peritoneal cavity (*), pancreatic fistula occurs. The concept of the inter-anastomosis drainage (IAD) method was to extract the undesirable fluid at an early stage. MPD, main pancreatic duct.

Disclosure Information: Nothing to disclose.

Presented at the 68th General Meeting of the Japanese Society of Gastroenterological Surgery, Kohriyama, Japan, July 2014.

Received March 24, 2015; Accepted May 14, 2015.

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http://dx.doi.org/10.1016/j.jamcollsurg.2015.05.010
ISSN 1072-7515/15

Abbreviations and Acronyms

IAD = inter-anastomosis drainage
ISGPF = International Study Group on Pancreatic Fistulas
MPD = main pancreatic duct
PD = pancreaticoduodenectomy
PDS = polydioxanone
PF = pancreatic fistula
PODs = postoperative days

short-channel-suction part was located in the inter-anastomosis space between the pancreas and jejunum, the middle extension part was located in the inner lumen of the jejunum, and the distal end protruded from the end of the jejunal limb, which is commonly referred to as Witzel's end (Fig. 2).

Dorsal half of the modified Blumgart method and main pancreatic duct anastomosis

As shown in Figures 3, 4 and Video 1, our pancreatic reconstruction was a modified Blumgart method[14–16] because this method confers secure watertight sealing at the circumference of the pancreatic anastomosis, without parenchymal laceration to tie the knot. Three seromuscular horizontal mattress sutures, using double-armed 3-0 polydioxanone (PDS)-II, were placed posteriorly in a semicircle, with care taken to minimize the distance between the neighboring sutures (Fig. 3). Both needles of the double-arm were then inserted through the full thickness of the pancreatic parenchyma, from back to front and 1 cm from the cut margin. The central loop circulated through the MPD to bind the

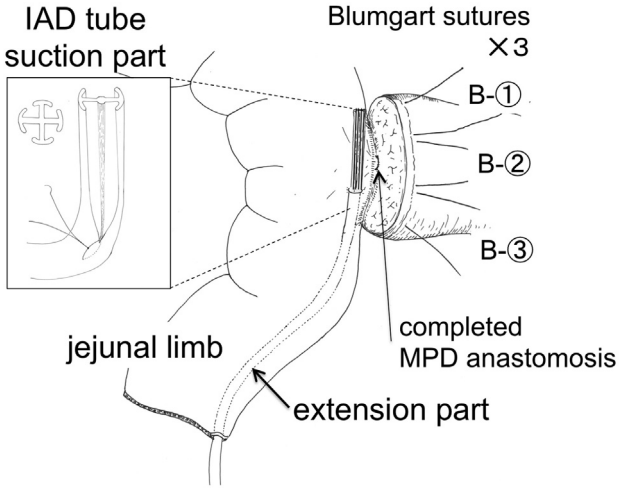

Figure 2. An outline of the inter-anastomosis drainage (IAD) method. After the dorsal half of the Blumgart sutures are made (B-1, B-2, B-3), the IAD tube is placed. MPD, main pancreatic duct.

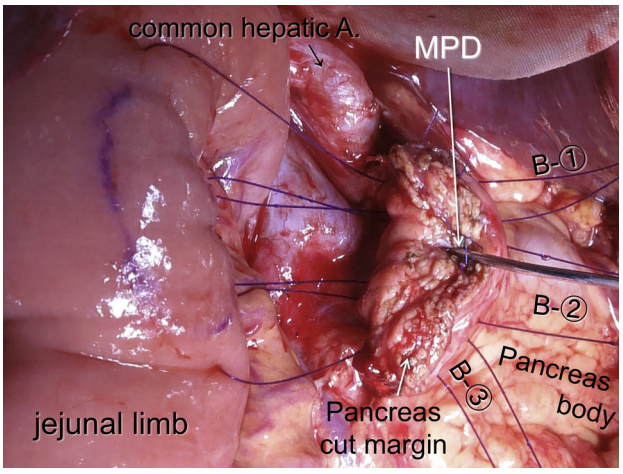

Figure 3. Intraoperative view of pancreaticojejunostomy using the modified Blumgart method plus an inter-anastomosis drainage tube. The first step is to place 3 Blumgart sutures (B-1, B-2, B-3). A, artery; MPD, main pancreatic duct.

MPD, supporting the MPD anastomosis by ensuring tight apposition. At this time, the MPD was anastomosed to the full thickness of the jejunal wall via our "quarter by four method," involving 4 secure knots (3, 6, 9, and 12 degrees) and 4 running sutures (double-armed 4-0 PDS-II), each accounting for 90 degrees of the circumference (Fig. 4). The modified Blumgart method is also useful for providing flexible handling space at the MPD anastomosis. A 6-Fr external stent tube (Akita Sumitomo Bake) was inserted into the MPD, and the opposite end protruded from the end of the jejunal limb, known as Witzel's end. When tying

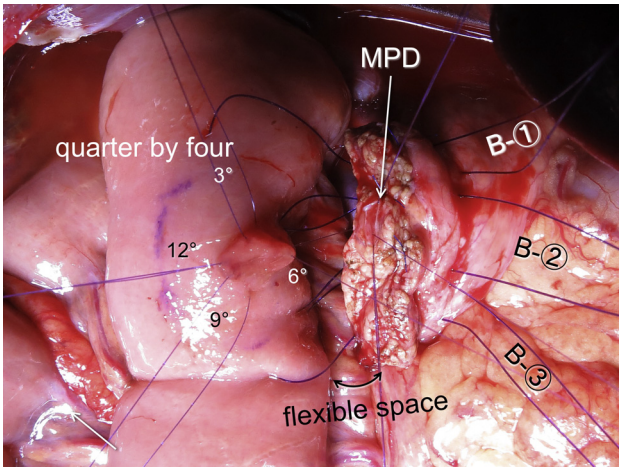

Figure 4. Intraoperative view of main pancreatic duct (MPD) anastomosis using our quarter-by-4 method, involving 4 secure knots (3, 6, 9, and 12 degrees) and 4 running sutures, each accounting for 90 degrees of the circumference. B-1, B-2, and B-3 are the 3 Blumgart sutures.