Pancreatic Disorders & Therapy
ISSN: 2165-7092

Chiba et al., Pancreat Disord Ther 2016, 6:3
DOI: 10.4172/2165-7092.1000174

Research Article Open Access

Efficacy of Modified Technique in Pancreatojejunostomy to Prevent Postoperative Pancreatic Fistula after Pancreatoduodenectomy

Naokazu Chiba*, **Motohide Shimazu, Masaaki Okihara, Toru Sano, Koichi Tomita, Kiminori Takano and Shigeyuki Kawachi**

Department Digestive and Transplantation Surgery, Tokyo Medical University, Hachioji Medical Center, Japan

***Corresponding author:** Naokazu Chiba, Department Digestive and Transplantation Surgery, Tokyo Medical University, Hachioji Medical Center, 1163 Tatemachi Hachioji, Tokyo 193-0998, Japan, Tel: +81-42-665-5611; Fax: +81-42-665-5639; E-mail: nchiba0632@yahoo.co.jp

Rec date: Jun 06, 2016, **Acc date:** Jun 22, 2016, **Pub date:** Jun 26, 2016

Abstract

Introduction: In pancreatoduodenectomy (PD), postoperative pancreatic fistula (POPF) remains the single most important cause of morbidity. We present a modification for duct to mucosa pancreaticojejunostomy.

Materials and Methods: Total 134 patients, who had undergone PD or pylorus preserving PD (PPPD) between November 2007 and October 2013 at our institution, were analyzed. From April 2012 to December 2014, 53 consecutive patients underwent PD or PPPD by the new modified technique and 81 patients by the former technique before March 2012. The preoperative demographics and clinical information were retrospectively obtained from both groups and were analyzed along with risk factors of POPF. Moreover, risk factors for POPF grade B/C were analysed by univariate and multivariate analysis.

Results: Operation procedures were pylorus preserving PD in 119 and PD in 15. Incidence of POPF grade B/C was 11% in the new method, which was significantly lower than in the former method (38%) (p=0.0135). Moreover, risk factors for POPF grade B/C in univariate analysis were texture of pancreas (p=0.0004), dilatation of pancreatic duct (p=0.0100), and anastomosis method (p=0.0135). In multivariate analysis, risk factors were texture of pancreas (p=0.0010) and anastomosis method (p=0.053).

Conclusions: The new technique in pancreticojejunostomy was safe and reliable with low POPF grade B/C rate.

Keywords: Pancreaticojejunostomy; Modified technique; Pancreatic fistula

Introduction

Since the first en bloc resection of the pancreas head and duodenum in 1898 by Codvilla, pancreatic surgery has undergone major modifications. Milestones by Kausch in 1909, Whipple in 1935, and Traverso in 1978 led to the pylorus-preserving pancreatoduodenectomy (PPPD), which is currently performed as a standard procedure [1-3]. Advances in perioperative management and surgical techniques have made PD a relatively safe surgical procedure, with a mortality rate lower than 5% [4]. However, morbidity is still high, between 30% and 50%. Postoperative pancreatic fistula (POPF) (5–29%) remains the single most important cause of morbidity, which can lead to prolonged hospitalizations, the need for repeated surgical interventions, and increased mortality rates [5]. The surgical technique is one improvable aspect that might reduce the pancreatic leakage rate after PD [6]. Several pancreatic anastomotic techniques have been proposed and tested, including end-to-side, with or without duct-to-mucosa anastomosis, end-to-end invagination and, arguably, anastomosis of the remnant pancreas with the stomach is an additional method, although it is still debated which of them has any clear advantage [7,8].

Pancreatojejunostomy has been the most commonly used method to restore pancreatoenteric continuity after PD. The main techniques to perform pancreatojejunal anastomosis are the invagination or "dunking" technique and the "duct-to-mucosa" anastomosis [9,10]. Many technical variations of the invagination technique exist, and they involve differences in the suture material, the number of layers, the number of sutures, running versus interrupted sutures, the binding versus the traditional suturing technique, and other modifications [11-13]. Moreover, it is also reported in a prospective randomized trial that external drainage of pancreatic duct with a stent reduced leakage rate of pancreatojejunostomy after PD [14]. Nevertheless, no consensus exists on which of these approaches represents the best way for reducing PF after PD. We present a modification for duct to mucosa end-to-side pancreatojejunostomy, with a seromuscular jejunal flap, in order to prevent POPF. In addition, we compared the operative and postoperative outcomes between new method and historical matched control and analyzed risk factors for POPF grade B/C.

Methods

Total 134 patients, who had undergone PD or PPPD between November 2007 and December 2014 at our institution by the same surgical team, were retrospectively analyzed. During the period April 2012 to December 2014, 53 consecutive patients underwent PD or PPPD by the new technique. 81 patients were underwent PD or PPPD by the former technique before March 2012. The following preoperative demographics and clinical information were retrospectively obtained from both groups' medical records and were analyzed along with risk factors of POPF: age, sex, underlying diseases, operative procedures, operative time, transfusion requirements, etc.

Same group of surgeons performed the former and modified pancreatojejenostomy procedure.

New surgical technique

In this report, we describe a new pancreatojejunostomy technique that has been in use since April 2012. Basically, the pancreatojejunostomy procedure can be separated into a duct-to-mucosa pancreatojejunostomy and an anastomosis between the pancreatic parenchyma and jejunum.

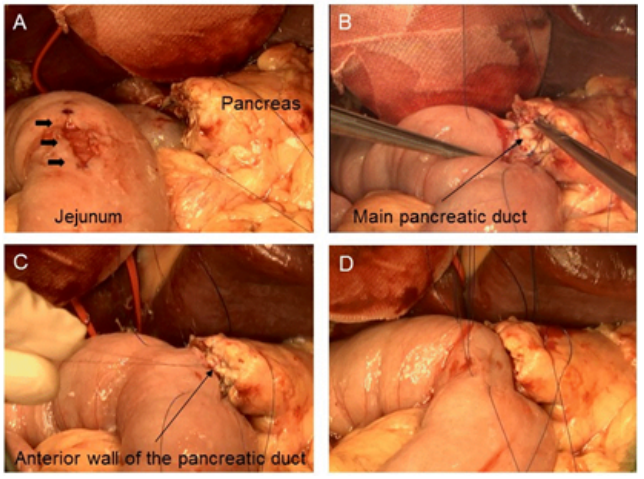

Figure 1: A) An incision is made on the serosa at the planned location of the jejunal anastomosis (arrows), up to the muscularis, with a width that is tailored to that of the pancreatic arenchyma. B) In duct-to-mucosa pancreaticojejunostomy, the anastomosis between the posterior wall of the pancreatic duct and jejunal mucosa is performed without initially creating a small opening in the jejunum. C) A small opening is created in the jejunum, and the anterior wall of the pancreatic duct and the jejunal mucosa are anastomosed together. D) In the anastomosis between the pancreatic parenchyma and jejunum, two needles in the caudal part of the head are tightly sutured with all the layers of the pancreatic parenchyma, whereas for the others, adhesive anastomosis was performed with two layers of the anterior and posterior walls of the pancreatic parenchyma.

First, an incision is made on the serosa at the planned location of the jejunal anastomosis, up to the muscularis, with a width that is tailored to that of the pancreatic parenchyma (Figure 1A). In duct-to-mucosa pancreatojejunostomy, the anastomosis between the posterior wall of the pancreatic duct and jejunal mucosa is performed without initially creating a small opening in the jejunum (Figure 1B); thereafter, a small opening is created in the jejunum, and the anterior wall of the pancreatic duct and the jejunal mucosa are anastomosed together (Figure 1C). In the anastomosis between the pancreatic parenchyma and jejunum, two needles in the cranial and caudal part of the head are tightly sutured with all the layers of the pancreatic parenchyma, whereas for the others, adhesive anastomosis was performed with two layers of the anterior and posterior walls of the pancreatic parenchyma (Figure 1D). Pancreatic duct drainage is usually performed using the incomplete drainage method. With regard to the pancreatic duct tube, lost tubes have been used only in patients with a cirrhotic pancreas and main pancreatic duct dilatation since April 2012. However, before April 2012, procedures involving the use of lost tubes have been generally performed.

The differences of the new method from the earlier anastomosis methods are as follows:

1) In duct-to-mucosa pancreaticojejunostomy, the timing of the creation of a small opening in the jejunum is different. In the conventional method, a small opening was first created in the jejunum, and then the pancreatic duct and the jejunal mucosa were anastomosed. In the new method implemented since April 2012, the posterior wall is first anastomosed and a small opening is created before the anterior wall of the pancreatic duct is anastomosed to the jejunal mucosa. 2) In the new method, the anastomosis is preceded by an incision of the jejunal serosa and opening of the muscle layer. 3) The anastomosis between the pancreatic parenchyma and jejunum had previously been performed by creating an adhesive anastomosis between the pancreatic parenchyma and jejunum; however, since April 2012, the procedure consisted of an adhesive anastomosis with all the layers of the pancreatic parenchyma with two needles on the caudal side of the head, and with two layers of the anterior and posterior walls of the pancreatic parenchyma for all the others.

Standard postoperative care

Amylase level was monitored daily in the serum and in the intraoperatively-placed abdominal drains on the first and fourth postoperative day. Computed tomography was performed on the fourth postoperative day. In the absence of signs of POPF, abdominal drains were removed and oral food intake was begun on the seventh postoperative day.

The diagnosis of a POPF was based on the definition of the International Study Group on Pancreatic Fistula (ISGPF) [15]. In this study, According to the ISGPF definitions, grades B and C fistulas were considered as POPF.

Statistical analysis

Data was expressed as mean (SD). Statistical calculations were performed using SPSS (version 13.0 for Windows; SPSS, Inc). Comparisons between groups were tested using the Pearson χ^2 test. For continuous variables, independent samples t-test was used to compare the 2 groups. Odds ratios were used to estimate relative risk for POPF. Logistic regression was used for univariate analysis, while multiple logistic regression analysis was used for multivariate analysis. For multivariate analysis, variables possibly significant ($p<0.05$) on univariate analysis were evaluated. P values less than 0.05 were considered significant.

Results

Clinical characteristics

The indications for operation were: adenocarcinoma of the head of the pancreas in 78 patients, distal bile duct cancer in 29, and the other tumor in 27 (Table 1). The median duration of the operation was 455 (337-810) minutes in the former technique group and 420 (270-595) minutes in the new technique group. The median blood loss was respectively 728 (140-2330) mL and 420 (50-1600) mL. The postoperative complication grade B/C POPF occurred in 31 patients

(38%) in the former technique group and 6 patients (11%) in the new technique group.

Clinical factors	Former technique n=81	Modified technique n=67	p-value
Age	Median 72 (27-28)	Median 72 (54-81)	0.7868
Gender Female Male	28 (34%) 53 (66%)	37 (55%) 30 (45%)	0.0368
Disease Pancreatic carcinoma Cholangiocarcinoma Others	46 (56%) 21 (27%) 14 (17%)	38 (57%) 15 (22%) 14 (21%)	0.1029
Texture of Pancreas Firm Soft	48 (59%) 33 (42%)	29 (43%) 38 (57%)	0.1377
Diameter of pancreatic duct <3.0 mm >3.0 mm	32(40%) 49 (60%)	35(52% 32(48%)	0.1289
Neoadjuvant Chemotherapy No Yes	78(96%) 3(4%)	64(97%) 3 (3%)	0.6679
Surgical Data PD/PPPD Operation time Operation blood loss Need transfusion Combined vasucular resection	13 (16%)/68(84%) Median 455(337-810) Median 728 (140-2330) 27 (33%) 24 (30%)	3 (3%)/64(97%) Median 420 (270-595) Median 400 (50-1600) 13 (19%) 15 (22%)	0.0544 0.0542 0.1856 0.9683 0.4819
POPF Grade B Grade C	22(27%) 9(11%)	5 (7%) 1 (1%)	0.0135

Table 1: Clinical factors between former techniques and modified technique

No differences were noted in age, sex, lying disease and neoadjuvant chemotherapy between the two groups without PD or PPPD procedure (Table 2). And the two groups were not statistically different for operation-related factors, including texture of pancreas, diameter of pancreatic duct, operative time, operative blood loss, need for transfusion, combined vascular resection. New method group (those who underwent new surgical technique of pancreatojejunostomy) had a significantly lower incidence of pancreatic fistula over grade B (P=. 00135). Pancreatic fistulas over grade B occurred in 31 of 81 patients (38%) in the former method group and in 6 of the 53 patients (11%) in the new method group. No statistically significant difference was noted in the occurrence of other complications except pancreatic fistula between the two groups (data not shown).

Identification of prognostic risk factors for POPF

In a logistic regression univariate analysis, soft pancreas (P=0.0004), diameter of pancreatic duct<3.0 mm (P=0.0100), and new method of pancreaticojejunostomy (P=0.0135) were identified as prognostic risk factors for POPF (Table 2). Other factors such as patient gender, age, neoadjuvant chemotherapy, operative time, operative blood loss, need for transfusion, and combined vascular resection were not significantly correlated with the incidence of POPF. And in a multivariate analysis, new surgical technique (OR=0.099, 95%CI=0.020 – 0.503, p-value=0.0053) were identified as prognostic risk factors for POPF (Table 3).

Variables	Odds ratio	95%CI	p-value
Age	0.978	Median 0.953-1.047	0.9588
Gender Female Male	1 1.301	0.555-3.050	0.5452
Texture of Pancreas Firm Soft	1 5.314	2.119-13.328	0.0004
Diameter of pancreatic duct <3.0 mm >3.0 mm	1 3.147	1.316-7.525	0.0100
Neoadjuvant Chemotherapy No Yes	1 0.001	<0.001	0.9698
PD/PPPD PD PPPD Operation time (min) Operation blood loss (g)	1 1.715 0.998 1.001	0.444 - 6.621 0.994- 1.003 1.000- 1.002	0.4337 0.4759 0.1340
Need transfusion NO Yes	1 0.759	0.287- 2.010	0.5792
Surgical technique Former Modified	1 0.155	0.034- 0.704	0.0135

Table 2: Risk factors for POPF by univariate analysis

Variables	Odds ratio	95%	P-value
Texture of pancreatic	8.721	2.387- 31.854	0.0010
Diameter of pancreatic duct	0.956	0.020-0.503	0.9441
Surgical techniques	0.099	0.020-0.503	0.0053

Table 3: Risk Factors for POPF by multivariate analysis

Discussion

In the pancreaticojejunostomy, several technical variations have been proposed, in an effort to minimize postoperative pancreatic fistula rates [16-18]. Postoperative pancreatic fistula (POPF) is the most common and severe complication after PD, and its incidence varies widely in the reported series, between 2% and over 31%. Because POPF may strongly associate with other complications and affect the short- and long-term outcomes, an uncomplicated course is particularly important for the patients who undergo PD or PPPD [19,20]. The most important risk factors identified are technique, soft pancreatic texture and main pancreatic duct diameter of 3 mm or less [21-23]. In this report, we describe a new pancreaticojejunostomy technique that has been in use since April 2012. Basically, the pancreaticojejunostomy procedure can be separated into a duct-to-mucosa pancreaticojejunostomy and an anastomosis between the pancreatic parenchyma and jejunum. Advantages of the new methodas follows; 1) Duct-to-mucosa pancreaticojejunostomy allows for a posterior wall anastomosis by facilitating the achievement of a reliable anastomosis between the pancreatic duct and jejunal mucosa by avoiding the need for the creation of a small opening in the jejunum—if the anastomosis is performed after creating a small opening, the jejunal mucosa may prolapse outside the serosa, making the anastomosis possibly difficult to achieve. Nevertheless, all of this can be prevented using the new method. 2) By making an incision in advance in the jejunal mucosa at the site of the planned anastomosis, a duct-to-mucosa pancreaticojejunostomy can be achieved without applying excessive tension. When the pancreatic duct and all the layers of the jejunum are anastomosed, the excessive tension exerted by the jejunal serosa on the anastomotic site can be prevented. 3) In the anastomosis between the pancreatic parenchyma and jejunum, the adhesion intensity can be strengthened by attaching two needles on the caudal side of the head to all the layers of the pancreatic parenchyma. In addition, damage to the main pancreatic duct can be prevented by creating an adhesive anastomosis between the pancreatic parenchyma around the main pancreatic duct, and anterior and posterior walls. 4) In the pancreatic duct drainage method, it remains controversial whether an external drainage or a lost tube should be chosen; however, in the present study, the lost tube was used only in the patients with a cirrhotic pancreas and main pancreatic duct dilation.

Based on clinical relevance, POPFs were classified as grade A, B, or C. Our study reflected the results of the retrospective clinical data; pancreatic fistulas over grade B occurred in 31 of 81 patients (38%) in the former method group and in 6 of the 53 patients (11%) in the new method group, which underlines the severe influence of "soft" pancreatic tissue on postoperative outcome. Other clinical and surgical factors that have been reported to correlate with the POPF rate include age>65 years, preoperative jaundice, operation time, amount of intraoperative blood loss, and intraoperative transfusion of erythrocyte concentrates [24,25]. In our study, soft pancreas and new method were identified by multivariate analysis as single prognostic risk factors for POPF.

Several limitations affect the interpretation of the present findings. This study was based on a retrospective analysis in a single center and a small number of patients were included. In conclusion, this modified new technique appears to be safe and reliable. Because this is a preliminary report of a small series, it is of essential importance that it is evaluated via a prospective study in a larger series, before firm conclusions can be drawn.

Ethics Approval

Collecting of the retrospective data from patients was approved by Tokyo Medical University Ethics Committee.

References

1. Crist DW, Cameron JL (1992) The current status of the Whipple operation for periampullary carcinoma. Adv Surg 25: 21-49.
2. Glanemann M, Bahra M, Neuhaus P (2008) Pylorus-preserving pancreatic head resection: a new standard for tumors. Chirurg 79: 1107-1114.
3. Whipple AO, Parsons WB, Mullins CR (1935) Treatment of carcinoma of the ampulla of Vater. Ann Surg 102: 763-779.
4. Govindarajan A, Tan JC, Baxter NN, Coburn NG, Law CH (2008) Variations in surgical treatment and outcomes of patients with pancreatic cancer: A population-based study. Ann Surg Oncol 15: 175-185.
5. Butturini G, Marcucci S, Molinari E, Mascetta G, Landoni L, et al. (2006) Complications after pancreaticoduodenectomy: The problem of current definitions. J Hepatobiliary Pancreat Surg 13: 207-211.
6. Adams DB (2009) The pancreatic anastomosis: The danger of a leak, which anastomotic technique is better? J Gastrointest Surg 13: 1182-1183.
7. Lee SE, Yang SH, Jang JY, Kim SW (2007) Pancreatic fistula after pancreaticoduodenectomy: A comparison between the two pancreaticojejunostomy methods for approximating the pancreatic parenchyma to the jejunal seromuscular layer: Interrupted vs. continuous stitches. World J Gastroenterol 13: 5351-5356.
8. Nguyen JH (2008) Distinguishing between parenchymal and anastomotic leakage at duct-to-mucosa pancreatic reconstruction in pancreaticoduodenectomy. World J Gastroenterol 14: 6648-6654.
9. Bassi C, Falconi M, Molinari E, Mantovani W, Butturini G, et al. (2003) Duct-to-mucosa versus end-to-side pancreaticojejunostomy reconstruction after pancreaticoduodenectomy: Results of a prospective randomized trial. Surgery 134: 766-771.
10. Lermite E, Pessaux P, Brehant O, Teyssedou C, Pelletier I, et al. (2007) Risk factors of pancreatic fistula and delayed gastric emptying after pancreaticoduodenectomy with pancreaticogastrostomy. J Am Coll Surg 204: 588-596.
11. Peng S, Mou Y, Cai X, Peng C (2002) Binding pancreaticojejunostomy is a new technique to minimize leakage. Am J Surg 183: 283-285.
12. Peng SY, Wang JW, Lau WY, Cai XJ, Mou YP, et al. (2007) Conventional versus binding pancreaticojejunostomy after pancreaticoduodenectomy: A prospective randomized trial. Ann Surg 245: 692-698.
13. Kleespies A, Albertsmeier M, Obeidat F, Seeliger H, Jauch KW, et al. (2008) The challenge of pancreatic anastomosis. Langenbecks Arch Surg 393: 459-471.
14. Poon RT, Fan ST, Lo CM, Ng KK, Yuen WK, et al. (2007) External drainage of pancreatic duct with a stent to reduce leakage rate of pancreaticojejunostomy after pancreaticoduodenectomy. A prospective randomized trial. Ann Surg 246: 425-435.
15. Bassi C, Butturini G, Molinari E, Mascetta G, Salvia R, et al. (2004) Pancreatic fistula rate after pancreatic resection. The importance of definitions. Dig Surg 21: 54-59.
16. Cameron JL, Riall TS, Coleman J, Belcher KA (2006) One thousand consecutive pancreaticoduodenectomies. Ann Surg 244: 10-15.
17. Hilal MA, Malik HZ, Hamilton-Burke W, Verbeke C, Menon KV (2009) Modified Cattell's pancreaticojejunostomy, buttressing for soft pancreases and an isolated biliopancreatic loop are safety measurements that improve outcome after pancreaticoduodenectomy: a pilot study. HPB (Oxford) 11: 154-160.
18. Birkmeyer JD, Siewers AE, Finlayson EV, Stukel TA, Lucas FL, et al. (2002) Hospital volume and surgical mortality in the United States. N Engl J Med 346: 1128-1137.
19. Callery MP, Pratt WB, Vollmer CM Jr (2009) Prevention and management of pancreatic fistula. J Gastrointest Surg 13: 163-173.

20. Schmidt CM, Choi J, Powell ES, Yiannoutsos CT, Zyromski NJ, et al. (2009) Pancreatic fistula following pancreaticoduodenectomy: Clinical predictors and patient outcomes. HPB Surg 404: 5-20.
21. Butturini G, Daskalaki D, Molinari E, Scopelliti F, Casarotto A, et al. (2008) Pancreatic fistula: definition and current problems. J Hepatobiliary Pancreat Surg 15: 247-251.
22. Van Berge Henegouwen MI, De Wit LT, Van Gulik TM, Obertop H, Gouma DJ (1997) Incidence, risk factors, and treatment of pancreatic leakage after pancreaticoduodenectomy: drainage versus resection of the pancreatic remnant. J Am Coll Surg 185: 18-24.
23. Yeo CJ, Cameron JL, Lillemoe KD, Sauter PK, Coleman J, et al. (2000) Does prophylactic octreotide decrease the rates of pancreatic fistula and other complications after pancreaticoduodenectomy? Results of a prospective randomized placebo-controlled trial. Ann Surg 232: 419-429.
24. Golub R, Golub RW, Cantu R Jr (1997) A multivariate analysis of factors contributing to leakage of intestinal anastomoses. J Am Coll Surg 184: 364-372.
25. Lerut JP, Gianello PR, Otte JB, Kestens PJ (1984) Pancreaticoduodenal resection. Surgical experience and evaluation of risk factors in 103 patients. Ann Surg 199: 432-437.