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A Prospective Analysis of the Factors Influencing Pancreaticojejunostomy Performed Using a Single Method, in 100 Consecutive Pancreaticoduodenectomies

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Abstract: The factors influencing the healing process of pancreaticojejunostomy (P-J) following pancreaticoduodenectomy (PD) are still ill defined, allowing the recommendation of various anastomotic methods. We conducted a prospective study to determine the risk factors influencing the protracted healing of P-J, examining 100 consecutive patients who underwent PD followed by P-J, performed as an end-to-side "mucosa-to-mucosa" anastomosis using vertical mattress sutures (VMS method). Protracted healing of P-J was classified as either peripancreatic sepsis (PPS), defined as prolonged suppurative discharge of less than 50 ml a day from the drain beneath the P-J for more than 1 week; or a pancreatic fistula (PF), defined as prolonged discharge of more than 50 ml a day with a high amylase content (>1000 IU) for more than 1 week. There were 80 patients with a malignant neoplasm, and 20 with benign disease. The overall incidence of healing problems following P-J was 9%, which included 6 patients (6%) with PPS and 3 (3%) with PF. Apart from an advanced age of more than 70 years, none of the patients' characteristics or postoperative complications influenced the healing of P-J. The type of reconstruction, an anastomotic stent, the duct size, and a "soft" pancreas were not risk factors either. In conclusion, no factors, apart from the age or any special problem of an individual patient, influenced the dehiscence of P-J when the VMS method was used after PD.

Key Words: pancreaticoduodenectomy, pancreaticojejunostomy, vertical mattress sutures, pancreatic fistula, anastomotic leak

Introduction

Recent advances in pancreatic surgery have rendered pancreaticoduodenectomy (PD) a safe operation with a very low mortality rate,[1,2] but complications arising from pancreaticojejunostomy (P-J) following PD remain a major source of morbidity. According to recent reports, the incidence of leakage of the pancreatic anastomosis after PD is high at between 6.3%[3] and 19%,[2,4] compared with the incidence of any other anastomosis in the abdominal surgical field. A number of methods of performing the pancreaticodigestive anastomotic procedure following PD have been proposed since this operation was first successfully carried out and popularized about 50 years ago.[5] Various authors have also suggested that an anastomotic leak after PD is related to a small pancreatic duct and a "soft" or normal pancreas,[5,6] large operative blood loss,[6] age, and jaundice.[7] Some authors have recommended alternating anastomotic methods according to the caliber of the pancreatic duct[5,8] or the condition of the pancreatic parenchyma, whether it is "soft" or "hard."[1,9,10] However, there have been no reports evaluating the risk factors associated with anastomotic healing in consecutive patients undergoing P-J with one single method.

The importance of the submucosal layer in promoting healing of the anastomoses of the digestive tract has been emphasized by Gambee[11] and others. Embracing this fundamental concept, in 1972 we designed a method of "mucosa-to-mucosa" anastomosis using vertical mattress stitches in the P-J,[12] which ensured contact fusion of the submucosal layer of the jejunum and the pancreatic duct. We subsequently demonstrated clinically that end-to-side "mucosa-to-mucosa," P-J using this vertical mattress suture (VMS) method, resulted in a lower frequency of anastomotic leakage than other conventional procedures.[13] Studying the healing process of the VMS method in dogs, we observed that fusion of the epithelia of the jejunal mucosa and the pancreatic duct took only a couple of weeks, whereas another method took more time.[14]

Since 1981, we have prospectively studied 100 consecutive cases to determine the risk factors associated

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with the healing process of P-J using a single method, namely the VMS method, following PD.

Materials and Methods

Patients

Between July 1981 and May 1996, 100 consecutive patients underwent PD at Tenri Hospital, Nara, Japan. P-J was performed following pancreaticoduodenal resection using one single method employing vertical mattress sutures (the VMS method) in all patients. The operations were performed by 12 expert abdominal surgeons who had specialized in gastrointestinal surgery for more than 4 years. All surgeons were allowed to choose the type of reconstruction and use an internal or external stent tube through the anastomosis.

Most of the patients were postoperatively nourished with peripheral parenteral nutrition (PPN) including a fat emulsion,[15] then allowed oral intake within less than 2 weeks. If the fasting period was prolonged for more than 2 weeks due to any complication, they were commenced on total parenteral nutrition (TPN).

We prospectively recorded the following data in each patient.

Preoperative Data
This included the characteristics of the patients, laboratory data including the serum albumin and total bilirubin levels, and whether or not any preoperative biliary decompression, such as endoscopic biliary drainage, percutaneous transhepatic biliary drainage, or T-tube drainage had been performed.

Operative Data
This included the operation time, estimated blood loss, transfusion details, combined resection of other organs, consistency of the pancreas, caliber of the pancreatic duct at the anastomotic site, type of reconstruction, whether an anastomotic stent had been used, and intraoperative irradiation employed after 1992.

Postoperative Data
This included the incidence of complications, outcome, and the length of hospital stay.

We focused particular attention on the protracted healing of P-J in all patients. The protracted healing of P-J was divided into peripancreatic sepsis (PPS) and pancreatic fistula (PF). PPS and PF were clinically defined as prolonged suppurative discharge less than 50 ml a day with a low amylase level of less than 1 000 IU, from a drain beneath the P-J site, for more than 1 week; and as prolonged discharge of more than 50 ml a day with a high amylase level of more than 1 000 IU, for more than 1 week, respectively.

Procedure of Pancreaticojejunostomy

The pancreaticojejunal anastomosis used in this procedure is of the end-to-side type. Following en bloc resection of the head of the pancreas, duodenum, choledochus, and gallbladder with or without the distal stomach, for standard or pylorus-preserving PD, respectively, the anastomosis is begun. Prior to performing the anastomosis, bleeding from the cut end of the pancreas must be completely controlled. The posterior cut border of the pancreas is sutured to the posterior wall of the jejunum with interrupted stitches of 4-0 atraumatic fine silk.

A small opening is made in the jejunum opposite to the pancreas to fit the pancreatic duct in size. The first mattress suture is then placed along the posterior row of the anastomosis: at the center of the posterior row of the jejunal orifice, an atraumatic needle equipped with 5-0 fine silk suture is passed from inside the lumen through the full thickness of the jejunal wall and brought out from the jejunal serosa (Fig. 1). The needle is then thrust at a point 5 mm away from the edge of the pancreatic duct, passed through the pancreatic parenchyma, and brought out of the lumen of the duct. Finally, the needle is passed through the ductal cut edge

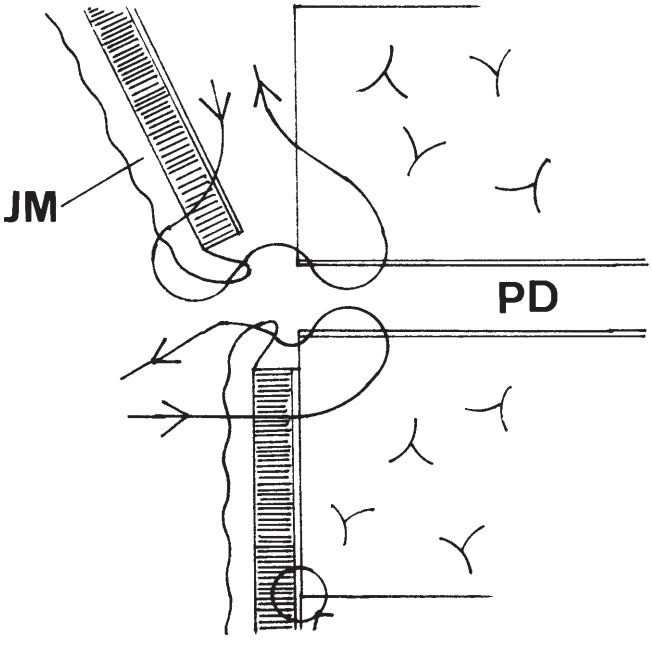

Fig. 1. The procedure used for pancreaticojejunostomy. The posterior cut border of the pancreas is sutured to the posterior seromuscular layer of the jejunum with interrupted stitches of 4-0 atraumatic fine silk. The schema shows the stitches along the posterior and anterior rows of the anastomosis using vertical mattress sutures for the "mucosa-to-mucosa" stitch. *JM*, jejunal mucosa; *PD*, pancreatic duct

and the free margin of the jejunal mucosa near the first insertion site of the needle.

In most cases, the sutures are left untied and grasped with mosquito forceps. All six or eight vertical mattress stitches are radially placed. Along the anterior row of anastomosis sutures, the needle is allowed to pass from the serosal surface of the jejunum into the lumen and then through the edge of the mucosa of the jejunum, the pancreatic duct, and pancreatic parenchyma, as shown in Fig. 1.

Before typing the first suture, the free end of the intraductal siliconized tube is inserted into the intestinal lumen, if a stent tube is to be used. After tying all the stitches, the anastomosis is completed by suturing the anterior jejunal wall to the remaining cut border of the pancreas in the same manner as for the posterior wall.

Statistics

Metric values are expressed as the mean and standard deviation (SD). Comparisons within groups were performed by a one-way analysis of variance followed by Scheffe's multicomparison method between the groups. Student's *t*-test was used to compare the differences of means between two groups. To test whether there was a significant trend in the incidence of anastomotic problems (PPS or PF) between two or more groups, the $2 \times k$ contingency table with the chi-square test was used. A *P*-values were two-tailed, with statistical significance indicated by a value of $P < 0.05$. All statistical calculations were performed using the SPSS package (SPSS for Macintosh, version 6.1).

Results

Patient Characteristics

Of the 100 patients, 65 were men (65%) and 35 were women (35%) with a median age of 62 years, ranging from 25 to 79 years. The causative diseases were pancreatic head carcinoma in 31 patients, bile duct carcinoma in 22, periampullary carcinoma in 15, cystic tumor of the pancreas in 13, gastric carcinoma in 6, chronic pancreatitis in 5, duodenal carcinoma in 4, colon cancer with involvement of the duodenum in 2, carcinoid tumor of the pancreatic head in 1, and perforated radiation duodenitis in 1. Of the 100 patients, 80 had malignant neoplasms and 20 had benign diseases; 35 of whom had significant concomitant diseases, as shown in Table 1, the most notable of which was diabetes mellitus seen in 16 patients. Hypoalbuminemia, defined as a serum albumin level of less than 3.5 g/dl, was found in 39 patients, and hyperbilirubinemia, defined as a serum bilirubin level of more than 0.8 mg/dl, was found in 65 patients. Before PD, 43 patients had undergone biliary drainage procedures, including percutaneous transhepatic in 23 patients, endoscopic retrograde in 17 patients, and operative T-tube in 3 patients.

Table 1. Characteristics of the patients undergoing pancreaticoduodenectomy

Age (years) (range)	60.4 ± 11.0 (25–79)
Sex (M/F)	65/35
Diagnosis (*n*)	
Adenocarcinoma	
Pancreas	31
Common bile duct	22
Papilla of Vater	15
Stomach	6
Duodenum	4
Colon	2
Cystic tumor	13
Chronic pancreatitis	5
Miscellaneous	2
Serum total bilirubin (mg/dl) (range)	4.1 ± 5.0 (0.3–24.6)
Serum albumin (g/dl) (range)	3.6 ± 0.6 (2.2–4.8)
Concurrent diseases (*n*)	
Diabetes	16
Cardiovascular	5
Hypertension	3
Other malignancies	2
Steroid therapy	2
Chronic hepatitis	2
Grave's disease	1
Idiopathic thrombocytic purpura	1
Cholecystolithiasis	1
Schizophrenia	1
Previous operation for (*n*):	7
lung disease	3
stomach diseases	2
other diseases	2
None	65

Operative Data

The pylorus preservation method was used in 6 patients, whereas standard PD with partial gastric resection was performed in 94 patients. Other organs were concurrently resected in 16 patients as combined resection of the portal vein or superior mesenteric vein in 7 patients, the colon in 7, the left lobe of the liver in 1, and a kidney in 1. The types of reconstruction employed were Cattell's method and its modification in 47 patients, Child's method in 43, Whipple's method in 8, and the Roux-en-Y method in 2, all of which are described in Fig. 2. An indwelling internal stenting tube through the anastomosis was used in 30 patients, and an external stenting tube was used in 17 patients. A stenting tube was not inserted in 53 patients. The median period of experience of the operating surgeons was 11 years, with

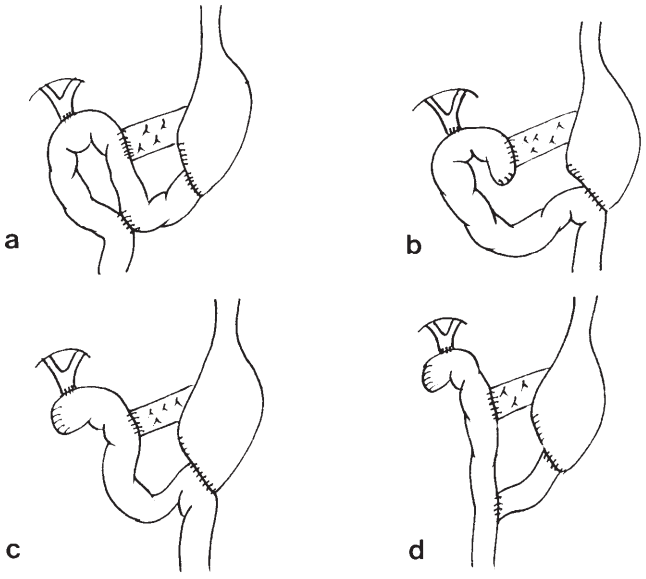

Fig. 2. Reconstructive methods after pancreaticoduodenectomy. **a** Cattell's method; **b** Child's method; **c** Whipple's method; **d** Roux-en-Y method

Table 2. Complications after pancreaticoduodenectomy

Complications	Number of patients
Complications concerning operative procedures	
P-J anastomotic problems	9
Peripancreatic sepsis	6
Pancreatic fistula	3
Cholangitis	7
Wound infection or dehiscence	5
Intestinal obstruction	2
Prolonged gastric emptying	2
Hepatic abscess	1
Bleeding from J-J anastomosis	1
Stenosis of G-J anastomosis	1
Pancreatitis	1
Lymphorrhea	1
Systemic complications	
Enterocolitis	5
Respiratory disorders	5
Urinary infection	4
Cerebral infarction	2
Catheter fever	1
Liver dysfunction	1
Postoperative delirium	1
None	60

P-J, pancreaticojejunal; J-J, jejunojejunal; G-J, gastrojejunal

a range of 4 to 26 years. The operative time ranged from 215 min to 820 min, with a mean time of 438 min, and the estimated blood loss ranged from 288 ml to 8845 ml, with a mean blood loss of 1386 ml. The number of units of blood transfused ranged from 0 to 17, with a median of 2 units.

Postoperative Course

Postoperative complications developed in 40 patients, as shown in Table 2, the majority of which involved problems of either pancreatic anastomosis or cholangitis. There were two patients who required reoperations during their hospitalization: one who underwent reoperation on the second postoperative day for bleeding from the jejunojejunal anastomotic site, and another who underwent reclosure of the abdominal wall for a wound infection. The mean and median hospital stays were 46.9 days and 41 days, respectively, ranging from 24 to 120 days.

There were four hospital deaths. One patient with carcinoma of the common bile duct died from a pleural disseminated tumor on the 59th postoperative day; a second patient died as a result of dissemination of pancreatic carcinoma on the 120th postoperative day; a third patient with pancreatic cancer who suffered cerebral thrombosis on the 28th postoperative day died from pneumonia on the 93rd postoperative day; and the fourth patient, who had carcinoma of the colon involving the duodenum with tumor emboli in the superior mesenteric vein, died from hepatic failure and pneumonia with pleural carcinomatosis on the 54th day.

Healing Problems of P-J

PPS developed in 6 patients: 2 had common bile duct carcinoma, 2 had carcinoma of the papilla of Vater, 1 had gastric carcinoma, and 1 had a pancreatic cystic tumor (Table 3). The purulent discharge ceased after 14 to 24 days, with a mean of 19.8 days on parenteral nutrition. A pancreatic fistula developed in 3 patients. The first was a 52-year-old man who underwent PD and rectal resection simultaneously for carcinoma of the papilla of Vater and rectal cancer. He had been taking steroid therapy for polymyositis for more than 3 years, and was given hydrocortisone 100 mg for 6 postoperative days. On the 7th day, fluid containing a high level of amylase leaked from a drain placed beneath the P-J site. The second patient was a 75-year-old man with concurrent diabetes mellitus and hypertension who underwent PD with an external stented P-J for a mucin-producing cystic tumor of the pancreatic head. On the fifth postoperative day, external drainage through stent tube abruptly stopped, and a pancreatic fistula was found the following day. The third patient was a 74-year-old woman who was operated on for carcinoma of the distal common bile duct. The postoperative course was uneventful up until the 11th postoperative day except for

less than 50 ml of purulent discharge from the peripancreatic drain. On the 11th postoperative day, oral intake was started, and a fistula developed with high fever. All the fistulae in these 3 patients were successfully closed with conservative treatment and parenteral nutrition for 56, 21, and 42 days, respectively.

The incidence of PF was significantly higher in those patients over 70 years old ($P = 0.02$). Conversely, sex, disease, malignancy, jaundice, serum albumin level, preoperative biliary drainage, and concurrent diseases did not influence the protracted healing of the P-J (Table 4). Moreover, the surgical experience, combined resection, type of reconstruction, whether or not there was a stent through the anastomosis, the caliber of the pancreatic duct, operative time, blood loss, blood transfusion, and intraoperative irradiation were not risk fac-

Table 3. Patients with protracted healing of the pancreaticojejunostomy

Age	Sex	Disease	Type of reconstruction	Surgeon's experience (years)	Size of PD (mm)	Stent	IOR	Hospital stay (days)
Peripancreatic sepsis								
49	M	PV cancer	Child	6	2.5	ex	no	68
66	M	CBD cancer	Child	5	3	ex	no	55
65	M	Gastric cancer	Cattell	19	2	in	no	79
63	F	PV cancer	Whipple	11	5	in	no	67
71	M	CBD cancer	Cattell	21	4	ex	yes	70
62	F	Pancreatic CT	Child	7	6	no	no	73
Pancreatic fistula								
52	M	PV cancer	Child	6	3	no	no	84
75	M	Pancreatic CT	Cattell	21	5	ex	no	68
74	F	CBD cancer	Child	8	2	no	no	75

PD, pancreatic duct; IOR, intraoperative irradiation; CBD, common bile duct; PV, papilla of Vater; CT, cystic tumor; ex, external; in, internal

Table 4. Preoperative factors influencing healing problems following pancreaticojejunostomy

Factor	No. of patients	PPS	*P*-value	PF	*P*-value
Age			0.92		0.02
≤69 years	82	5		1	
≥70 years	18	1		2	
Sex			0.92		0.92
Male	65	4		2	
Female	35	2		1	
Diagnosis			0.84		0.38
Malignant	80	5		3	
Benign	20	1		0	
Concurrent disease			0.76		0.07
None	67	6		2	
One	26	0		0	
More than one	7	0		1	
Serum bilirubin			0.92		0.25
≤0.8 mg/dl	35	2		2	
>0.8 mg/dl	65	4		1	
Serum albumin			0.57		0.16
≥3.5 g/dl	61	3		3	
<3.5 g/dl	39	3		0	
Preoperative biliary drainage			0.12		0.59
None	57	3		3	
PTBD	23	3		0	
ERBD	17	0		0	
T-tube drainage	3	0		0	

PPS, peripancreatic sepsis; PF, pancreatic fistula; PTBD, percutaneous transhepatic biliary drainage; ERBD, endoscopic retrograde biliary drainage

Table 5. Operative factors and healing problems associated with pancreaticojejunostomy

Factor	No. of patients	PPS	*P*-value	PF	*P*-value
Experience of surgeon			0.49		0.88
<10 years	37	3		2	
≥10 years	63	3		1	
Pylorus preservation			0.52		0.66
Standard PD	94	6		3	
Pylorus preservation	6	0		0	
Combined resection			0.27		0.40
None	84	6		2	
One organ or more	16	0		1	
Reconstruction method			0.38		0.37
Cattell	47	2		1	
Child	43	2		2	
Whipple	8	1		0	
Roux-en-Y	2	0		0	
Stent tube			0.86		0.18
None	53	1		2	
Internal	30	2		0	
External	13	3		1	
Caliber of pancreatic duct			0.51		0.29
<3 mm	31	2		1	
3–5 mm	36	3		2	
>5 mm	33	1		0	
Operative time			0.49		0.09
≤420 min	47	2		0	
>402 min	53	4		3	
Estimated blood loss			0.06		0.84
≤1 000 ml	39	0		1	
>1 000 ml	61	6		2	
Blood transfusion			0.16		0.42
None	44	1		2	
≥1 unit	56	5		1	
Intraoperative irradiation therapy			0.84		0.38
None	80	5		3	
Radiation	20	1		0	
Postoperative complications			0.21		0.37
None	68	4		2	
One	17	2		1	
More than one	15	0		0	

PPS, peripancreatic sepsis; PF, pancreatic fistula; PD, pancreatic duct

Table 6. Pancreatic consistency and anastomotic problems

Pancreas	Disease	Number of patients	Diameter of PD (mm)	Problems	
				PPS	PF
Hard	Pancreatic cancer	31	6.10 ± 2.54	0	0
	Papillary cancer	15	4.60 ± 2.58	2	1
	Chronic pancreatitis	5	5.20 ± 2.56	0	0
	Total	51	5.55 ± 2.96[a]	2[b]	1
Soft	Cancer of the CBD	22	2.70 ± 1.27	2	1
	Pancreatic CT	13	4.88 ± 2.31	1	1
	Gastric cancer	6	2.17 ± 0.41	1	0
	Duodenal cancer	4	3.13 ± 2.10	0	0
	Others	4	2.75 ± 0.96	0	0
	Total	49	2.96 ± 2.78[a]	4[b]	2

PD, pancreatic duct; PPS, peripancreatic sepsis; PF, pancreatic fistula; CBD, common bile duct; CT, cystic tumor
[a] $P < 0.01$; [b] not significant

tors either. Operative complications did not relate to the healing of P-J (Table 5). The caliber of the pancreatic duct in the "normal" or "soft" pancreas was significantly smaller than that in the hard pancreas. There was no significant increase in the incidence of PPS or PF formation in patients with a "soft" or "normal" pancreas (Table 6).

Discussion

Since the early days of pancreatic surgery, leakage from P-J after PD has been said to be associated with pancreatic consistency[6] or the caliber of the pancreatic duct.[6] The employment of alternative P-J anastomotic methods according to the size of the pancreatic duct has been strongly recommended;[9] however, the true risk factors for anastomotic leakage cannot be strictly defined because a blinded controlled study is absolutely impossible under these circumstances. We believe that only a prospective cohort study using a single method of P-J under stable skills could reveal the risk factors associated with this anastomosis.

Investigators who want to evaluate the relationship between certain surgical methods for various diseases and their results have usually referred to the technical level of the operators, which becomes an important factor for difficult and complicated surgical procedures. If only one expert surgeon performed a procedure using a single method, better results could be obtained, but relevant results cannot be achieved by this method, because they are often regarded as the personal experience of a skilled surgeon. Therefore, if a number of expert operators perform a procedure, the result may be made more applicable to the surgical community at large. Warshaw[16] stated that PD must be performed by operators with special expertise in academic health-care centers, where high-tech or special skills are available and large volumes of cases are experienced.

Our surgical residency program requires that postgraduate year-4, -5, and -6 residents perform PD under close supervision by senior surgeons. In the current study, 12 abdominal surgeons with more than 4 years of experience performed the operations, 85% of which were carried out by staff surgeons, while senior residents performed the remaining 15%.

The incidence of leakage or pancreatic fistula at the P-J site is lower now than in the 1970s.[17] Several authors have reported that the current incidence ranges from 6.3%[3] to 19%,[2] and have recommended placement of an exact suture between the pancreatic duct and the intestinal wall. In our study, a pancreatic fistula occurred in three patients (3%), although one had been on long-term steroid therapy, one had experienced problems in the management of an external stent tube, and one had commenced oral intake too early despite a PPS. There was no correlation between the leakage and causative diseases, concurrent diseases, preoperative serum albumin, jaundice, preoperative biliary drainage, stenting, caliber of the pancreatic duct, type of reconstruction, operative course, and postoperative complications. However, a relationship between leakage and advanced age of more than 70 years did exist.

Although a number of surgeons have advocated the use of stents through the anastomosis and their efficacy,[3] their effectiveness on healing of the anastomotic site has never been proven. In our study, each surgeon was allowed to decide whether or not to use a stent, and there was no relationship between the problems associated with anastomotic healing and the use of stents. We believe that the use of an intraanastomotic tube as a stent is not necessary for intraductal decompression in our VMS method, because the connection between the epithelia of the jejunal mucosa and pancreatic duct and watertight status in the anastomosis are achieved in the early postoperative period.[14] The necessity of a stent has not been clearly proven except in a few experimental studies.[18] Since external stent tubes that lead out require more complex management, we have not used them recently.

One of the authors (S.M.) experimentally proved that by using the VMS method, the epithelium of the jejunal mucosa becomes fused to the epithelium of the pancreatic duct smoothly by postoperative day 14.[14] Moreover, almost all patients who undergo PD with this type of anastomosis can start eating within 2 weeks, although prolonged fasting for more than 2 weeks and parenteral nutrition may be needed for resting the anastomotic sites to reduce pancreatic secretion in patients with special systemic conditions such as hyperglucocorticoidemia, which could delay wound healing.[19] Although some authors have recommended the prophylactic administration of somatostatin analog,[2] the efficacy of this agent for preventing anastomotic leakage is still controversial.

PPS developed in six patients and was successfully treated by immediate fasting and short-term parenteral nutrition. However, in our opinion, PPS is not a severe complication of P-J, because it is not "leakage," but rather a failure of healing between the cut surface of the pancreatic parenchyma and the jejunal serosa without breakdown of the connection between the pancreatic duct and the jejunal lumen (Fig. 3). Of the six patients with PPS, four had a relatively "soft" or nearly "normal" pancreas. The management of the cut end of the pancreas and the sutures between the cut border of the pancreas and the jejunal seromuscular layer is of utmost importance, as injuries, ischemia, or hematoma formation during the above procedure may lead to PPS. Therefore, surgeons who intend to perform this opera-

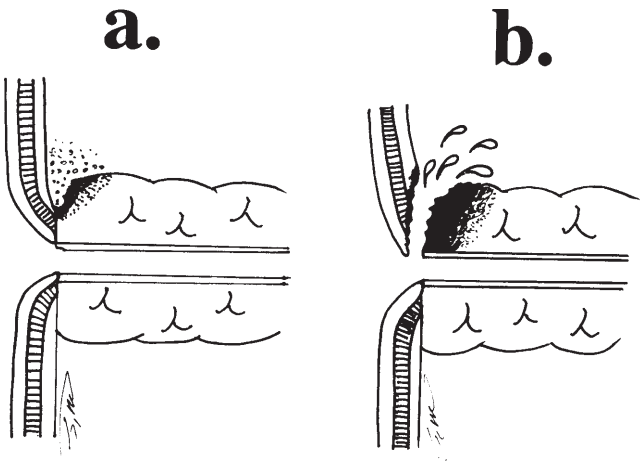

Fig. 3. Image of **a** peripancreatic sepsis and **b** pancreatic fistula

tion are required to attain precise techniques in suturing and ligation so as never to injure the pancreatic parenchyma, even if it is soft or normal. Surgeons should also select a fine atraumatic needle and use material gentle to the pancreatic parenchyma. Some authors have recommended the use of loupe magnification during anastomosis for precise procedures.[18]

A PPS should heal within 2 or 3 weeks if conservatively managed by fasting and parenteral nutrition, as in our patients. On the other hand, it may precipitate pancreatic fistulae due to various reasons, such as oral intake stimulating pancreatic secretion. Therefore, management with fasting and parenteral nutrition should be initiated, and oral intake suspended until purulent discharge from the drain beneath the anastomotic site has significantly decreased.

The hospital stays of the patients in this study were longer than those of patients reported from the United States,[20] which may be attributable to the difference in the medical insurance system between the US and Japan, and the lack of facilities for home care of patients in Japan. Almost all patients in Japan try to stay in hospital for as long as possible if covered by insurance. If a home infusion therapeutic system became popular in Japan, as in the US, we believe that the stay in hospital after PD would be reduced to two-thirds of that reported in this study.

The results of the current study demonstrated that traditional factors, such as pancreatic consistence and duct size, did not influence the incidence of pancreaticojejunal anastomotic dehiscence following the use of a single method, namely, the VMS method. This method proved to be safe, with pancreatic fistula formation developing in only 3% of patients, although more precise and accurate suturing techniques are required, especially for patients with a "soft" and "normal" pancreas.

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