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Marginal ulceration after pylorus-preserving pancreaticoduodenectomy

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Abstract: Marginal ulceration is a serious problem after both standard pancreaticoduodenectomy (PD) and pylorus-preserving pancreaticoduodenectomy (PPPD). The relationship between this complication and the method of reconstruction after PPPD was analyzed in this study. Patients who underwent standard PD ($n = 72$) or PPPD ($n = 28$) in the 20-year period from 1978 to 1997 were retrospectively reviewed. After PPPD, 4 patients (14.3%) developed marginal ulceration on the jejunal side of the duodenojejunal anastomosis, while none of the patients had marginal ulceration after standard PD. The marginal ulcer occurred in 3 of 14 patients treated with the Roux-en-Y method, and in 1 of 9 treated with pancreatogastrostomy. In the Roux-en-Y method, the anal jejunal loop anastomosed to the bulb was directly exposed to gastric juice without neutralization by pancreatic juice from the oral jejunal limb. Of the 4 patients with marginal ulceration, 2 of those treated by the Roux-en-Y method required gastrectomy; the other 2 patients were treated medically. Our analysis of the literature showed that the Roux-en-Y method had the highest incidence of marginal ulcerations. The gastrointestinal reconstruction method without a mixture of gastric juice and pancreatic juice may be a causal factor in the marginal ulceration that occurs after PPPD. In reconstruction after PPPD, we should not create a jejunal loop that is exposed to gastric juice alone.

Key words: pancreaticoduodenectomy, pylorus-preserving pancreaticoduodenectomy, marginal ulceration

Introduction

Pancreaticoduodenectomy (PD) is performed for the treatment of periampullary tumors and chronic pancreatitis. Since the reintroduction of pylorus-preserving pancreaticoduodenectomy (PPPD) by Traverso and Longmire,[1] this method has been increasingly used instead of the standard PD, because: (1) the preservation of the stomach and the duodenal bulb improves postoperative gastrointestinal function, and (2) the survival of cancer patients after PPPD is similar to that after standard PD.[2] Despite the improved quality of life after PPPD, marginal ulceration remains a considerable problem.[3] Some investigators have found a higher incidence of marginal ulceration after PPPD than after standard PD,[3–6] although others reported that PPPD was less ulcerogenic than standard PD.[7–15] The reason for this discrepancy is unclear. Moreover, the factors involved in the development of marginal ulcers after PPPD have not been fully studied.

Various gastrointestinal reconstruction methods are employed because the most dreaded complication after PPPD is disruption of the pancreatic anastomosis.[16] The aim of this study was to analyze the relationship between marginal ulceration and the method of reconstruction after PPPD.

Patients and methods

From 1978 to 1997, 100 patients underwent PD in our hospital. Standard PD with two-thirds distal gastrectomy was performed in 72 patients (for malignant periampullary tumors in 69 and chronic pancreatitis in 3; SPD group). In the SPD group, the gastrointestinal tract was reconstructed by the Roux-en-Y method in 48 patients, Imanaga's method in 10,[17] Child's method in 8, Cattell's method in 5, and pancreatogastrostomy in 1. These patients consisted of 43 men and 29 women, with a mean age of 61 years. H2-receptor antagonists were not used postoperatively.

PPPD was performed in 28 patients (for malignant periampullary tumors in 26, duodenal leiomyoma in 1, and chronic pancreatitis in 1; PPPD group) since 1992.

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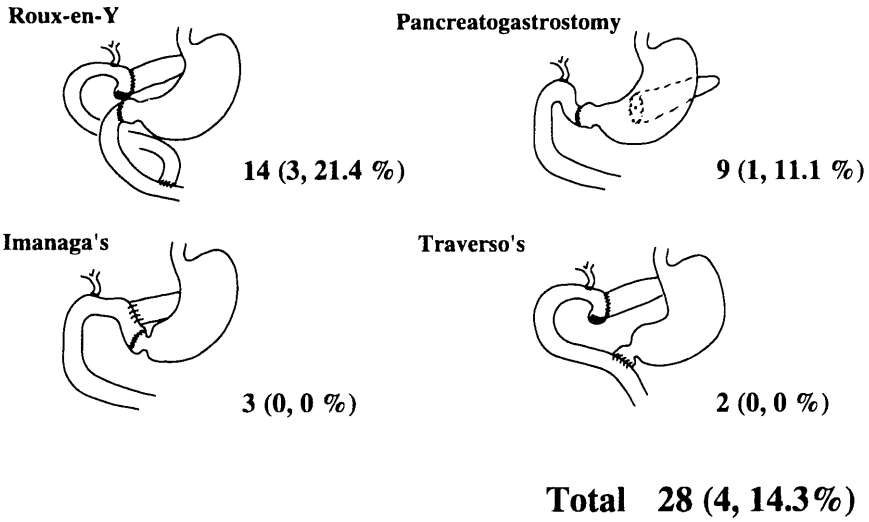

Fig. 1. Incidence of marginal ulcer in relation to reconstruction methods used after pylorus-preserving pancreaticoduodenectomy in our series. Numbers in parentheses indicate the number of patients and the incidence of marginal ulceration

Table 1. Marginal ulceration after PPPD

	Age (years)/ sex	Disease	Reconstruction	Onset of ulcer (months after PPPD)	Treatment
1.	56/M	Carcinoma of the papilla of Vater	Roux-en-Y	12	Gastrectomy for bleeding (42 months after PPPD)
2.	77/M	Carcinoma of the distal bile duct	Roux-en-Y	21	Gastrectomy for perforated ulcer (36 months after PPPD)
3.	49/M	Chronic pancreatitis	Roux-en-Y	1	Medication
4.	65/F	Carcinoma of the gallbladder	Pancreatogastrostomy (with hepatic resection)	1	Medication

PPPD, Pylorus-preserving pancreaticoduodenectomy

PPPD included resection of the pancreatic head and the duodenum 3 cm distal to the pylorus. Neither the right gastric artery nor the right gastroepiploic artery was preserved. For gastrointestinal reconstruction after PPPD, the Roux-en-Y method was used in 14 patients, pancreatogastrostomy in 9, Imanaga's method in 3,[18] and Traverso's method[1] in 2 (Fig. 1). The mean age of these patients was 61 years, and there were 18 men and 12 women. An H2-receptor antagonist was administered for at least 2 weeks postoperatively.

In the Roux-en-Y method after PPPD or standard PD, the oral jejunal limb was end-to-side anastomosed to the pancreas (mucosa-to-duct) and then to the bile duct, and the anal jejunal limb was anastomosed end-to-end to the stump of the duodenum or remnant stomach, respectively. In the pancreatogastrostomy, the first anastomosis was a pancreatogastrostomy (pancreas-to-gastric wall), followed by duodenojejunal and then choledochojejunal anastomosis.

To evaluate the status of the duodeno- or gastrojejunal anastomosis, upper gastrointestinal endoscopy was performed 1 month after surgery. Periodic endoscopy was performed at least once every 6 months. If patients developed melena or hematemesis, endoscopy was performed immediately. The location and size of any marginal ulcers, as well as the presence or absence of active bleeding, were confirmed by endoscopy.

Results

Four patients in the PPPD group (14.3%) developed marginal ulceration (Table 1). All ulcers occurred on the jejunal side of the duodenojejunal anastomosis. Two of the three patients reconstructed with the Roux-en-Y method developed marginal ulceration more than 1 year after surgery and required gastrectomy because of uncontrollable bleeding or perforation of the ulcer. The third patient reconstructed with the Roux-en-Y method developed an ulcer within 1 month after surgery and was treated medically. The remaining patient with a marginal ulcer had been reconstructed with a pancreatogastrostomy. In that patient, ulceration occurred within 1 month after surgery, and was well controlled with H2-receptor antagonist therapy. This ulcer may have been associated with gastric stasis, as medication

Table 2. Literature review of marginal ulceration after PPPD

Author	Year	Incidence of ulcers (%)	Onset (months after PPPD)	Treatment for ulcer		Reconstruction
Traverso and Longmire[7]	1980	0/18 (0)	—	—		Traverso's method
Gebhardt et al.[4]	1982	7/18 (39)	3, 13, 14, 14, 15, 16, 17	Gastrectomy	6	Roux-en-Y (7/15)
				Vagotomy	1	Traverso's method (0/3)
Warshaw and Torchiana[5]	1985	1/8 (13)	12	Gastrectomy	1	Traverso's method
Flautner et al.[8]	1985	0/19 (0)	—	—		Pancreatogastrostomy
Braash et al.[9]	1986	5/71 (7)	NR	Medication	3	Traverso's method
				Gastrectomy	1	
				Vagotomy	1	
Pearlman et al.[10]	1986	0/6 (0)	—	—		Traverso's method
Kim et al.[11]	1987	0/13 (0)	—	—		Imanaga's method
Fink et al.[12]	1988	2/46 (4)	16, 61	Medication	1	Traverso's method
				Gastrectomy	1	
McAfee et al.[3]	1989	4/13 (31)	Early (n = 1)	Medication	3	Traverso's method
			Late (n = 3)	Vagotomy	1	
Hunt and McLean[6]	1989	3/16 (19)	Late (n = 3)	Medication	3	Traverso's method (2/12) pancreatogastrostomy (1/4)
Roder et al.[13]	1992	2/48 (4)	NR	Medication	2	Traverso's method
Klinkenbijl et al.[14]	1992	3/47 (6)	NR	NR		Traverso's method
Nishikawa et al.[15]	1994	1/29 (3)	NR	NR		Imanaga's method
Present patients	1998	4/28 (14)	1, 1, 12, 21	Gastrectomy	2	See Fig. 1 and Table 1
				Medication	2	
Total		32/380 (8.4)		Gastrectomy	11	
				Vagotomy	3	
				Medication	14	
				NR	4	

NR, Not reported

Table 3. Incidence of marginal ulceration with different types of reconstruction after PPPD

Reconstruction	Total no. of patients	No. of patients with marginal ulcer (%)	No. of patients requiring surgery (%)
Roux-en-Y	29	10 (34.5)*	9 (90)
Traverso's method	274	19 (6.9)	5 (26.3)
Pancreatogastrostomy	32	2 (6.3)	0 (0)
Imanaga's method	45	1 (2.2)	0 (0)

* $P < 0.01$ vs the other reconstruction methods (χ^2 test)

was not necessary after the remission of gastric stasis. Ulcer was not observed again endoscopically in this patient until death from recurrence of gallbladder carcinoma.

In the SPD group, none of the 72 patients developed marginal ulceration, including all 48 patients reconstructed with the Roux-en-Y method.

Review of the literature on marginal ulceration after PPPD

To clarify the cause of marginal ulcers after PPPD, we investigated the relationship between the incidence of marginal ulceration and the reconstruction method used after PPPD. We found 13 detailed reports on marginal ulceration after PPPD (Table 2). The incidence of this complication ranged widely, from 0 to 39%, with the overall incidence of marginal ulceration after PPPD being 8.4% (32/380). The onset was biphasic, peaking first at 1–3 months, and then again at 12–20 months after PPPD.

The incidence of marginal ulceration after the Roux-en-Y method (34.5%; 10/29) was significantly higher than after other reconstruction methods ($P < 0.01$) (Table 3). Nine of the 10 patients with marginal ulcers after the Roux-en-Y method (90%) and 5 of the 19 with marginal ulcers after Traverso's method (26.3%) re-

quired gastrectomy or vagotomy. These results suggest to us that the development of marginal ulcers after PPPD is related to the reconstruction method.

Discussion

Marginal ulceration is a considerable problem after standard PD, with the incidence varying between 6% and 25%.[19,20] Factors that promote marginal ulcer after standard PD have been reported to include: (1) lack of alkaline intestinal fluid, caused by separation of the pancreas and the bile duct from the gastric outlet, (2) inadequate gastric resection, (3) postoperative pancreatic duct stenosis, and (4) deficiency of hormones that inhibit gastric acid secretion.[19] However, none of our 72 patients who underwent standard PD developed marginal ulcers over a period of 20 years.

Recently, PPPD has become a common procedure for periampullary neoplasms, as well as for chronic pancreatitis, because the survival of cancer patients after PPPD is similar to that after standard PD and the quality of life is better after PPPD.[2] In view of the tradition of partial gastrectomy, it has been feared that gastric preservation may increase marginal ulceration.[9] In fact, Nishikawa et al.[15] showed that gastric acidity was not significantly changed after PPPD when compared with the preoperative level, unlike the decline in acidity after standard PD. However, they and other investigators have postulated that PPPD is less ulcerogenic than standard PD.[7–15] Possible explanations for the low incidence of marginal ulcer after PPPD were suggested to be: (1) excessive gastric secretion is avoided because pylorus-preservation prevents alkaline reflux from jejunum to antrum;[15] (2) the duodenal bulb possesses an acid-sensitive mechanism and plays a primary role in the inhibition of gastric acid secretion by releasing inhibitory hormones;[21] and (3) the Brunner's glands in the bulb neutralize gastric acid by secreting mucus and bicarbonate.[22] Despite these cooperative actions of the pylorus and the duodenal bulb, the incidence of marginal ulceration after PPPD is not necessarily low[3–6] (Table 2).

From our analysis of the literature, we found that marginal ulceration was most common after the Roux-en-Y method (Table 3). In patients reconstructed with the Roux-en-Y method, gastric juice is not neutralized by pancreatic juice in the duodenojejunal loop, because the loop is separated from the limb with the pancreaticojejunostomy. Moreover, the anal jejunal loop anastomosed to the duodenum may be vulnerable to acid, because the acid-buffering capacity in the bowel decreases progressively as the distance from the pylorus increases.[23] For these reasons, the duodenojejunostomal loop in the Roux-en-Y method may be susceptible to ulceration. In addition, our literature review revealed that marginal ulcers after the Roux-en-Y method were resistant to medication. Judging from these findings, in reconstruction after PPPD, we should not create a jejunal loop which is exposed to gastric juice alone.

At our institute, the Roux-en-Y method was used preferentially because: (1) major leakage of the pancreatic anastomosis was easily treated with this method, and (2) distortion of the jejunal loop anastomosed to the bulb was often observed with other reconstruction methods. Since 1998, however, we have changed the reconstruction method after PPPD to pancreatogastrostomy because of the high incidence of marginal ulceration with the Roux-en-Y method. Of 9 patients who underwent pancreatogastrostomy, 8 showed no marginal ulcer. Although the remaining 1 patient after pancreatogastrostomy and 1 patient after the Roux-en-Y method developed marginal ulcers around 1 month after PPPD, they were successfully treated with an H2-receptor antagonist. During the early postoperative period, the duodenojejunal anastomosis may be directly exposed to highly acidic gastric juice, because pancreatic juice is drained by catheterization of the pancreatic duct during that period. Moreover, gastrojejunal stasis often occurs around that period.[2] Therefore, gastric stasis may be one of the factors which promote marginal ulceration in the early postoperative period. This hypothesis is supported by our result that well controlled ulcers were associated with delayed gastric emptying and they were alleviated after the remission of gastric stasis. H2-receptor antagonists may be required until remission of gastric stasis.

In conclusion, the factors promoting marginal ulceration after PPPD were: (1) gastric stasis during the early postoperative period, and (2) direct exposure of the jejunum to gastric juice without neutralization by alkaline juice. Since the marginal ulcer promoted by factor (2) was resistant to medication, we should avoid reconstruction procedures that create a loop in which gastric juice is not neutralized by alkaline juice after PPPD.

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