Acta Med. Nagasaki 50: 55－59

A Retrograde Tube-Gastrostomy Technique for Management of Delayed Gastric Emptying after Pylorus-Preserving Pancreatoduodenectomy

Yoshitsugu TAJIMA, Sumihiro MATSUZAKI, Kenzo FUKUDA, Ryuji TSUTSUMI, Tamotsu KUROKI, Junichiro FURUI, Takashi KANEMATSU

Department of Transplantation and Digestive Surgery, Nagasaki University Graduate School of Biomedical Sciences, Nagasaki, Japan

Delayed gastric emptying (DGE) is one of the most frequent and unpleasant postoperative discomforts in patients who were given pylorus-preserving pancreatoduodenectomy (PPPD). To prevent DGE after PPPD with the modified version of Traverso's reconstruction procedure, we have used retrograde tube-gastrostomy technique. In our method, a 16-Fr gastrostomy tube with several pores was inserted in the retrograde direction from the jejunal stump into the gastric fundus, by leading the catheter tip through the jejuno-jejunal anastomosis, the efferent jejunum and the pylorus. Between January 1996 and September 2003, 51 patients underwent PPPD for periampullary malignancy in our department. DGE after PPPD was observed in 12 patients (23.5%); 2 of the 19 patients (10.5%) with retrograde tube-gastrostomy technique and 10 of the 32 patients (31.3%) with conventional tube-gastrostomies. Because of effective internal drainage of gastric juice to the efferent jejunum by this method, the external gastric drainage from the gastrostomy tube was extremely small when compared to conventional tube-gastrostomies, resulting in reduction of postoperative venous infusion and hypochloremia. Oral intake was also started earlier after surgery, and the postoperative hospital stay was shortened. In conclusion, the retrograde tube-gastrostomy technique was found easy to perform and beneficial to the patients undergoing PPPD.

ACTA MEDICA NAGASAKIENSIA 50: 55－59, 2005

Keywords: Delayed gastric emptying; Pylorus-preserving pancreatoduodenectomy; Tube-gastrostomy

Introduction

Pylorus-preserving pancreatoduodenectomy (PPPD) has gained wide acceptance for the treatment of periampullary malignancy as well as for benign pancreatic conditions, since the quality of life of the patients in the late postoperative course is better with PPPD compared to conventional pancreatoduodenectomy. However, many surgeons are concerned with how to cope with delayed gastric emptying (DGE), which has been often experienced at the early postoperative course in patients treated with PPPD.[1-4] This complication needs prolonged nasogastric suction, resulting in severe respiratory complications, such as silent aspiration and aspiration pneumonia,[5] delayed food intake, prolonged central venous nutrition, prolonged hospital stay and greater cost.[6]

The present report documents our newly-devised tube-gastrostomy technique for the successful management of DGE after PPPD. In this method, a retrograde insertion of a gastrostomy tube with many side pores from the jejunal stump into the gastric fundus, through the efferent jejunum and the pylorus, was carried out to achieve an effective internal drainage of gastric juice to the efferent jejunum, and good postoperative course was resulted.

Patients and Methods

Between January 1996 and September 2003, 51 patients underwent PPPD, following Traverso's modified reconstruction of the digestive tract,[7] for periampullary malignancy in our department. The patients ranged in age from 48 to 76 years, with the mean (±standard deviation) of 62.4±8.9 years. There were 29 men and 22 women. The PPPDs were performed for carcinoma of the distal bile duct (22 patients), the papilla of Vater (16 patients) and the pancreas head (13 patients).

Address correspondence: Yoshitsugu Tajima, M.D., Ph.D., Department of Transplantation and Digestive Surgery, Nagasaki University Graduate School of Biomedical Sciences, 1-7-1 Sakamoto, Nagasaki 852-8501 JAPAN
TEL: +81-(0)95-849-7316, FAX: +81-(0)95-849-7319, E-mail: ytajima@net.nagasaki-u.ac.jp

Received January 20, 2005; Accepted March 28, 2005

Tube-gastrostomy techniques

At a PPPD, the entire stomach and 3 cm of the first part of the duodenum was preserved. The right gastric artery and the superior pyloric branches of the vagus were cut to allow suprapyloric lymph node dissection for periampullary malignancy. Reconstruction of the digestive tract was established by modifying the original procedure of Traverso and Longmire.[7] The first jejunal loop was transposed retrocolically through the right side of the transverse mesocolon and then pancreatojejunostomy, hepaticojejunostomy, jejuno-jejunal anastomosis, and duodenojejunostomy were performed at 5 cm, 15 cm, 45 cm, and 55 cm from the jejunal stump, respectively. Prior to reconstruction of the alimentary tract, a 16-Fr gastrostomy tube with many side pores (Salem Sump Tube, Nippon Sherwood Medical Industries Ltd., Tokyo, Japan) was inserted into the jejunal loop through the jejunal stump, along with the pancreatic and biliary decompression tubes, and the catheter tip was inserted up to the site proposed for jejuno-jejunal anastomosis. Pores were made every 1 cm from the tip to the 40 cm position on the lateral surface of the catheter. First, an end-to-side pancreatojejunostomy was employed in a fashion of the duct-to-mucosa anastomosis. Next, an end-to-side hepaticojejunostomy was performed. Subsequently, the posterior suture of jejuno-jejunal anastomosis was performed, and the gastrostomy tube indwelled in the jejunum (afferent jejunum) was brought out through the anastomotic aperture. The catheter tip was reinserted into the efferent jejunum, and then the anterior wall was anastomosed. Finally, a retrocolic duodenojejunostomy was performed. As in the procedures of duodenojejunostomy, the gastrostomy tube in the efferent jejunum was removed from the anastomotic aperture and reinserted deeply into the gastric fundus via the pylorus (Figure 1). The gastrostomy tube and decompression tubes from the main pancreatic duct and common hepatic duct were individually fixed on the jejunal wall by the Mikulicz's method, and brought out through the anterior abdominal wall.

We performed the retrograde tube-gastrostomy technique (Method A) described above in 19 of the 51 patients. Insertion of a porous gastric catheter from the anterior wall of the gastric body into the efferent jejunum via the pylorus (Method B) was performed in 18 patients (Figure 2). In the remaining 14 patients, a porous gastric catheter was inserted into the gastric fundus through the anterior gastric wall (Method C, Figure 3). In all the patients, the decompression tubes were placed in both the biliary and pancreatic anatomoses and brought out through the jejunal stump. A nasogastric tube was not used in any patient.

Detailed data recorded

Preoperative data obtained included age, gender, concentrations of serum albumin, total bilirubin and hemoglobin, lymphocyte counts, creatinine clearance, oral glucose tolerance test (OGTT), and *N*-benzoyl-L-tyrosyl-*p*-aminobenzoic acid (BT-PABA) test. For the OGTT, plasma glucose levels were measured in blood samples obtained before and 30, 60 and 120 min after oral administration of Trelan G 75® (Shimizu Seiyaku, Shizuoka, Japan). The BT-PABA test involved the administration of 500 mg of BT-PABA (PFD® Oral, Eizai, Tokyo, Japan) in 250 mLwater followed by a further 250 mL water. After 6 h, the percentage of BT-PABA excreted in the urine was determined.

Intraoperative data obtained included the extent of lymphadenectomy (regional or extended), operative time, intraoperative blood loss, and blood transfusion (with or without).

The postoperative course was recorded with special regard to the

Figure 1. Retrograde tube-gastrostomy technique in the modified version of Traverso's reconstruction of the digestive tract after pylorus-preserving pancreatoduodenectomy (Method A). a-Pancreatic tube, b-Biliary tube, c-Gastrostomy tube; a porous gastric catheter is inserted from the jejunal stump into the gastric fundus, through the jejuno-jejunal anastomosis, the efferent jejunum and the pylorus.

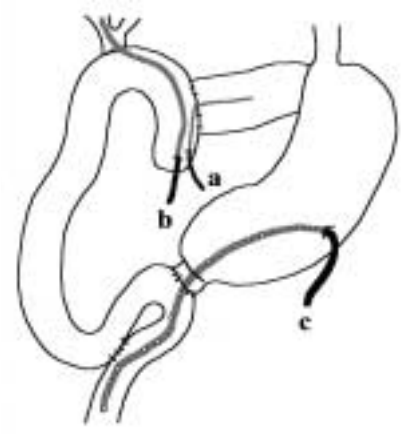

Figure 2. Our conventional tube-gastrostomy after pylorus-preserving pancreatoduodenectomy, followed by the modified version of Traverso's reconstruction of the digestive tract (Method B). a-Pancreatic tube, b-Biliary tube, c-Gastrostomy tube; a porous gastric catheter is inserted from the anterior wall of the gastric body into efferent jejunum via the pylorus.

Figure 3. Our initial tube-gastrostomy after pylorus-preserving pancreatoduodenectomy, followed by the modified version of Traverso's reconstruction of the digestive tract (Method C). a-Pancreatic tube, b-Biliary tube, c-Gastrostomy tube; a porous gastric catheter is inserted from the anterior wall of the gastric body into the gastric fundus.

pancreatic anastomotic leakage, DGE, daily output of gastric juice and bile juice from the decompression tubes, the postoperative day at which liquid diet was started, and the duration of postoperative hospital stay. The daily amount of venous infusion required and the electrolyte disturbance were also recorded. Pathology of periampullary diseases was registered as a baseline parameter. Gastric emptying was considered delayed when the gastric output was above 600mL/day on or after postoperative day 7. Postoperative pancreatic anastomotic leakage was defined as: (1) discharge from the peripancreatic drains with amylase concentrations >5000 IU/mL on or after postoperative day 7; or (2) pancreatic anastomotic disruption demonstrated radiographically on fistulography or cholangiography. The gastrostomy tube was clamped if gastric retention was below 300 mL/day, and then oral feeding of liquids was begun and advanced to a semi-solid diet as rapidly as tolerated.

Statistical Analysis

We classified patients into 3 groups by the type of tube-gastrostomy techniques, and compared their baseline characteristics and clinical characteristics among the groups; the difference among 3 groups was tested by chi-square test and Kruskal-Wallis test for discrete data such as gender and for continuous data such as age, respectively. The necessary calculations were performed using StatView 5.0 (SAS Institute, Cary, NC, USA).

Results

Clinicopathological characteristics of patients in the 3 study groups are shown in Table 1. Preoperative characteristics, intraoperative parameters, and histologic findings were similar in the 3 groups. Although postoperative pancreaticojejunal anastomotic leakage was identified in 10 patients, there was no significant difference in the incidence of pancreatic anastomotic leakage among the 3 groups.

Clinical characteristics related to DGE after PPPD in each tube-gastrostomy technique are summarized in Table 2. DGE was observed in 12 patients (23.5%); 2 (10.5%) in Method A, 4 (22.2%) in Method B, and 6 (42.9%) in Method C. There was a significant difference in the incidence of DGE among the 3 groups. The volume of both gastric and biliary drainage after surgery was significantly small in Method A, reducing the volume of postoperative venous infusion required. The incidence of hypochloremia was also low with Method A. In the patients treated by Method A, oral intake could be started earlier after surgery compared to those treated with Methds B and C, resulting in shorter postoperative hospital stay.

Table 1. Baseline characteristics of patients who underwent pylorus-preserving pancreatoduodenectomy with the modified version of Traverso's reconstruction of the digestive tract

Characteristics	Tube-gastrostomies			*p*-value
	Method A (n=19)	Method B (n=18)	Method C (n=14)	
Age (years)	62.3±5.1[b]	63.8±11.7	61.8±8.7	0.786
Gender (male/female)	11/8	10/8	8/6	0.623
Preoperative laboratory analysis				
Lymphocyte (1000/mm^3)	1.7±0.8	1.7±0.6	1.6±0.7	0.734
Hemoglobin (g/dL)	12.6±0.4	12.2±0.2	12.8±0.6	0.887
Albumin (g/dL)	3.8±0.3	3.7±0.4	3.7±0.8	0.912
Total bilirubin (mg/dL)	1.6±1.9	1.4±1.3	1.5±1.7	0.632
Creatinine clearance (mL/min)	64±17	69±14	67±19	0.713
Diabetes	6 (32)[c]	5 (28)	4 (29)	0.965
BT-PABA test (%)[a]	62.3±11.4	58.4±16.1	61.3±15.3	0.689
Intraoperative indices				
Lymphadenectomy (regional/extended)	4/15	4/14	3/11	0.996
Operative time (hours)	8.7±1.6	8.6±0.9	8.6±0.7	0.902
Blood loss (mL)	1396±258	1231±205	1273±236	0.786
Blood transfusion (yes/no)	8/11	7/11	5/9	0.936
Pathological findings				0.962
Bile duct carcinoma	8 (42)	8 (44)	6 (42)	
Ampullary carcinoma	6 (32)	6 (33)	4 (29)	
Pancreatic ductal adenocarcinoma	5 (26)	4 (22)	4 (29)	
Postoperative pancreatic anastomotic leakage	4 (21)	3 (17)	3 (21)	0.927

[a]BT-PABA=N-benzoyl-L-tyrosyl-p-aminobenzoic acid

[b]Mean±standard deviation.

[c]Parenthetic entries refer to percentage.

Table 2. Clinical characteristics related to delayed gastric emptying after pylorus-preserving pancreatoduodenectomy with the modified version of Traverso's reconstruction of the digestive tract

Characteristics		Tube-gastrostomies			*p*-value
		Method A (n=19)	Method B (n=18)	Method C (n=14)	
Delayed gastric emptying		2 (10.5)[b]	4 (22.2)	6 (42.9)	0.042
Average gastric juice output (mL/day)	at POD 1-15[a]	156±86[c]	317±107	533±198	0.061
	at POD 16-30	30±17	177±107	432±167	0.033
Average gastric and bile juice output (mL/day)	at POD 1-15	351±109	497±115	677±215	0.004
	at POD 16-30	112±55	263±135	537±198	0.032
Average venous infusion required (mL/kg body weight/day)	at POD 1-15	43±4	48±4	60±2	0.007
	at POD 16-30	24±8	32±9	54±5	0.002
Incidence of hypochloremia		4 (21.1)	8 (44.4)	9 (64.3)	0.044
Start of oral intake (POD)		16.9±5.2	22.3±7.0	32.9±5.5	0.001
Postoperative hospital stay (days)		35.3±6.3	38.5±8.2	48.7±9.4	0.042

[a]POD=Postoperative day.

[b]Parenthetic entries refer to percentage.

[c]Mean±standard deviation.

Discussion

The pathogenesis of DGE after PPPD has been proposed in the past; ischemic injury to the antropyloric muscle,[8] disruption of the gastroduodenal neural connection,[9] gastric atony in response to resection of the duodenal pacemaker[10] or reduction in circulating levels of motilin,[11] and gastric dysrhythmia secondary to an intraabdominal septic focus,[12] but it remains unclear. Some authors have recently emphasized that a transient torsion or angulation of the duodenojejunostomy play a role in the pathogenesis of DGE after PPPD.[13,14]

With the aim of managing DGE after PPPD, several clinical trials have been carried out such as preservation of the right gastric artery and the vagal pyloric branches,[15] and administration of metoclopramide,[16] cisapride[4] or erythromycin.[17,18] However, we have not obtained clinically fine and reliable results with these methods.

In this study, a retrograde insertion of a gastrostomy tube from the jejunal stump into the gastric fundus was carried out in patients who underwent PPPD, followed by the modified version of Traverso's reconstruction procedure, to prevent postoperative DGE, and good postoperative course was resulted. Initially, we used Method C at a PPPD. Although gastric decompression was well accomplished with this method, DGE after PPPD was recognized in 6 of the 14 patients (42.9%). The incidence of hypochloremia was also high with Method C because of a large amount of external gastric drainage. Thus, we performed Method B to achieve an internal drainage of gastric fluid to the distal intestine, resulting in 20% reduction of DGE after PPPD compared to Method C. In both techniques, however, the anterior gastric wall was inevitably fixed to the abdominal wall. Moreover, the effect of the gastrostomy tube on internal drainage of gastric fluid was insecure in Method B. Method A, inducing a gastrostomy tube from the efferent jejunum deeply into the gastric fundus and making many pores on the lateral surface of the catheter, provided an effective internal drainage of gastric fluid to the distal intestine and decreased the incidence of DGE after PPPD to 10.5%. Effective internal drainage of gastric fluid to the distal intestine may improve gastrointestinal dysfunction seen in the early postoperative period following PPPD. If a gastrostomy tube was induced through the afferent jejunum in the retrograde tube-gastrostomy technique, stasis of gastric fluid would occur in the jejunal loop, including the afferent jejunum. Consequently, successful reduction of postoperative venous infusion and hypochloremia was accomplished in Method A. In Method A, oral intake was also started earlier after surgery and the postoperative hospital stay was shortened. The catheter can be pulled out any time depending on patient's conditions and also used as an enteral feeding tube. After a removal of gastrostomy tube, subsequent reappearance of DGE was not recognized in any patient.

In conclusion, our retrograde tube-gastrostomy technique was considered easy to perform and useful for the management of DGE in the early postoperative course after PPPD with the modified version of Traverso's reconstruction of the digestive tract.

References

1. Grace PA, Pitt HA, Long mire WP. Pylorus preserving pancreatoduodenectomy: an overview. *Br J Surg* 77: 968-974, 1990
2. Cameron JL, Pitt HA, Yeo CJ, Lillemoe KD, Kaufman HS, Coleman J. One hundred and forty-five consecutive pancreaticoduodenectomies without mortality. *Ann Surg* 217: 430-435, 1993
3. van Berge Henegouwen MI, van Gulik TM, DeWit LT et al. Delayed gastric emptying after standard pancreaticoduodenectomy versus pylorus-preserving pancreaticoduodenectomy: an analysis of 200 consecutive patients. *J Am Coll Surg* 185: 373-379, 1997
4. Yamaguchi K, Tanaka M, Chijiiwa K, Nagakawa T, Imamura M, Takada T. Early and late complications of pylorus-preserving pancreatoduodenectomy in Japan 1998. *J Hepatobiliary Pancreat Surg* 6: 303-311, 1999
5. Harkness GA, Bentley DW, Roghmann KJ. Risk factors for nosocomial pneumonia

in the elderly. *Am J Med* 89: 457-463, 1990
6. Miedema BW, Sarr MG, van Heerden JA, Nagorney DM, McIlrath DC, Ilstrup D. Complications following pancreaticoduodenectomy. Current management. Arch Surg 127: 945-949, 1992
7. Traverso LW, Longmire WP Jr. Preservation of the pylorus in pancreaticoduodenectomy. *Surg Gynecol Obstet* 146: 959-962, 1978
8. Liberski SM, Koch KL, Atnip RG, Stern RM. Ischemic gastroparesis: resolution after revascularization. *Gastroenterology* 99: 252-257, 1990
9. Braasch JW, Deziel DJ, Rossi RL, Watkins E Jr, Winter PF. Pyloric and gastric preserving pancreatic resection. Experience with 87 patients. *Ann Surg* 204: 411-418, 1986
10. Tanaka M, Sarr MG. Total duodenectomy: effect on canine gastrointestinal motility. *J Surg Res* 42: 483-493, 1987
11. Tanaka M, Sarr MG. Role of the duodenum in the control of canine gastrointestinal motility. *Gastroenterology* 94: 622-629, 1988
12. Traverso LW, Kozuschek RA. Long-term follow-up after pylorus-preserving pancreaticoduodenectomy for severe complications of chronic pancreatitis. *Dig Surg* 13: 118-126, 1996
13. Ueno T, Tanaka A, Hamanaka Y, Tsurumi M, Suzuki T. A proposal mechanism of early delayed gastric emptying after pylorus preserving pancreatoduodenectomy. *Hepato-Gastroenterol* 42: 269-274, 1995
14. Horstmann O, Becker H, Post S, Nustede R. Is delayed gastric emptying following pancreaticoduodenectomy related to pylorus preservation? *Langenbecks Arch Surg* 384: 354-359, 1999
15. Sumida K, Nimura Y, Yasui A, Miyachi M, Shibata Y, Kobayashi I. Influence of vagal pyloric branches on gastric acid secretion and gastrointestinal motility in patients following a pylorus preserving pancreatoduodenectomy. *Hepato-Gastroenterol* 46: 336-342, 1999
16. Warshaw AL, Torchiana DL. Delayed gastric emptying after pylorus-preserving pancreaticoduodenectomy. *Surg Gynecol Obstet* 160: 1-4, 1985
17. Yeo CJ, Barry MK, Sauter PK, et al. Erythromycin accelerates gastric emptying after pancreaticoduodenectomy. A prospective, randomized, placebo-controlled trial. *Ann Surg* 218: 229-237, 1993
18. Ohwada S, Satoh Y, Kawate S et al. Low-dose erythromycin reduces delayed gastric emptying and improves gastric motility after Billroth I pylorus-preserving pancreaticoduodenectomy. *Ann Surg* 234: 668-674, 2001