Pylorus Preserving Pancreaticoduodenectomy with Low Incidence of Early Delayed Gastric Emptying

Suvit Sriussadaporn MD*,
Supparerk Prichayudh MD*, Sukanya Sriussadaporn MD*,
Kritaya Kritayakirana MD*, Rattaplee Pak-art MD*

** Department of Surgery, Faculty of Medicine, Chulalongkorn University*

Background and objective: *Early delayed gastric emptying (early DGE) is a common complication after pylorus-preserving pancreaticoduodenectomy (PPPD). The authors studied the occurrence of early DGE in the presented patients. The explanation of authors' results was discussed and a brief literature review was performed.*
Material and Method: *The occurrence of early DGE was studied in 37 patients with periampullary neoplasms or other benign conditions who underwent PPPD between from April 1992 and March 2006. The operations were performed by the first author with uniform surgical techniques. After the year 2000, an external pancreatic stent was routinely inserted into the pancreatic duct during pancreaticojejunostomy anastomosis.*
Results: *Early DGE occurred in two patients (5.4%), one in the non-stented and one in the stented group. Two patients had pancreatic fistula and two had wound infection. The overall morbidity rate was 16.2%. There was no re-operation or intra-abdominal abscess requiring drainage or mortality in the present study.*
Conclusions: *The occurrence of early DGE after PPPD may be lessened by strict awareness and avoidance of complications associated with PPPD. Surgical experiences with faultless and meticulous surgical techniques are important for lowering such complications.*

Keywords: *Early delayed gastric emptying, Pylorus preserving pancreaticoduodenectomy*

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Pylorus-preserving pancreaticoduodenectomy (PPPD) was popularized by Traverso and Longmire in 1978[1]. Since then, it has been widely performed and accepted as a standard treatment for resection of the periampullary neoplasms and other benign conditions. Early delayed gastric emptying (early DGE) is a common complication following PPPD. The reported incidence of early DGE varied between 15% and 50%[2-8]. Although the condition is usually transient and resolves with conservative treatment in most patients, it may take several weeks before normal oral intake resumes. Prolonged parenteral nutrition and lengthening of the hospital stay resulting from early DGE increase hospital costs, patients' discomfort, and surgeons' workload. The purpose of the present study was to examine the occurrence of early DGE after PPPD in our patients. The explanation for the present results is also discussed.

Correspondence to : Sriussadaporn S, Department of Surgery, Faculty of Medicine, Chulalongkorn University, Rama 4 Rd, Bangkok 10330, Thailand. Phone: 0-2256-4117, Fax: 0-2256-4194. E-mail: Suvit.s@chula.ac.th

Material and Method

This is a retrospective study of patients who underwent PPPD at the authors' Surgical Unit, King Chulalongkorn Memorial Hospital, Bangkok, Thailand between April 1992 and March 2006. All operations were performed by the first author with uniform surgical techniques including meticulous dissection, gentle handling of tissue, complete hemostasis, and careful reconstruction after the surgical specimen was removed. Reconstruction was performed by passing the open end of the jejunum through the bed of the resected duodenum to anastomose with the pancreatic stump and the common bile duct, respectively. First, the

pancreaticojejunostomy anastomosis was performed by insertion of the end of the pancreas into the open end of the jejunum (dunking technique)[9]. Subsequently, the end of the common bile duct was anastomosed to the side of the jejunum. Then, the antecolic end-to-side duodenojejunostomy anastomosis was finally performed (Fig. 1). Until the year 2000, no external pancreatic stent was used for pancreatico jejunostomy anastomosis. After the year 2000, an external pancreatic stent was routinely placed into the pancreatic duct stump (Fig. 2). This pancreatic stent was sutured to the pancreatic duct with absorbable suture No 5-0 and was removed 3 to 4 weeks later, when the suture resolved. The nasogastric tube was withdrawn when the bowel function returned and oral diet was about to begin. Two Penrose drains were routinely placed at right subhepatic area. No octreotide was administered during the early postoperative period. Early DGE was defined as either (a) duration of the nasogastric tube placement > 10 days or (b) its re-insertion because of vomiting after initiation of oral intake[8,10,11]. Descriptive statistics: mean, median, standard deviation, and interquartile range were used to present the result.

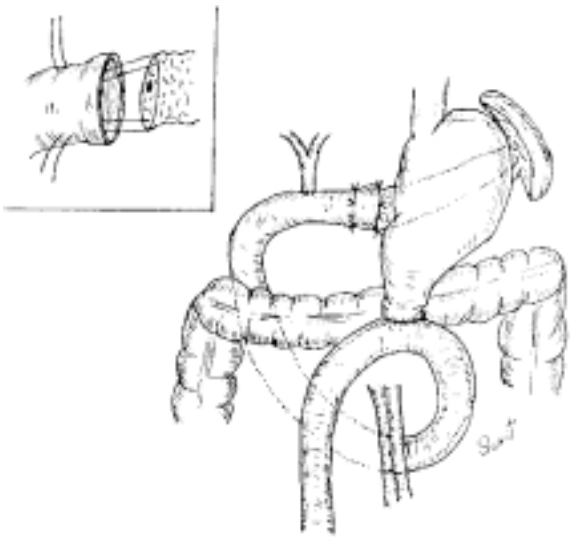

Fig. 1 Reconstruction of the pancreatico-biliary-duodeno-enteric anastomosis following PPPD until the year 2000

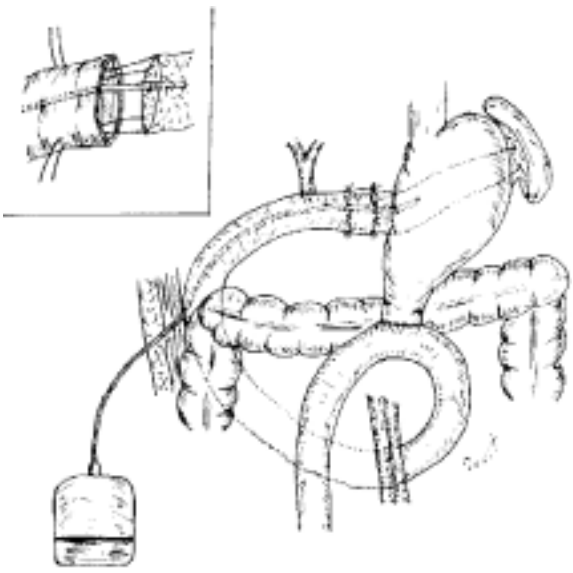

Fig. 2 Reconstruction of the pancreatico-biliary-duodeno-enteric anastomosis following PPPD after the year 2000. An external pancreatic stent was placed into the pancreatic duct stump

Results

During the 14-year period, 37 patients entered into the present study. Twenty-two (59%) were male and 15 (41%) were female. The age ranged from 33 to 92 years (mean 60.7 $\pm$ 16.7 years). The indications for PPPD are detailed in Table 1. Carcinoma of the ampulla of Vater, carcinoma of the head of the pancreas, and carcinoma of the distal common bile duct were among the most common indications. Twenty-six patients (70.3%) had external pancreatic stent insertion. The operative time ranged from 270 to 660 minutes (mean 450 $\pm$ 98 minutes). The operative blood transfusion ranged from 0 to 7 units (mean 2.6 $\pm$ 1.7 units). The duration of nasogastric tube placement ranged from 4 to 17 days (median 5 days). The duration of non per oral (NPO) ranged from 4 to 17 days (median 6 days). The hospital stay ranged from 11 to 41 days (mean 22.1 $\pm$ 7.9 day) (Table 2).

Early DGE occurred in two patients (5.4%), one in the external pancreatic stented group and one in the non-stented group. One of them had carcinoma of the ampulla of Vater and the other had carcinoma of the distal common bile duct. The former required re-insertion of the nasogastric tube 9 days after its initial removal, the latter had nasogastric tube placement for 17 days. Both of them had uncomplicated recovery and resumed regular diet a few days later. They were discharged home on day 23 and day 31 postoperatively. No specific cause of early DGE could be identified in both patients. Two patients in the non-stented group had pancreatic fistula and two patients in the stented group had wound infection, none of them had

Table 1. Indications for PPPD

Indications	Number of patients	Percent
Carcinoma of the ampulla of Vater	16	43.2
Carcinoma of the head of the pancreas	7	19.0
Carcinoma of the distal common bile duct	6	16.2
Carcinoma of the duodenum	1	2.7
Leiomyosarcoma of the duodenum	1	2.7
Gastrointestinal stomal tumor of the head of the pancreas	1	2.7
Mucinous cystadenoma of the head of the pancreas	1	2.7
Primary biliary stones with distal common bile duct obstruction	1	2.7
Infected pseudocyst of the head of the pancreas	1	2.7
Benign epithelial cyst of the head of the pancreas	1	2.7
Chronic pancreatitis	1	2.7
Total	37	100.00

Table 2. General characteristics of patients undergoing PPPD

Characteristics	Statistic	Min-Max (n = 37)	Early DGE (2 patients)
Sex Male / Female	22/15		
Age (years)			
Mean	60.7	33-92	33, 36
SD	16.7		
Operative time (minutes)			
Mean	450	270-660	345, 630
SD	98		
Operative blood transfusion (units)			
Mean	2.6	0-7	0, 4
SD	1.7		
Days of nasogastric intubation			
Median	5	4-17	10**, 17
IQR*	4-7		
Days of NPO			
Median	6	4-17	10**, 17
IQR*	5-7		
Hospital stay (days)			
Mean	22.1	11-41	23, 31
SD	7.9		

* Inter-Quatile Range (percentile 25-75)

** 8 days of NG tube and NPO + 2 days of reinsertion of NG tube and NPO

early DGE. The overall morbidity was 16.2%. There was no re-operation or intra-abdominal abscess requiring drainage or mortality in the present study.

Discussion

Traverso and Longmire in 1978 reported an encouraging result of PPPD in two patients, one with chronic pancreatitis and one with localized carcinoma of the third part of the duodenum. The underlying reasons of such operation that modified from previous classical Whipple operation were to avoid the side effects of a reduced gastric reservoir and a direct gastroenteric connection following the extensive operative excision and reconstruction[1]. Subsequent reports have confirmed a better long-term gastrointestinal function of PPPD based on weight gain and lack of digestive

symptoms[2,3,7]. However, this advantage of PPPD over classical Whipple operations had been questioned by some investigators[3,6,7]. Along with the increasing number of patients undergoing PPPD, early DGE has also been observed in a significant portion. Early DGE is a well-known, non-life-threatening complication following this operation causing extended hospital stays and greater hospital cost. The reported incidence of this troublesome complication ranged from 15% to 50%[2-8]. The wide range of incidence of early DGE may be explained partly by the difference in definition of early DGE in various reports[6,11-17]. The definition of early DGE used in the current study is among the most commonly used in clinical practice[8,10,11,18,19]. This excluded the bias of low occurrence of early DGE (5.4%) in the presented patients compared to those previously reported.

The etiology of DGE mentioned in the literature are 1) anastomotic leakage and/or intra-abdominal collection or abscess[7,18,20,21], 2) disruption of the gastroduodenal neural connections[22,23], 3) ischemic injury to the antropyloric muscle mechanism[24], 4) reduction in circulating levels of motilin[14,25-27], 5) transient torsion or angulation of the reconstructed alimentary tract[28], and 6) venous congestion of the jejunum from passing the afferent jejunum through the retromesenteric route[18].

Several non-surgical and surgical methods have been advocated for prevention of early DGE. Yeo et al, did a prospective, randomized, placebo-controlled trial using intravenous erythromycin, a motilin agonist, from the third to tenth postoperative day in patients undergoing pancreaticoduodenectomy. Their results were promising and found a 37% reduction in the incidence of early DGE[14]. Takeda et al studied the use of oral cisapride, a gastrointestinal prokinetic drug, in 10 patients who underwent PPPD and found that orally administered cisapride accelerated gastric emptying during the intermediate postoperative period (< 6 months) when delayed. Kingsnorth et al reported a good result in 30 patients undergoing PPPD in which the anastomoses were constructed in the sequence: retrocolic end-to-end duodenojejunostomy, end-to-side hepaticojejunostomy (8-10 cm distal), and finally duct-to-mucosa pancreaticojejunostomy to a separate Roux loop. The authors commented that the end-to-end duodenojejunostomy anastomosis in conjunction with a biliary anastomosis 6-8 cm downstream, restored the natural anatomical arrangement, and appeared to avoid the early DGE. Furthermore, the isolated Roux loop pancreaticojejunostomy was reported to minimize pancreatic leaks[30]. Park et al recommended reconstruction of the pancreatic-biliary anastomoses by bringing the jejunal limb through the transverse mesocolon (antemesenteric method) instead of underneath the mesenteric vessels (retromesenteric method). The authors claimed that this technique avoided the venous congestion of the jejunal limb of the retromesenteric route[18]. Sugiyama et al recommended a reconstruction method in which the pancreas and the bile duct were anastomosed to the proximal jejunum brought through the transverse mesocolon, and the duodenum was antecolically anastomosed to the jejunum below the mesocolon. The right gastric artery was divided in order to place the stomach, the duodenum, and the jejunum in a straight line resulting in avoidance of torsion or angulation of the reconstructed alimentary tract[19]. Kurosaki and Hatakeyama recommended reconstruction with Billroth II type antecolic duodenojejunostomy to minimize the occurrence of DGE[31]. Kim et al reported a 2.2% incidence of early DGE after PPPD when pyloromyotomy was added to the procedure. The authors concluded that DGE might be caused by operative injuries to the vagus innervating the pyloric region[32].

The low occurrence of early DGE (5.4%) in the current study deserves some practical points to be discussed that may be beneficial to surgeons frequently frustrated by this complication of PPPD. All cases were performed by the first author who performed resection and reconstruction with the same techniques except for the adding of external pancreatic stent after the year 2000. Reconstruction of the pancreatic stump, the common bile duct, and the duodenal stump after removal of the surgical specimen was accomplished with the method commonly used by several investigators (Fig. 1, 2). The jejunum was brought through the retromesenteric passage (duodenal bed) to anastomose to the pancreatic stump and the common bile duct, respectively. The duodenojejunostomy anastomosis was performed anterior to the transverse colon. Since the year 2001, the authors have routinely inserted an external pancreatic stent to the pancreatic stump on the belief that it would help to prevent pancreaticojejunostomy anastomotic leakage. This stent was removed 3 or 4 weeks after the operation. During the operation, the authors were strictly concerned with the meticulous dissection, gentle tissue handling, complete hemostasis, and careful performing anatomical oriented anastomosis. At the end of reconstruction, no angulation, kinking or redundancy of the jejunal limb should be present. Right gastric artery was ligated and divided

in some patients with the same reason as described by Sugiyama[19]. Rough and hasty movement should be avoided at all time during this technically demanding operation. With the above mentioned surgical techniques, the authors have not encountered any anastomotic angulation or leakage or intra-abdominal collection or abscess requiring re-operation or percutaneous drainage, the speculated factors for early DGE. Moreover, avoidance of forceful and prolonged gastrointestinal clamping while performing Billroth II type duodenojejunostomy and other anastomoses was also another technique to keep clear of unnecessary injuries to the blood supply, the nerve supply and the myoneural components of the gastrointestinal wall.

Except for prophylactic antibiotics, the authors did not use any pharmacologic agent to improve gastrointestinal motility or to prevent pancreaticojejunostomy anastomotic leakage. The authors believe that excellent surgical techniques with absolute awareness of complications that may occur in every step of the operation are key factors for satisfactorily results of this complex procedure. The authors admit that the operative time was relatively long (mean 450 $\pm$ 98 minutes), yet this is comparable to many previous studies[14,33-35]. For both patients in the presented study who had early DGE, the authors could not identify any specific cause and fortunately, the patients had uncomplicated recovery.

In conclusion, a low occurrence of early DGE after PPPD has been presented. Although several methods of prevention have been mentioned in the literature, careful and faultless surgical techniques seem to be the most important armamentarium. The authors believe that surgical experience and unhurried, meticulous operative procedure enhance the outcome.

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การผ่าตัดแพนครีเอติโคดูโอเดเนกโตมี่ชนิดเก็บหูรูดที่พบอุบัติการณ์ต่ำในแง่ของกระเพาะอาหารกลับมาทำงานช้าในระยะแรกหลังผ่าตัด

สุวิทย์ ศรีอัษฎาพร, สุกัญญา ศรีอัษฎาพร, ศุภฤกษ์ ปรีชายุทธ, รัฐพลี ภาคอรรถ, กฤตยา กฤตยากีรณ

ความเป็นมาและวัตถุประสงค์: *ภายหลังการผ่าตัดแพนครีเอติโคดูโอเดเนกโตมี่ชนิดเก็บหูรูดใหม่ ๆ มักมีภาวะแทรกซ้อนที่พบบ่อย คือ กระเพาะอาหารกลับมาทำงานช้า ผู้นิพนธ์และคณะได้ศึกษาถึงอุบัติการณ์ของภาวะแทรกซ้อนดังกล่าวของผู้ป่วยในความรับผิดชอบและได้วิเคราะห์ถึงผลการศึกษาร่วมกับทบทวนวรรณกรรมที่เกี่ยวข้องกับภาวะแทรกซ้อนดังกล่าวพอสังเขป*

วัสดุและวิธีการ: *เป็นการศึกษาผู้ป่วยจำนวน 37 รายที่ได้รับการผ่าตัดแพนครีเอติโคดูโอเดเนกโตมี่ชนิดเก็บหูรูดเนื่องจากมะเร็งบริเวณแอมพูล่าออฟวาเตอร์ ส่วนหัวของตับอ่อน ดูโอเดนั่ม และส่วนปลายของท่อน้ำดีหรือพยาธิสภาพอื่น ๆ บริเวณส่วนหัวของตับอ่อน ระหว่างเดือนเมษายน พ.ศ. 2535 ถึงเดือนมีนาคม พ.ศ. 2549 การผ่าตัดทำโดยผู้นิพนธ์คนแรกโดยใช้เทคนิคการผ่าตัดแบบเดียวกันตลอดยกเว้นได้ใส่ท่อระบายเข้าท่อตับอ่อนเพื่อระบายน้ำย่อยตับอ่อน ออกสู่ภายนอกร่างกายในผู้ป่วยที่ได้รับการผ่าตัดภายหลังปี พ.ศ. 2543*

ผลการศึกษา: *ภาวะกระเพาะอาหารกลับมาทำงานช้าในระยะหลังผ่าตัดใหม่ ๆ เกิดขึ้นในผู้ป่วยจำนวน 2 ราย (ร้อยละ 5.4) โดย 1 รายอยู่ในกลุ่มที่ไม่มีท่อระบายท่อตับอ่อน และ 1 รายอยู่ในกลุ่มที่มีท่อระบายท่อตับอ่อนออกสู่ภายนอกร่างกาย ผู้ป่วย 2 รายมีการรั่วของน้ำย่อยตับอ่อน และ 2 รายมีแผลติดเชื้อ ภาวะแทรกซ้อนโดยรวมคิดเป็นร้อยละ 16.2 ผู้ป่วยในรายงานนี้ไม่มีผู้ใดต้องรับการผ่าตัดซ้ำหรือมีภาวะติดเชื้อในช่องท้องที่ต้องผ่าตัดหรือใส่ท่อระบายหนองออก รายงานนี้ไม่มีผู้ป่วยเสียชีวิต*

สรุป: *อุบัติการณ์ของภาวะกระเพาะอาหารกลับมาทำงานช้าในระยะหลังผ่าตัดแพนครีเอติโคดูโอเดเนกโตมี่ชนิดเก็บหูรูดใหม่ ๆ ในรายงานนี้ค่อนข้างต่ำ ซึ่งผู้นิพนธ์เข้าใจว่ามีความสัมพันธ์กับการที่การผ่าตัดมีภาวะแทรกซ้อนต่าง ๆ น้อยอันเนื่องมาจากความระมัดระวังในเทคนิคการผ่าตัด ประสบการณ์ในการผ่าตัดมีส่วนสำคัญที่ทำให้ภาวะแทรกซ้อนดังกล่าวเกิดขึ้นน้อยลง*