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ORIGINAL ARTICLE

Antecolic gastrointestinal reconstruction with pylorus dilatation. Does it improve delayed gastric emptying after pylorus-preserving pancreaticoduodenectomy?

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Abstract

Objective. The aim of our study focuses upon prevention of delayed gastric emptying (DGE) after pancreaticoduodenectomy using a alternative reconstruction procedure. *Method.* Forty consecutive patients underwent a typical pylorus-preserving pancreaticoduodenectomy (PPPD) with antecolic reconstruction in a two-year period (January 2002 until January 2004), while a similar group of 40 consecutive patients underwent PPPD with application of pyloric dilatation between January 2004 and January 2006. Early and late complications were compared between the two groups. *Results.* DGE occurred significantly more often in the group of patients treated by the classical PPPD technique (nine patients −22%) compared with those operated on with the addition of pyloric dilatation technique (two patients −5%) ($p < 0.05$). The incidence of other complications did not differ significantly between the two groups. *Conclusions.* The application of dilatation may decrease the incidence of DGE after PPPD and facilitates earlier hospital discharge.

Key Words: *pylorus-preserving pancreaticoduodenectomy, pyloric dilatation, delayed gastric emptying (DGE)*

Introduction

Pancreatic cancer remains one of the most fatal malignances today characterized by poor five-year survival rates even after curative resection [1,2]. Recent advances in surgical technique have reduced significantly the perioperative mortality rates of patients undergoing pancreatic head resection, and mortality rates below 5% have been reported in high volume centers of pancreatic surgery.

Pylorus-preserving pancreaticoduodenectomy (PPPD), introduced by Traverso and Longmire during the late 1970s, has been shown to represent an adequate alternative resection method to classical pancreaticoduodenectomy (PD) (Whipple's procedure) [3].

Several recent studies have demonstrated that PPPD has equal or even superior outcomes regarding quality of life without compromising the oncological outcome when compared with the classical Whipple operation [4–8].

Furthermore, randomized trials comparing the two techniques have implicated significant benefit toward PPPD regarding operative time and blood loss showing at least equivalent survival [9–12]. Although in these studies morbidity and mortality were similar in both groups, a higher incidence of delayed gastric emptying (DGE) in the pylorus-preserving modification has been noted, thus preventing its wide adoption by all pancreatic surgery centers [8].

Despite the fact that DGE is a transient and not life-threatening phenomenon, is considered responsible for prolonged inhospital stay and increased associated morbidity [13,14].

The incidence of DGE reported in recent literature ranges between 15 and 45%, following pylorus preservation, but the underlying pathomechanism remains ill defined [5–7]. Several factors have been related to DGE occurrence, including gastric atony as a result of decreased plasma motilin levels, pylorospasm, hormonal dysrythmias due to local devascularization, as well as septic complications due to anastomotic leakage [14–18]. Additionally, significant attention has been drawn to the position of the

duodenojejunostomy as a factor predisposing to DGE occurrence. Several studies have postulated that antecolic route of reconstruction of duodenojejunostomy in PPPD is associated with lower rates of DGE (<15%) when compared with a retrocolic fashion of reconstruction (>30%) [19,20].

We describe herein the use of an alternative surgical technique of pyloric dilatation performed at the time of pylorus-PPPD and concomitant antecolic gastrointestinal (GI) reconstruction in a prospective cohort of patients undergoing standard pylorus PPPD.

Material and methods

Patients

Between January 2002 and January 2006, 40 consecutive patients underwent a standard PPPD for periampullary disease, followed by a consecutive group of 40 patients who underwent a PPPD with mechanical dilatation of the pylorus after duodenal transection.

Both groups were operated by the same surgical team. Our standardized surgical technique of PPPD employs the following steps; the right gastroepiploic vessels are divided at their origin while the gastroepiploic arcade is preserved along the greater curvature. The right gastric artery is divided at its origin. This procedure allows the stomach and the proximal duodenum to be mobilized downward in a straight line. A standard lymphadenectomy is performed along the hepatoduodenal ligament, superior mesenteric vessels and the celiac trunk. After resection of the pancreatic head, an end-to-side pancreaticojejunostomy is formed in a two-layered fashion (duct to mucosa anastomosis and a second layer of interrupted sutures) with the use of monofilament absorbable sutures (PDS 5-0; Johnson & Johnson). A hepaticojejunostomy is formed by single interrupted sutures PDS 4-0, or 5-0 according to the width of the hepatic duct remnant. The duodenum is transected with a linear stapler 3–4 cm *distal to* the pylorus, and a duodenojejunostomy is made via a hand-sewn double-layer technique with PDS 4-0 (a running inner layer followed by a interrupted outer layer). The duodenojejunostomy is always formed in an antecolic position, and pyloric dilatation precedes reconstruction, by using *a metal sizer of 26–30 mm* for five seconds. Two soft vacuum drainage tubes are used routinely, one placed at the site of pancreaticojejunostomy while the other at the area of the biliary anastomosis. Surgical drains are removed approximately in postoperative day 7, unless a pancreatic fistula is established.

Starting preoperatively, all patients undergoing pancreatic head resection receive 3×200 μg Octreotide subcutaneously until postoperative day 7, in order to minimize the possibility of postoperative leakage and pancreatic fistula formation. They all receive antibiotic prophylaxis and proton pump inhibitors as stress ulcer prophylaxis, too. The nasogastric (NG) tube is removed when the daily drainage was less than 250 ml along with recovery of bowel function. Clear liquids were initiated soon after the removal with tapering of i.v. fluids progressively. The NG tube was reinserted if the patient vomited a volume of more than 300 ml on more than one occasion, if persistent nausea not responding to medication had developed, or if epigastric fullness sensation has occurred. In such cases radiographic evaluation with contrast medium in the upright position was performed to exclude potential anastomotic leakage from the duodenojejunostomy and to assess upper GI free passage.

Relying on clinical judgement, we adopted the definition of DGE by Hartel et al. as need for maintenance of NG tube for more than 10 days after surgery, inability to proceed to regular diet within 10 days, vomiting for more than three consecutive days after the fifth postoperative day and by whether radiographic passage with water soluble contrast medium revealed a hold-up of the contrast medium in the stomach [21].

DGE was managed with prolonged NG intubation with or without prokinetic agents (e.g. erythromycin) administration.

Preoperative evaluation

All candidates for pancreatic head resection fulfilled the criteria of resectability, namely (1) absence of metastatic disease; (2) absence of tumor extension to the superior mesenteric artery or celiac axis; and (3) patency of the superior mesenteric vein (>50%), and portal vein confluence with a suitable segment of superior mesenteric and portal vein to allow venous resection and reconstruction if necessary.

Perioperative complications

Major perioperative complications were defined as follows: perioperative mortality as death within the first 30 days after surgery or during the same hospital admission for surgery; need for reoperation; pancreaticojejunal anastomotic leak (pancreatic fistula) was defined as the presence in the drain of any quantity of amylase-rich fluid (three times the upper limit of normal serum amylase) on postoperative day 3 and on; intra-abdominal hemorrhage; intra-abdominal fluid collection (sterile or abscess); myocardial infarction or sudden cardiac death; pulmonary complications including pneumonia; GI bleeding; and sepsis syndrome. Prolonged intensive care unit stay greater than seven days was defined as a complication. Length of stay was calculated by considering the next day of surgery as day 1.

Statistical analysis

Covariates included age, sex, tumor size, resection status, and lymph node involvement; comorbid factors included diabetes, coronary disease, peripheral vascular disease, chronic obstructive pulmonary disease, and type of pyloric reconstruction (standard and pyloric dilatation); postoperative complications, including pancreatic leak, biliary leak, pneumonia, bleeding, reoperation and intra-abdominal abscess. Categorical data were analyzed with Fisher's exact test, while the Mann Witney test was used for the analysis of quantitative variables. Analysis was performed with SPSS 10 (SPSS, Chicago, IL). Factors with a level of significance of <0.05 were considered to be statistically significant. The study had the approval of the scientific committee of our hospital.

Results

Between January 2002 and January 2006, 80 patients underwent PD for periampullary disease.

Forty consecutive operations were performed with a standard technique of pylorus- PPPD, followed by 40 consecutive patients who underwent pylorus-PPPD and pyloric dilatation at the time of surgery. Among the 80 patients, 52 (65%) underwent PPPD for adenocarcinoma of the pancreas, five (6.25%) for cholangiocarcinoma, six (7.5%) for ampullary adenocarcinoma, two (2.5%) for duodenal adenocarcinoma, one (1.25%) for neuroendocrine malignancy, and 14 (17.5%) for chronic pancreatitis (Table I).

The median age, sex distribution, tumor size, rate of lymph nodes retrieval, Ro resection rate, and requirement for vascular resection were similar between patients undergoing PPPD and PPPD with pyloric dilatation (Table II).

DGE occurred in nine out of 40 patients who underwent a standard PPPD (22%). Five patients required maintenance of NG tube for more than 10 days after surgery (15, 12, 14, 14, and 11 days, respectively), two patients demonstrated vomiting after the 5th postoperative day, while inability to proceed to regular diet occurred in all nine patients. Only two out of 40 patients developed DGE in the group of PPPD+pyloric dilatation (5%). The differ-

Table I. Final diagnosis for patients who underwent pancreatic head resection 1.

	PPPD	PPPD+pyloric dilatation
Histology		
Pancreatic AdenoCa	28	24
Bile duct Ca	3	2
Duodenum Ca	1	1
Ampullary Ca	1	5
Neuroendocrine tumor	1	0
Chronic pancreatitis	6	8
Totals	40	40

Table II. Patients characteristics and perioperative parameters.

	PPPD	PD+pyloric dilatation	
Male/Female	17/23	14/26	ns
Age*	62.9 (41–83)	64.3 (24–79)	ns
Tumor size (cm)†	2.3 (0.5–3.5)	1.7 (0.6–3.1)	ns
R0 resection n (%)	35/40 (87.5%)	33/40 (82.5%)	ns
Lymph nodes*	17 (12–24)	18 (13–26)	ns
Vascular resection	6/46	8/46	ns
Length of stay (days)†	12.2 (8–25)	7.8 (7–21)	$P<0.05$
DGE	9/40 (22%)	2/40 (5%)	$P<0.05$

*Median.
†Mean.
ns, not significant.

ence reached statistical significance ($p<0.05$). Additionally, the average length of stay was significantly shorter in the pyloric dilatation group comparing to the classical PPPD procedure (7.8 vs. 12.2 days, $p=0.008$).

Overall the complication rate, with the exception of DGE, was 27.5% (22 patients out of 80), but no significant difference was noticed in any type of complications among the study groups (Table III).

Discussion

PPPD has been adopted by many surgeons as the operation of choice for periampullary surgical pathology. Whether PPPD is a superiorly "curative" resection compared to classical Whipple or vice versa cannot be established, since many reports including several Randomized Control Trials (RCTs) cannot conclude in favor of one technique over the other. Pooled long-term results of four RCTs showed no difference in terms of overall survival [11,12,20,22].

Although the procedure has overcome the primary criticism regarding the therapeutic oncological adequacy, controversy still exists regarding the incidence of DGE, the considered major disadvantage of the operation.

The reported incidence of early DGE after PPPD, ranges between 15 and 45% compared to less than 10% following the classical Whipple operation [5–7].

Table III. Postoperative complications.

	PPPD	PD+pyloric dilatation	P-value
DGE	9/40	2/40	$P<0.05$
Days of gastric suction[a]	5.2 (2–15)	3.6 (2–14)	ns
Postoperative complications(n)	10	12	ns
Pancreatic fistula	4	4	ns
Intraabdominal abscess	2	3	ns
Cholangitis	1	2	ns
Pneumonia	3	3	ns

†Mean.
ns, not significant.

However, other studies have demonstrated no difference in DGE rates among the two procedures but a temporary gastric dysfunction in both types of operations due to the surgical trauma [23]. Although DGE can be described in general as the need for persistent NG decompression leading in delay in food intake, the lack until recently, of a uniformly accepted definition of this entity is largely responsible for the above discrepancy.

Because of the time period during which we conducted our study we adopted the definition given by Hartel et al. instead of the more detailed definitions recommended recently by the International Study Group of Pancreatic Surgery (ISGPS) [21], which classified DGE in three Grades depending on the period NG tube was maintained and/or the time it was reinserted plus the day the patient proceeds to solid food intake. Grade A represents cases of NG tube remainance between days 4 and 7, or when the tube is reinserted, due to vomiting, in case it was originally taken out, during the first three postoperative days. Solid food intake is not possible on postoperative day 7, something that is reversible till day 14. DGE is considered as grade B, when the NG tube remains in place between days 8 and 14, or when is reinserted, due to nausea and vomiting, after day 7 and the patient cannot tolerate regular diet on day 14, which is possible on day 21. Finally, grade C includes those patients who retain NG tube, or to whom it is reinserted after postoperative day 14 and cannot proceed to solid food intake till day 21.

Furthermore, our sample size is not adequate enough to perform sound analysis according to grades of DGE as these are defined in the above recommendations.

Recently, a number of reports have shown a strong association between DGE and the route of GI reconstruction. According to these findings, DGE is decreased when the duodenojejunal anastomosis is positioned antecolically [17,18,20,21,24, 27]. Torsion or angulation of the duodenojejunostomy giving rise to ischemia may affect gastric emptying due to less efferent loop mobility and transverse colon dilatation in the retrocolic group.

In the present study, the incidence of DGE in the group of patients who underwent PPPD + pyloric dilatation was 5% (two out of 40 patients), compared to 22% (nine out of 40) in those without pyloric dilatation, showing a statistically significant difference ($p < 0.05$). Both groups under investigation had an antecolicaly reconstructed gastroenteroanastomosis, but those in whom the dilatation technique was applied achieved shortened length of hospital stay.

Although pyloric dilatation has already been reported to contribute in a positive manner to incidence of DGE, it is the first report to our knowledge where it is combined with antecolic reconstruction of the duodenojejunal anastomosis. Fischer et al. demonstrated similarly low rates of DGE as in our study in a group of patients with retrocolicaly placed gastroenteroanastomosis, despite the fact that this route of reconstruction is considered a potential contributor to DGE.

Although in our study we did not confirm radiographically or by manometry the concept of improved motility of the pylorus after dilatation, the theory that temporary pyloric muscle contraction due to perioperative injury of the motility mechanism seems attractive and is supported by others [15,25].

DGE in association with postoperative intrabdominal complications, such as anastomotic leakage, fluid collections or abscess, appears to be a generally accepted concept in literature. However, in our study there was no significant difference regarding the rate of those complications between the two groups under investigation. Hence, we could not confirm this parameter as a potential risk factor for the development of DGE. This finding is in agreement with the results reported by Jimenez et al. that DGE can be also apparent as isolated event [26].

Although our study has the limitations of a nonrandomized trial, our data demonstrate that pyloric dilatation following antecolic PPPD, may reduce the incidence of DGE to a rate similar or even less than that of studies where a classical PPPD is utilized. Further randomized trials are needed to clarify the potential benefit of pyloric dilatation in the occurrence of DGE.

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