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Slowing of Motor–Evacuation Function of the Stomach After Pancreatoduodenectomy: A Modern Approach to the Problem

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Abstract: To investigate the effectiveness of the existing methods of forming anastomoses and to determine the influencing factors on the development of delayed gastric emptying (DGE) or slowing of motor–evacuation function of the stomach. An assessment of the frequency, features of the clinical course of DGE after pancreatoduodenectomy, in cases with underwent pylorus-preserving pancreaticoduodenectomy (PPPD), and pylorus-removing pancreaticoduodenectomy (PrPD), the way of reconstruction of the gastrointestinal tract based on the analysis of the given options for surgical interventions. A retrospective study was conducted of 102 patients between January 2019 and November 2021 who underwent Traverso pylorus-preserving pancreaticoduodenectomy and pylorus-removing pancreaticoduodenectomy. The patients were divided into two groups: I - 26 patients who had delayed gastric emptying and II - 76 patients without symptoms of DGE. complications occurred in 42% (43 patients), and DGE was diagnosed in 25.5% (26) of 102 patients. An postoperative pancreatic fistulas (POPF) was found in 14% (14 patients), and clinically significant fistulas (grades B and C) in 9% (9 patients). Among 26 patients, DGE in 16 patients had the degree of severity A, 8 - B, and 2 - C. The type of gastrojejunostomy ($P < 0.05$) significantly affects the occurrence of DGE. The type of pancreaticojejunostomy anastomosis ($P = 0.85$) does not affect the occurrence of delayed evacuation from the stomach. Patients with complications were discharged from the hospital 6 days later on average. General surgical complications ($P \leq 0.001$); pancreatic fistula ($P < 0.05$) is significantly associated with a clinically significant delay in DGE; biliary fistulae ($P = 0.75$), bleeding ($P = 0.44$) - no correlation was noted. The data obtained from the study of influencing factors are presented in Table 1.

Keywords: Delayed Gastric Emptying (DGE), Pancreaticoduodenectomy (PD), Pylorus-Removing Pancreaticoduodenectomy (PrPD), Pylorus-Preserving Pancreaticoduodenectomy (PPPD), Postoperative Pancreatic Fistulas (POPF)

1. Introduction

Delayed gastric emptying is a serious complication during hepatopancreatobiliary operations and a complex phenomenon with multifactorial genesis. Pancreatoduodenectomy is considered one of the most technically complex operations in abdominal surgery. The frequency of complications ranges from 30% to 70% [1-3]. The most frequent and dangerous complications are related to the state of the pancreatic parenchyma and the diameter of the main pancreatic duct, which leads to a high frequency of

postoperative pancreatic fistulas (POPF) [4, 5]. One of the frequent complications is the delay in emptying the stomach, which causes significant discomfort in patients in the postoperative period, which increases the length of the patient's stay in the hospital and additional costs for treatment [6]. Although this complication is not considered life-threatening, the problem needs to be studied with further treatment. Research shows that surgical techniques and other clinical features of patients can influence the occurrence of this complication, which is observed in 20-55% of cases [7-10]. These huge differences in incidence depend on which classification the research surgeons use. There is no single statement in the literature as to whether preservation of the pylorus increases the frequency of its occurrence after PD. Some studies report the benefits of pyloric resection to prevent impaired gastric emptying [11, 12]. In addition, preservation of the pylorus or retrocolic reconstruction did not increase the number of patients with delayed evacuation from the stomach. Also, entero-enterostomy according to Brown and Billroth II reconstruction reduced the frequency of DGE [13-15].

2. Materials and Methods

A single-center retrospective study of the results of treatment of 102 patients from January 2019 to November 2021 who underwent PD: with preservation of the pylorus according to Traverso and pancreatoduodenectomy with removal of the pylorus according to Whipple. Patients are divided into two groups: 1st – 26 patients who had delayed gastric emptying; 2nd – 76 patients, without signs of delay. Criteria for inclusion in the study: pylorus-preserving pancreatoduodenectomy (PPPD) and pylorus-removing pancreaticoduodenectomy (PrPD), age of the patient of any gender from 18 years, route of duodeno- and gastrojejunostomy (antecolic, retrocolic). All patients underwent a standard lymphadenectomy. Criteria for excluding patients from the study: simultaneous operations. DGE was recorded according to the ISGPS definition and classified into three grades (A–C) based on the length of time the nasogastric tube (NGT) was in place; the need for re-introduction of NGT; days when solid food was first started; vomiting and the use of prokinetics. Complications were classified according to the recommendations of the International Study Group on Pancreatic Surgery (ISGPS). Postoperative mortality was 3% (3 patients). Total surgical complications were 42% (43 patients). Specific surgical complications included: POPF, DGE, and infectious complications according to the new revision of the International Research Group on Pancreatic Fistula (The 2016 update of the International Study Group definition and grading of postoperative pancreatic fistula). An POPF was observed in 14% (13 patients), and clinically significant fistulas (grades B and C) in 9% (9 patients). Gastrointestinal bleeding occurred in 5% (5 patients), biliary fistula in 3% (3 patients), other complications in 16% (15 patients) of 102. DGE occurred in 26 (25.5%) of 102 patients The classification ISGPS was used to determine the severity of impaired gastric motor evacuation function. After PPPD, this complication was diagnosed in 26% (13 patients) out of 50, after PrPD in 25% (13 patients) out of 52 patients.

Statistical Analysis

Statistical processing of the obtained data was carried out using the GraphPAD 8 statistical package, MS Excel. Variables were assessed for normality using the Kolmogorov-Smirnov test. For normally distributed variables, data were expressed as mean ± standard deviation (SD); t - test was used to compare means. Non-normally distributed variables were expressed as medians (range), and non-parametric tests (Mann–Whitney U-test) were used for statistical comparison. The xi-square test was used for nominal data, and Fisher's exact test was used in the case of low expected frequency. Variables that were considered significant ($P \leq 0.05$) in univariate analysis. Odds ratios are presented with corresponding 95% confidence intervals.

Table 1. *Factors affecting the occurrence of DGE.*

Factors affecting the occurrence of delayed gastric emptying.	Total quantity %, range (n [102)	With DGE 25.5% (n [26)	Without DGE 74.5% (n [76)	p
Type of pancreatic anastomosis				0.85
Ductojejunal	22 (23)	19 (5)	24 (18)	
External drainage of the versung duct	13 (13)	12 (3)	13 (10)	
Another	65 (66)	69 (18)	63 (48)	
With preservation of the pylorus	49 (50)	50 (13)	49 (37)	
Type of duodenojejunostomy				0.91
Antecolithic	49 (50)	50 (13)	49 (37)	
Retrocolitic	0	0	0	
Type of gastrojejunostomy				0.01
Antecolithic	47 (48)	38 (10)	50 (38)	
Retrocolitic	4 (4)	12 (3)	1 (1)	
Postoperative complications				
General surgical complications	42 (43)	50 (26)	22 (17)	<0.001
Pancreatic fistula	14 (14)	19 (5)	12 (9)	0.05
Fluid accumulations in the abdominal cavity	3 (3)	8 (2)	1 (1)	0.09
Pulmonary complications	2 (2)	0 (0)	3 (2)	
Bleeding	5 (5)	8 (2)	4 (3)	0.44
External biliary fistula	3 (3)	4 (1)	3 (2)	0.75

Factors affecting the occurrence of delayed gastric emptying.	Total quantity %, range (n [102)	With DGE 25.5% (n [26)	Without DGE 74.5% (n [76)	p
Sepsis	1 (1)	0 (0)	1 (1)	
Acute pancreatitis	8 (8)	8 (2)	8 (6)	0.98
Intestinal fistula	2 (2)	4 (1)	1 (1)	

The studied groups of patients did not differ significantly in average age and gender. There were no statistically significant differences between groups (p=0.97) in the distribution of malignant and benign tumors.

3. Result and Discussion

Postoperative complications occurred in 42% (43 patients), and delayed gastric emptying was diagnosed in 25.5% (26) of 102 patients. POPF was detected in 14% (14 patients), and clinically significant fistulas (grades B and C) in 9% (9 patients). DGE occurred in 25.5% (26) of 102 patients and was the only postoperative complication in 16 patients, but occurred concurrently with other complications in the remaining 10 patients. Among 26 patients with impaired motor evacuation function, 16 had degree A, 8 - B, and two C. The type of gastro-jejunostomy, antecolitic or retrocolytic ($P < 0.05$), had a significant effect on the occurrence of delayed gastric emptying. The type of duodenojejunostomy is difficult to assess because of the majority of patients who underwent exclusively anticolitic reconstruction. Discharge from the hospital ($P < 0.05$) was observed later in patients with delayed evacuation from the stomach. The need for total parenteral nutrition was significantly higher in patients with DGE with grades B/C. The type of pancreaticojejunal anastomosis ($P = 0.85$) does not affect the occurrence of delayed evacuation from the stomach. Overall surgical complications ($P \leq 0.001$), POPF ($P < 0.05$), were significantly associated with clinically significant delayed gastric emptying; biliary fistulae ($P = 0.75$), bleeding ($P = 0.44$) - no correlation was noted.

4. Conclusion

The main factors of influence that played a key role in the development of a violation of the motor-evacuation function of the stomach are defined as: POPF; general surgical complications; route of gastrointestinal reconstruction during pancreatoduodenectomy (Antecolic versus retrocolic) was associated with delayed gastric emptying. DGE requires complex conservative treatment and a long time to restore the evacuation function of the gastrointestinal tract. In this way, it is necessary to provide selective assistance to patients with delayed gastric emptying and implement quick ways to restore the patient, as well as prevent the occurrence of complications. It is obvious that further research is needed, focused on surgical reconstructive techniques in pancreatoduodenectomy.

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