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Risk factors for delayed gastric emptying after pancreaticoduodenectomy

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Abstract
Introduction: Delayed Gastric Emptying (DGE) is one of the most common postoperative complications after pancreatic surgery, occurring in 19%-57% of patients. Although DGE is known to be associated with other intra-abdominal complications, factors responsible for DGE in patients without intra-abdominal complications are poorly understood.
Aim: The aim of the present study is to analyze factors causing Delayed Gastric Emptying after pancreaticoduodenectomy.
Materials and Methods: This was a prospective study done in the Department of Surgical Gastroenterology, Nizam's Institute of Medical Sciences, Hyderabad between Feb 2007 and Jun 2009. All patients who underwent elective pancreaticoduodenectomy were included in this study. The risk factors assessed were patient factors, disease factors, operative factors and postoperative factors. The risk factors for DGE, Grade B & C DGE and DGE without intrabdominal complication were assessed.
Results: Delayed Gastric emptying occurred in 29 patients (45.3%) according to ISGPS criteria (Grade A 14; Grade B 8; Grade C 7). DGE without intrabdominal complication was seen in 12 patients (18.7%). The significant factors independently predicting DGE were Intraabdominal complication (OR 6.5, CI 1.424 -14.95, p = .011) and Diabetes (OR 3.5, CI .926 - 27.04, p = .06). Independent factor for Grade B & C DGE was Intraabdominal complication (OR 4.76, CI 1.15 - 19.63, p = 0.03). Factors independently predicting DGE without intraabdominal complication was retrocolic duodenojejunostomy (OR 3.99, CI 1.037 - 42.664, p = 0.04).
Conclusions: Intraabdominal complications and diabetes were independent risk factors for DGE. Retrocolic duodenojejunostomy was an independent risk factor for DGE without intraabdominal complication.

Keywords: Risk factors, delayed gastric emptying, pancreaticoduodenectomy

Introduction
Although mortality has decreased after pancreaticoduodenectomy (PD) morbidity rate is still high. Delayed Gastric Emptying (DGE) is one of the most common postoperative complications after pancreatic surgery, occurring in 19%-57% of patients [1]. Yeo *et al.* [2] defined DGE as a NGT left in place for ≥ 10 days plus one of the following or for 10 days plus 2 of the following: (a) repeated emesis after removal of the NGT, (b) need for prokinetic agents after POD 10, (c) need for reinsertion of the NGT, or (d) failure to progress with the diet. Later DGE was defined by the International Study Group of Pancreatic Surgery (ISGPS) [1]. Studies defining the role of potential risk factors for the development of postoperative complications are few, and sometimes with conflicting results. There is need to identify potential risk factors for predicting complications after pancreatic resections. Pathogenesis of DGE is varied: disruption of the vagal nerve system around the stomach with antroduodenal ischemia, decreased plasma concentration of motilin, gastric dysarythmia from peripancreatic inflammation, angulation or torsion of the duodenojejunostomy, aggressive lymph node dissection in the hepatoduodenal ligament, and pancreatic fibrosis. Although DGE is known to be associated with other intra-abdominal complications, factors responsible for DGE in patients without intra-abdominal complications are poorly understood.

Aim

The aim of the present study is to analyze factors causing Delayed Gastric Emptying after pancreaticoduodenectomy.

Materials and Methods

This was a prospective study done in the Department of Surgical Gastroenterology, Nizam's Institute of Medical Sciences, Hyderabad between Feb 2007 and Jun 2009.

Inclusion criteria

1. All patients who underwent elective pancreaticoduodenectomy were included in this study.
2. Both benign and malignant conditions of pancreas for which pancreaticoduodenectomywas done were included in the study.

Exclusion criteria

1. Emergency pancreatic surgeries were also excluded

A standardized preoperative operative workup was done in all cases. Preoperatively, all patients underwent an abdominal ultrasonography and computerized tomography with intravenous contrast. ERCP, Magnetic resonance imaging and Endoscopic US were only used in select cases. Details of these patients were entered into a prospective database.

Risk factors

Patient risk factors that were studied are age, sex, comorbid factors, Alcoholism, ASA physical status score, BMI, hemoglobin, blood urea, serum creatinine and serum Albumin. Disease factors studied are liver function tests, cholangitis, preoperative pancreatitis, site of tumor, histopathology, positive resection margin. Operative factors studied were Preoperative biliary drainage, type of procedure, total operative time, blood loss, intraoperative blood transfusions, intraoperative hemodynamic status, prophylactic administration of octreotide, pancreatic texture (soft vs hard), pancreatic duct size, bile duct size. Technical factors studied were Pylorus preserving or classical, Pancreaticogastrostomy (PG) vs Pancreaticojejunostomy (PJ), Duct to mucosa vs Dunking method, Antecolic vs retrocolic gastrojejunostomy, pancreatic duct stenting – internal or external, any additional procedures performed. Postoperative factors studied were serum AST and ALT.

Pancreatic fistula, Delayed Gastric Emptying and Hemorrhage were also graded according to International Study Group for Pancreatic Surgery definition.

Statistical analysis

Statistical analysis was performed using SPSS 17 software. Categorical variables were compared by Fisher exact test or Chi-square test when applicable. Continuous variables were analysed by student t test or Mann Whitney U test when applicable. We performed a univariate analysis and variables with $p < 0.20$ were selected for inclusion as independent factors in the sequential binary logistic regression analysis[3]. Factors with a level of significance of ≤ 0.05 were considered to be significant risk factors.

Results

Sixty four patients underwent pancreaticoduodenectomy between Feb 2007 to Jun 2009.

Complications after Whipple's procedure

Pancreatic fistula occurred in 13(20.4%) patients (Grade A 6; Grade B 4; Grade C 3). The incidence of Grade B & C fistula was 10.9%. Grade C pancreatic fistula occurred in 3 patients. Hemorrhage occurred in 7 patients after Whipples procedure. Early hemorrhage (< 24 hrs) was seen in 3 patients and late hemorrhage (> 24 hrs) in 4 patients. Early secondary hemorrhage (in 1st week) occurred in 2 and late secondary hemorrhage (after 1st week) occurred in 2 patients. Six patients required surgery. Associated conditions were pancreatic fistula 1 and hepatic artery thrombosis and ischemic hepatitis in1.

Delayed Gastric emptying (DGE)

Delayed Gastric emptying occurred in 29 patients (45.3%) according to ISGPS criteria (Grade A 14; Grade B 8; Grade C 7). DGE without intrabdominal complication was seen in 12 patients (18.7%).

Table 1: Risk factors for DGE

		DGE			DGE ISGPS B&C		
		absent	**present**	**P value**	**absent**	**present**	**P value**
Age	upto 50yrs	23(60.5)	15(39.5)	0.31	31(81.6)	7(18.4)	0.36
	>50 yrs	12(46.2)	14(53.8)		18(69.2)	8(30.8)	
	> 60yrs	4(50)	4(50)		6(75)	2(25)	
Sex	Male	22(50)	22(50)	0.29	33(75)	11(25)	0.759
	Female	13(65)	7(35)		16(80)	4(20)	
Pulmonary	absent	30(56.6)	23(43.4)	0.52	41(77.4)	12(22.6)	0.71
	present	5(45.5)	6(54.5)		8(72.7)	3(27.3)	
Cardiac	absent	33(54.1)	28(45.9)	1	47(77)	14(23)	0.55
	present	2(66.7)	1(33.3)		2(66.7)	1(33.3)	
Hypertension	absent	31(55.4)	25(44.6)	1	44(78.6)	12(21.4)	0.37
	present	4(50)	4(50)		5(62.5)	3(37.5)	
Diabetes	absent	31(59.6)	21(40.4)	0.119	42(80.8)	10(19.2)	0.13
	present	4(33.3)	8(66.7)		7(58.3)	5(41.7)	
Alcoholism	absent	23(51.1)	22(48.9)	0.42	34(75.6)	11(24.4)	1
	present	12(63.2)	7(36.8)		15(78.9)	4(21.1)	
Liver disease	Absent	33(54.1)	28(45.9)	1	47(77)	14(23)	0.55
	Child A	2(66.7)	1(33.3)		2(66.7)	1(33.3)	
Smoking	absent	25(51)	24(49)	0.37	34(69.4)	15(30.6)	0.01
	present	10(66.7)	5(33.3)		15(100)	0	
BMI	Underweight	10(83.3)	2(16.7)	0.05†	11(91.7)	1(8.3)	0.39†

	Normal	21(51.2)	20(48.8)		30(73.2)	11(26.8)	
	Overweight & obese	4(36.4)	7(63.6)		8(72.7)	3(27.3)	
Hb gms/dl		10.7±0.4	11.1±0.4	0.52*	10.8±0.3	11.3±0.6	0.43
Raised serum creatinine	absent	34(54.8)	28(45.2)	0.7	47(75.8)	15(24.2)	1
	present	1(50)	1(50)		2(100)	0	
	> 3 gms%	25(53.2)	22(46.8)		37(78.7)	10(21.3)	
Hypoalbuminemia (<3.5 gms/dl)	absent	16(53.3)	14(46.7)	1	23(76.7)	7(23.3)	1
	present	19(55.9)	15(44.1)		26(76.5)	8(23.5)	
Serum Bilirubin > 2 mg/dl	absent	19(63.3)	11(36.7)	0.21	27(90)	3(10)	0.02
	present	16(47.1)	18(52.9)		22(64.7)	12(35.3)	
Preoperative SGOT U/L	Up to 88	27(56.3)	21(43.8)	0.77	40(83.3)	8(16.7)	0.04
	> 88	8(50)	8(50)		9(56.3)	7(43.8)	
Preoperative SGPT U/L	Up to 119	27(56.3)	21(43.8)	0.77	41(85.4)	7(14.6)	0.44
	> 119	8(50)	8(50)		8(50)	8(50)	
Preop pancreatitis	absent	34(54.8)	28(45.2)	1	48(77.4)	14(22.6)	0.41
	present	1(50)	1(50)		1(50)	1(50)	
Cholangitis	absent	20(54.1)	17(45.9)	1	29(78.4)	8(21.6)	0.76
	present	15(55.6)	12(44.4)		20(74.1)	7(25.9)	
Preopbiliary drainage	absent	18(46.2)	21(53.8)	0.12	27(69.2)	12(30.8)	0.13
	present	17(68)	8(32)		22(88)	3(12)	
Operative time	<390 min	29(55.8)	23(44.2)	0.75	39(75)	13(25)	0.71
	>390 min	6(50)	6(50)		10(83.3)	2(16.7)	
	> 1000	6(54.5)	5(45.5)		9(81.8)	2(18.2)	
Intraop hypotension	absent	28(50.9)	27(49.1)	0.16	41(74.5)	14(25.5)	0.67
	present	7(77.8)	2(22.2)		8(88.9)	1(11.1)	
soft pancreas	absent	24(57.1)	18(42.9)	0.608	34(81)	8(19)	0.35
	present	11(50)	11(50)		15(68.2)	7(31.8)	
HPE	benign	1(25)	3(75)	0.34	3(75)	1(25)	0.65
	ch pancreatitis	2(40)	3(60)		3(60)	2(40)	
	malignant	32(58.2)	23(41.8)		43(78.2)	12(21.8)	
	present	2(100)	0		2(100)	0	
Type of whipples	pylorus preserving	30(53.6)	26(46.4)	0.71	41(73.2)	15(26.8)	0.18
	classical	5(62.5)	3(37.5)		8(100)	0	
PJ VS PG	PJ	33(54.1)	28(45.9)	1	47(77)	14(23)	0.55
	PG	2(66.7)	1(33.3)		2(66.7)	1(33.3)	
Type of PJ	Dunking	25(54.3)	21(45.7)	1	35(76.1)	11(23.9)	1
	Duct to mucosa	8(53.3)	7(46.7)		12(80)	3(20)	
PD <3 MM	absent	28(59.6)	19(40.4)	0.25	36(76.6)	11(23.4)	1
	present	7(41.2)	10(58.8)		13(76.5)	4(23.5)	
DJ	antecolic	18(60)	12(40)	0.46	25(83.3)	5(16.7)	0.25
	retrocolic	17(50)	17(50)		24(70.6)	10(29.4)	
	present	1(50)	1(50)		1(50)	1(50)	
Postop ventilatory support	absent	18(56.3)	14(43.8)	1	27(84.4)	5(15.6)	0.23
	present	17(53.1)	15(46.9)		22(68.8)	10(31.3)	
	> 17	8(57)	6(42.9)		10(71.4)	4(28.6)	
Pancreatic fistula	absent	32(62.7)	19(37.3)	0.014	43(84.3)	8(15.7)	0.008
	present	3(23.1)	10(76.9)		6(46.2)	7(53.8)	
Intraabdominal abscess	absent	34(59.6)	23(40.4)	0.04	48(84.2)	9(15.8)	0.0001
	present	1(14.3)	6(85.7)		1(14.3)	6(85.7)	
Haemorrhage	absent	33(57.9)	24(42.1)	0.23	45(78.9)	12(21.1)	0.34
	present	2(28.6)	5(71.4)		4(57.1)	3(42.9)	
Intraabdominal complication	absent	27(69.2)	12(30.8)	0.005	34(87.2)	5(12.8)	0.017
	present	8(32)	17(68)		15(60)	10(40)	

Numbers in parenthesis are row percentages; All continuous variables are expressed as Mean ± S.E.M; * indicate student t test; † indicate Pearson Chi-square test; ‡ indicate Mann Whitney U test; rest all p values are by Fischer Exact Test

Risk factors for Delayed Gastric Emptying (DGE) after Whipples procedure

Risk factors were analyzed for DGE, Grade B & C DGE and DGE without intraabdominal complications. Significant risk factors for DGE were diabetes (p = 0.11), BMI (p = 0.05), preoperative biliary drainage (p = 0.12) and intraabdominal complication (p=0.005). Risk factors for Grade B & C DGE were age (p = 0.04), diabetes (p = 0.13), absence of smoking (p = 0.01), serum bilirubin > 2mgs% (p = 0.02), preoperative SGOT > 88 U/L (p = 0.04), preoperative biliary drainage (p = 0.13) and presence of intraabdominal complication (p = 0.017). Factors analyzed are shown in Table 1.

Multivariate analysis using binary logistic regression for risk factors for DGE after Whipples procedure

In a multivariate model adjusting for each of the univariate risk factors, significant factors independently predicting DGE(Table2) were Intraabdominal complication (OR 6.5, CI 1.424 -14.95, p = .011) and Diabetes (OR 3.5, CI .926 - 27.04, p = .06). Significant factor for Grade B & C DGE (Table 3) was Intraabdominal complication (OR 4.76, CI 1.15 - 19.63, p = 0.03).

Table 2: Binary Logistic regression for DGE after Whipples procedure

Variable	Odds Ratio	95% Confidence Interval	p value
Intraabdominal complication	6.500	1.424 -14.95	0.011
Diabetes	3.500	0.926 - 27.04	0.061
Intraophypotension	2.164	0.03 - 1.59	0.141
BMI	1.481	0.555 - 12.366	0.224
Serum bilirubin > 2 mg/dl	1.054	0.581 - 5.697	0.305

Table 3: Binary Logistic regression for DGE B & C after Whipples procedure

Variable	Odds ratio	95% Confidence Interval	p value
Intraabdominal complication	4.768	1.15 - 19.63	0.031
Serum bilirubin > 7.1 mgs%	0.334	0.075 - 1.49	0.152
Diabetes	2.131	0.415 - 10.94	0.365
Preop SGOT > 88 U/L	0.267	0.06 - 1.172	0.080

Risk factors for DGE without intraabdominal complication

Table 4: Risk factors for DGE without intraabdominal complication

		DGE without IAC			DGE B&C without IAC		
		Absent	Present	p value	absent	present	p value
Age	Up to 50yrs	19(79.2)	5(20.8)	0.15	21(95.5)	1(4.5)	0.13
	>50 yrs	8(53.3)	7(46.7)		11(73.3)	4(26.7)	
	> 60yrs	2(40)	3(60)		3(60)	2(40)	
Sex	Male	17(65.4)	9(34.6)	0.71	19(79.2)	5(20.8)	0.14
	Female	10(76.9)	3(23.1)		13(100)	0	
Pulmonary	absent	23(76.7)	7(23)	0.1	25(89.3)	3(10.7)	0.57
	present	4(44.4)	5(55.6)		7(77.8)	2(22.2)	
Diabetes	absent	24(75)	8(25)	0.17	27(90)	3(10)	0.23
	present	3(42.9)	4(57.1)		5(71.4)	2(28.6)	
Alcoholism	absent	18(66.7)	9(33.3)	0.7	22(84.6)	4(15.4)	1
	present	9(75)	3(25)		10(90.9)	1(9.1)	
Serum bilirubin >2mg/dl	absent	15(75)	5(25)	0.5	18(94.7)	1(5.3)	0.18
	present	12(63.2)	7(36.8)		14(77.8)	4(22.2)	
Preoperative SGOT U/L	Up to 88	21(72.4)	8(27.6)	0.69	25(92.6)	2(7.4)	0.11
	> 88	6(60)	4(40)		7(70)	3(30)	
Preoperative SGPT U/L	Up to 119	22(71)	9(29)	0.68	27(93.1)	2(6.9)	0.05
	> 119	5(62.5)	3(37.5)		5(62.5)	3(37.5)	
Duodenojejunostomy	antecolic	15(83.3)	3(16.7)	0.09	17(94.4)	1(5.6)	0.34
	retrocolic	12(57.1)	9(42.9)		15(78.9)	4(21.1)	
Numbers in parenthesis are row percentages; All continuous variables are expressed as Mean ± S.E.M; * indicate student t test; † indicate Pearson Chi-square test; ‡ indicate Mann Whitney U test; rest all p values are by Fischer Exact Test							

Risk factors for DGE without intraabdominal complication (Table 4) were age (p = 0.13) and retrocolic duodenojejunostomy (p = 0.09). Risk factors for Grade B & C DGE without intraabdominal complication were age (p= 0.07), sex (p = 0.14), preoperative SGOT (p = 0.06) and preoperative SGPT (p = 0.02). In a multivariate model (table5)adjusting for each of the univariate risk factors, significant factors independently predicting DGE without intraabdominal complication was retrocolic duodenojejunostomy (OR 3.99, CI 1.037 - 42.664, p = 0.04).

Table 5: Binary logistic regression for DGE without intraabdominal complication

Variable	Odds Ratio	95% Confidence Interval	p value
Retrocolic DJ	3.994	1.03 - 42.664	0.04
Age > 50 yrs	1.439	0.499 - 17.95	0.23
Diabetes	1.269	0.399 - 30.04	0.26
Pulmonary	0.528	0.29 - 14.03	0.46

Table 6: Binary logistic regression for Grade B & C DGE without intraabdominal complication

	Odds ratio	95% Confidence interval	p value
Preoperative SGPT >119 U/L	5.438	0.57 - 51.54	0.14
Retrocolic DJ	5.868	0.45 - 76.4	0.17
Age > 50 yrs	7.775	0.62 - 96.96	0.11

Discussion

Delayed Gastric emptying occurred in 29 patients (45.3%) according to ISGPS criteria (Grade A 14; Grade B 8; Grade C 7) in our study. DGE without intrabdominal complication was seen in 12 patients (18.7%). DGE was the most common complication in our study. The leading cause of morbidity after PD is early DGE, which has been reported to occur in 20% to 50% of such patients. Although DGE is not

associated with mortality, it can jeopardize nutritional status and prolongs the postoperative hospital stay.

The wide range of occurrence of DGE in the different studies can be explained partially by differences in the definition of this complication. There are two widely used definitions for DGE after pancreatic resection. Yeo *et al*. [2] defined DGE as a NGT left in place for ≥ 10 days plus one of the following or for 10 days plus 2 of the following: (a) repeated emesis after removal of the NGT, (b) need for prokinetic agents after POD 10, (c) need for reinsertion of the NGT, or (d) failure to progress with the diet. Similarly, van Berge Henegouwen *et al*. [4] defined DGE as gastric stasis requiring nasogastric intubation for ≥10 days or the inability to tolerate a regular diet after POD 14. According to the standards of fast-track surgery and current postoperative management, the NGT should be removed as soon as possible after pancreatic resection. In some centers, the NGT is removed at the time the patient is extubated. Therefore, any nasogastric intubation lasting >3 postoperative days should be considered as DGE or a prolongation of DGE. In view of current practice, definitions from the early 1990s, in which maintenance of nasogastric intubation for>10 postoperative days was considered a sign of DGE, should be considered outdated. Therefore, need for maintenance of NGT for > 3 days or the need to reinsert the NGT for persistent vomiting after POD 3 was considered DGE according to ISGPS definition [1]. Kurosaki and Hatakeyama [5] compared 3 existing definitions of DGE in a series of 55 consecutive patients undergoing pylorus-preserving pancreaticoduodenectomy. Using the definitions of Fabre *et al*. van Berge Henegouwen *et al*. and Yeo *et al*. they showed that the presence of DGE by these different definitions was 6%, 29%, and 18%, respectively, exemplifying again the need for objective, universally accepted consensus definitions of morbidity after pancreatic surgery.

Using the ISGPS definition our DGE rate was 45.3% of which almost half of them were Grade A. Pathogenesis of DGE is varied: disruption of the vagal nerve system around the stomach with antroduodenal ischemia, decreased plasma concentration of motilin, gastric dysarythmia from peripancreatic inflammation, angulation or torsion of the duodenojejunostomy, aggressive lymph node dissection in the hepatoduodenal ligament, and pancreatic fibrosis. We analysed the risk factors for DGE and DGE without intrabdominal complication separately. Right gastric artery was ligated in all the cases. Pylorus preserving pancreaticoduodenectomy was the most common procedure performed (Pylorus preserving 56 /64, 87%; Classical in 8/64, 13%). Antecolic route of GI continuity was done in 30 (46.8%) and retrocolic route was done in 34 patients (53.2%). Ryles tube was removed on POD 2 or3. Feeding jejunostomy was done in all patients and trial feeds were started on POD1. In multivariate model adjusting for each of the univariate risk factors, significant factors independently predicting DGE were intraabdominal complication (OR 6.5, CI 1.424 -14.95, p = .011) and diabetes (OR 3.5, CI .926 - 27.04, p = .06). Significant factor for DGE of Grade B & C was intraabdominal complication (OR 4.76, CI 1.15 - 19.63, p = 0.03). The influence of complications on the appearance of DGE as in our study, has already been reported in several studies [4, 6, 7]. For some authors, the presence of intraabdominal complications was the most severe risk factor for DGE, which occurred in 65% of patients with those complications [4].

Retrocolic/antecolic GI reconstruction

Retrocolic GI reconstruction was identified as an independent risk factor for DGE without intrabdominal complication in our study. The antimesenteric position of the duodenojejunostomy has a lower risk of DGE than the retromesenteric position in various studies [8-10]. The theoretical background for this technique is that decreased blood circulation (especially venous drainage) of the jejunal limb following biliarypancreato-enteric reconstructions can lead to decreased motility and profound edema of the jejunal limb itself, and eventually edema of the duodenojejunal anastomosis. From a theoretical point of view, antecolic duodenojejunostomy avoids mechanical problems, because the descending jejunal loop is more mobile than after retrocolic reconstruction. Tani *et al*. [8] in a prospective randomized controlled trial showed that DGE occurred in 50% of patients in whom the retrocolic route was used but in only 5% in whom the antecolic route was used. However, the study included only 20 patients in each arm. In a recent prospective randomized controlled study [11] of gastric emptying assessed by 13C-acetate breath test the incidence of DGE and gastric emptying variables (Tmax, T1/2) after PPPD were similar between patients in whom reconstruction was performed by the antecolic route and those in whom it was performed by the vertical retrocolic route. This study had more objective measurement of gastric emptying but only 35 patients were studied. Our study is consistent with previous reports [8-10] that antecolic reconstruction has less DGE. Further larger RCT's are required to confirm the findings.

Early enteral nutrition

The fear that early feeding could increase the complication rate by stimulating pancreatic secretion led surgeons traditionally to maintain patients on long fasting periods after PD. Some studies showed that early enteral nutrition correlated with an impaired postoperative course, such as DGE or impaired respiratory mechanics [12, 13]. Lermite *et al*. [14] has shown that age and early enteral feeding with nasojejunal tube were independent risk factors for DGE. Recently, early postoperative enteral nutrition was suggested to surgeons as a way of improving the postoperative outcomes of patients having major digestive operations. Early postoperative feeding can be a further means of improving gastric emptying, as the fasting state impairs the peristaltic activity of the stomach and small intestine, whereas the fed state is characterized by more forceful peristaltic waves of contraction [15]. Balzano *et al*. [16] in a recent study of 252 patients undergoing PD followed a fast-track programme that included earlier postoperative feeding and mobilization. The programme of enhanced recovery resulted in a significantly reduced incidence of DGE, from 24·6 to 13·9 per cent, confirming that early feeding can improve gastric motility even after major pancreatic surgery. Our protocol is to start trial feeds from POD1 through feeding jejunostomy and allow enteral nutrition depending on patient's tolerance.

Pylorus preservation

In our study majority of patients underwent pylorus preservation. There was no significant difference in the incidence of DGE between classical and pylorus preserving pancreaticoduodenectomy. Initial reports suggested an increased rate of DGE after PPPD. Kim *et al*. [17] in a study

of 47 patients hypothesized that DGE may be due to pylorospasm secondary to vagal injuries at operation and he added pyloromyotomy. The addition of pyloromyotomy to pylorus-preserving pancreaticoduodenectomy was effective in preventing DGE. Two RCT however did not show any increased DGE after PPPD [18, 19]. However, the third RCT from Taiwan [20] has reported significantly increased rate of DGE in PPPD group, though with very small numbers. Three metaanalyses [21-23] published recently showed increased DGE after PPPD. Cochrane review opined that given a non-significant difference for the occurrence of DGE when considering all included studies (29.0% PPPD versus 24.4% CW; OR 2.35; P = 0.16), this result indicates that underpowered studies potentially overestimate the benefits of classical Whipples on the outcome DGE [23].

Diabetes

Incidence of DGE in patients with and without diabetes was 66.7% and 40.4% respectively. Diabetes was an independent risk factor for DGE in our series (OR 3.5, CI .926 - 27.04, p = .06). Idiopathic, diabetes and postsurgical causes account for a majority of all cases of gastroparesis from all causes [24]. However diabetes as an independent risk factor for DGE was not described previously. In our study 18% of patients were diabetics. Diabetics because of their predisposition to gastroparesis may be at an increased risk for DGE after pancreatic surgery.

Table 8: Risk factors for DGE on multivariate analysis

Author	No.	Incidence	Risk factors on multivariate analysis
Park YC *et al*. [9] JACS 2003	150	24%	preoperative cholangitis, postoperative intraabdominal complications, retromesenteric group
Kurosaki *et al*. [5] Hepatogastroenterology 2005	44		Antecolic duodenojejunostomy is protective and major complication is risk factor
O. Kollmar *et al*. [25] EJSO 2008	67	20%	Postoperative intraabdominal bleeding and infection
G. Balzano *et al*. [16] BJS 2008	252	38%	Fast-track programme protective
Emilie Lermite *et al*. [14] JACS 2007	131	31.30%	Age and early enteral feeding with nasojejunal tube
Present study	64	45.3%	1. DGE of all grades - Intraabdominal complication and Diabetes 2. DGE of Grade B & C - Intraabdominal complication 3. DGE without intraabdominal complication - retrocolic GI reconstruction

Conclusions

Intraabdominal complications and diabetes were independent risk factors for DGE. Retrocolic duodenojejunostomy was an independent risk factor for DGE without intraabdominal complication.

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