

Original Research Article

Comparison between the outcome of pancreaticogastrostomy and pancreaticojejunostomy after pancreaticoduodenectomy: a cross-sectional study

Rasel Mahmud^{1*}, S. M. Mortaza Ahsan², M. Mustafizur Rahman³, M. Abdul Quiyum⁴,
M. Zabiul Islam⁵, Mohammad M. Rahman⁶, Mostafa M. Warid⁷, Asma Sultana²

¹Department of Hepatobiliary Surgery, Sylhet M. A. G. Osmani Medical College, Sylhet, Bangladesh

²Sheikh Russel National Gastroliver Institute and Hospital, Mohakhali, Dhaka, Bangladesh

³Department of Hepatobiliary Surgery, Sheikh Russel National Gastroliver Institute and Hospital, Mohakhali, Dhaka, Bangladesh

⁴Department of Surgery, 300 Bedded Hospital, Narayanganj, Bangladesh

⁵Sir Salimullah Medical College and Mitford Hospital, Dhaka, Bangladesh

⁶Department of Hepatobiliary Surgery, Sir Salimullah Medical College and Mitford Hospital, Dhaka, Bangladesh

⁷Department of Hepatobiliary Surgery, Aichi Medical College, Demra, Dhaka, Bangladesh

Received: 08 June 2024

Accepted: 05 July 2024

*Correspondence:

Dr. Rasel Mahmud,

E-mail: raselmmc36@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Complications of pancreatic stump reconstruction after pancreaticoduodenectomy (PD) can lead to severe morbidity or even mortality. This study is taken to see the postoperative outcome of pancreatico-gastrostomy (PG) over pancreaticojejunostomy (PJ) after PD. Aim of the study was to compare the outcomes of PG and PJ following PD in a cross-sectional analysis.

Methods: This comparative cross-sectional study was done in the department of hepatobiliary pancreatic and liver transplant surgery, BSMMU, Dhaka. A total of twenty-five patients (N=25), who underwent PD from July 2019 to June 2020, were included in this study. These patients were divided into two group, group A with PG (n=10) and group B with PJ (n=15). All patients were evaluated before and after surgery for assessing post-operative outcome by clinically, biochemically and radiologically.

Results: This study showed no significant differences in demographic characteristics, co-morbidity and post-operative outcomes/complications between this two groups. However, PG demonstrated significantly shorter anastomosis time and required fewer sutures than PJ. Although a higher incidence of wound infections was observed in PJ compared to PG, these differences were not statistically significant. Peri-operative mortality did not significantly differ between the two techniques. Though postoperative hospital stay was shorter in the PG group compared to PJ but the difference was not statistically significant.

Conclusions: PG can be considered as a safe and alternative procedure after PD.

Keywords: Pancreaticoduodenectomy, Pancreaticogastrostomy, Pancreaticojejunostomy, Pancreatic fistula, Anastomosis

INTRODUCTION

Pancreaticoduodenectomy (PD) is the standard surgical procedure for various benign and malignant conditions of

the pancreas, periampullary region and duodenum.¹ However, PD is associated with significant morbidity and mortality, mainly due to leakage from pancreatic anastomosis (pancreatic fistula (PF)). The rate of PF varies

widely, ranging from 2% to 30%.² After PD, pancreatic continuity can be restored by two common methods: pancreaticogastrostomy (PG) and pancreaticojejunostomy (PJ).

PJ is the most commonly done method of pancreato-enteric anastomosis after PD. This method encompasses various forms such as end-to-side anastomosis, end-to-end anastomosis or pancreatic intussusception in the jejunum.⁴ These are named as Dunkin method, Duct-to-mucosa anastomosis and invagination technique respectively. Among them, duct-to-mucosa anastomosis is most frequently used, especially when the duct is dilated and the parenchyma is firm.⁵ In the end-to-end PJ, the pancreatic stump is released 3–4 cm for invagination into the jejunum, and the cut surface of the jejunum is sewn to the inner margin of the pancreas. An additional anterior layer of interrupted sutures is placed to pull the jejunal wall up over the pancreatic parenchyma for approximately 2 cm.⁶

PG has been studied as an alternative to reduce the incidence of pancreatic fistula (PF), where pancreatic stump is placed/invaginated into gastric lumen through posterior gastrotomy. It is commonly done in soft pancreas and pancreatic duct is very narrowed. It is simple, easy, safe, and quick to perform, and can be created easily due to the proximity of the stomach and the pancreas.⁷ But, it increases incidence delayed gastric emptying and pancreatic duct may be obstructed by overgrowth of the gastric mucosa.⁸

However, which reconstructive method following PD is the best, remains a topic of ongoing debate. Recent systematic reviews and meta-analysis have suggested PG to be superior to PJ for preventing pancreatic fistula after PD. Nevertheless, the latest multicenter randomized controlled trial revealed that PG was not associated with lower risks of pancreatic fistula.³

As there is no comparative study in Bangladesh regarding these two methods, so this study is designed to see the outcome of PG and PJ following PD after considering all above discussion and published data.

Objectives

Objectives of the study were to compare the outcomes of PG and PJ following PD in a cross-sectional analysis.

METHODS

This comparative cross-sectional study was conducted at the department of hepatobiliary pancreatic and liver transplant surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), over a 12-month period from 01 July 2019 to 30 June 2020. All patients, who underwent PD and pancreato-enteric anastomosis during this period irrespective of age and sex, were included in this study. Patients were non-randomly assigned to two groups: PG or PJ, based on surgeon preference. Initially, the target

sample size was 30 patients (15 in each group), but practical constraints led to inclusion of 25 patients, with 15 in the PJ group and 10 in the PG group.

Institutional approval was obtained from the institutional review board (IRB) of BSMMU. Data collection involved structured interviews and clinical examinations with variables covering pre-operative, intra-operative, and post-operative outcomes. Statistical analysis was performed using statistical package for the social sciences (SPSS) version 23. Statistical analysis included calculation of mean and standard deviation for patient age, BMI, PG or PJ anastomosis time, sutures required for anastomosis during operation, and post-operative hospital stay for each group. Additionally, post-operative outcomes were compared between the two groups using unpaired t-test, Mann-Whitney U test for quantitative variables, and Chi-square (χ^2) test, Fisher's exact test for qualitative variables. Statistical significance was set at $p < 0.05$ with a confidence interval of 95%.

RESULTS

The mean age of patients was 49.80 ± 10.60 years and 50.67 ± 9.22 years in PG group and PJ group respectively. Male-female ratio and BMI in between this two group were almost similar. Among the 25 patients, 12 did not have any comorbidities with 4 (40.0%) in the PG group and 8 (53.3%) in the PJ group. The common comorbidities were diabetes, hypertension, COPD and asthma. The incidence of associated comorbidity was not significantly different between this two groups of patients.

Table 1: Comparison of patient demographics and comorbidities between two groups.

Variables	Anastomosis performed (%)		P value
	PG	PJ	
Age (years)			
30-40	2 (20.0)	3 (20.0)	0.830 ^b
41-50	4 (40.0)	5 (33.3)	
51-60	3 (30.0)	5 (33.3)	
61-65	1 (10.0)	2 (13.3)	
Mean±SD	49.80±10.60	50.67±9.22	
Sex			
Male	5 (50.0)	9 (60.0)	0.697 ^a
Female	5 (50.0)	6 (40.0)	
BMI (kg/m ²)			
Under weight	2 (20.0)	4 (26.7)	0.832 ^b
Normal	8 (80.0)	11 (73.3)	
Mean±SD	20.30±2.03	20.09±2.61	
Co-morbidity			
DM	2 (20.0)	3 (20.0)	0.999
HTN	5 (50.0)	3 (20.0)	0.194
IHD	0 (0)	0 (0)	
COPD	0 (0)	1 (6.7)	0.999
Asthma	1 (10.0)	0 (0)	0.4
None	4 (40.0)	8 (53.3)	0.688

The operative time for PG and PJ were 22.10 ± 3.93 minutes and 28.20 ± 7.70 minutes respectively, p value=0.031. Less time was required for PG than PJ and the difference was statistically significant. Also, the table showed the number sutured material that required for anastomosis of PG than PJ. Suture material required for PG and PJ anastomosis were 4.10 ± 0.74 and 5.40 ± 1.06 respectively. So, the difference was significant and fewer sutures required in PG group than PJ. The most common postoperative complications were delayed gastric emptying (DGE) and wound infection. DGE developed 10.0% patients in PG and 13.3% in PJ group. Wound infection was more in PJ but the difference was not significant. In both group, there was one mortality respectively. Post-operative hospital stay was 16.78 ± 4.94 days in PG group and 19.43 ± 11.06 days in PJ group. Although the hospital stay is less in PG group than PJ but there is no level of significance between two groups.

Table 2: Comparison of time and suture required for doing anastomosis of PG and PJ.

Duration of anastomosis (min)	Anastomosis performed (%)		P value
	PG	PJ	
20-30	10 (100.0)	11 (73.3)	0.031
31-45	0 (0)	4 (26.7)	
Mean $\pm$ SD	22.10 $\pm$ 3.93	28.20 $\pm$ 7.70	

Table 3: Comparison of post-operative complications.

Post-operative complications	Anastomosis performed (%)		P value
	PG (n=10)	PJ (n=15)	
Gastric emptying			
Delayed	1 (10.0)	2 (13.3)	0.999 ^a
Normal	9 (90.0)	13 (86.7)	
Wound infection			
Present	2 (20.0)	6 (40.0)	0.402 ^a
Absent	8 (80.0)	9 (60.0)	

Table 4: Comparison of patients according to the peri-operative mortality in two groups.

Perioperative mortality	Anastomosis performed (%)		P value
	PG	PJ	
Yes	1 (10.0)	1 (6.7)	0.999
No	9 (90.0)	14 (93.3)	

Table 5: Comparison of the postoperative hospital stay of patients between two groups (n=23).

Post-operative hospital stay	Anastomosis performed (%)		P value
	PG	PJ	
Mean $\pm$ SD	16.78 $\pm$ 4.94	19.43 $\pm$ 11.06	0.726
Mean rank	12.61	11.61	

DISCUSSION

Pancreaticoduodenectomy is one of the most complicated surgical procedures, described by Moussa as “the cadillac of abdominal surgery”.⁹ It is performed for malignant and benign diseases of the pancreatic head and periampullary region, representing the only potentially curative therapy for malignant neoplasms. Since the introduction of one-step PD by Whipple in 1941, the treatment of the pancreatic stump has been a major concern due to the frequency of complications, thus it has been named the “Achilles heel” of PD.¹⁰

Numerous publications have discussed different approaches to handle the pancreatic stump. However, there is still no universally accepted method of pancreatic reconstruction after PD.¹¹

PG, introduced by Waugh and Claggett in 1946, has recently gained favour among the surgeons. It has several advantages over PJ as it is simple, easy, safe, and quick to perform, which can be created easily because of the proximity of the stomach and the pancreas. However, some potential disadvantages of PG have been recognized including increasing evidence of delayed gastric emptying, pancreatic duct obstruction due to overgrowth of the gastric mucosa and risk of hemorrhage due to acid erosion.¹²

PJ is the most commonly used method of pancreato-enteric anastomosis after PD. Many authors have found that PJ duct-to-mucosa anastomosis is the safest option, particularly in cases of wide pancreatic ducts, usually associated with firm or hard pancreatic tissue.^{13,14} They identified low and high-risk patients considering patient-related risk factors such as age (>70 years), gender (male), jaundice, malnutrition, and pancreas anatomic and functional related factors such as pancreatic disease, pancreatic softness, and pancreatic duct caliber. Based on this categorization, the authors determine that in patients at low risk (dilated and obstructed duct, firm and fibrotic gland, malignant pancreatic disease), the safest procedure is the end-to-side PJ. In patients at high risk (not dilated duct, soft parenchyma, older than 70 years) where duct-to-mucosal anastomosis is difficult, pancreaticojejunal invagination technique is applied for surgical anastomosis.¹⁴

In this study, we evaluated the outcomes of PG and PJ after PD. Among the 25 patients we studied, there were no significant differences in the demographic variables of the two groups. There was no significant association of comorbidity between the two groups of patients. There was also no significant difference between groups in pre-operative diagnosis based on clinical findings, laboratory investigations, imaging and preoperative biliary decompression.

After preparing for pancreatic stump anastomosis with the stomach or jejunum, the duration of anastomotic time in

the PG group was 22.10 ± 3.93 minutes and in the PJ group was 28.20 ± 7.70 minutes ($p=0.031$), which is significantly shorter for PG than PJ. The number of suture materials required for anastomosis of PG and PJ was 4.10 ± 0.74 and 5.40 ± 1.06 respectively with a p value of 0.003. Thus, the difference was significant and fewer sutures were required in the PG group than in the PJ group.

PG anastomosis is less time consuming and simpler to perform because the posterior wall of the stomach lies immediately anterior to the mobilized pancreatic remnant and is always wider than the transected pancreatic neck.¹⁵

As there is no significant difference in demographic variables, nutritional assessment, co-morbidity, preoperative diagnosis and preoperative biliary decompression between these two groups, we now focused on postoperative outcomes in between them.

In most studies, delayed gastric emptying was defined as gastric stasis requiring nasogastric intubation for more than 7 days, more or less associated with vomiting and reinsertion of a nasogastric tube after failure of postoperative feeding. Another study showed that delayed gastric emptying developed in 11.7% and 11.1% of patients in the PJ and PG groups, respectively.¹⁶ In this study, it is 13.3% and 10% in the PJ and PG groups, respectively.

A study showed that wound infection developed in 29.1% and 33% of patients in the PG and PJ groups, respectively.¹⁷ In this study, wound infection developed in 20% of the PG group and 40% of the PJ group, with a p value of 0.402, which is not statistically significant.

Another study conducted a meta-analysis where the mean hospital stay was 15.6 days in the PG group and 17.3 days in the PJ group after pancreaticoduodenectomy.¹⁸ This study shows the mean hospital stay is lower in the PG group (16.7 days) than in the PJ group (19.4 days), but the difference is not statistically significant.

A study showed that mortality within 90 days after the operation was 7.1% in the PG group and 8.6% in the PJ group in their study.¹⁹ This study shows mortality is 10% in the PG group and 6.7% in the PJ group, with no significant difference.

In this study, PG is more convenient than PJ based on the required pancreaticoenteric anastomotic time and suture materials. However, based on short-term outcomes such as postoperative pancreatic fistula (POPF), delayed gastric emptying (DGE), bile leakage, and wound infection, the results are almost similar in both groups of patients.

Limitations

This study had some limitations: the study period was relatively short, and the sample size was limited, potentially affecting the generalizability of the findings;

post-operative outcomes were assessed only up to the duration of hospital stay, limiting the ability to capture long-term effects or complications; evaluation of changes in stomach condition or development of alkaline reflux gastritis was not feasible within the scope of this study; and assessment of quality of life beyond the hospital discharge period was not conducted, thus limiting a comprehensive understanding of patient outcomes post-operation.

CONCLUSION

PG can be considered as a safe procedure after PD as the time required for pancreaticoenteric anastomosis and suture materials requirement are fewer with similar postoperative outcome in compare to PJ.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Ahmed M, Hussain SM. Pancreaticojejunostomy or Pancreaticogastrostomy to prevent pancreatic fistula formation after Pancreaticoduodenectomy. Pak Armed Forces Med J. 2016;66(1):68-70.
2. Aroori S, Puneet P, Bramhall SR, Muiesan P, Mayer AD, Mirza DF, et al. Outcomes comparing a pancreaticogastrostomy (PG) and a pancreaticojejunostomy (PJ) after a pancreaticoduodenectomy (PD). HPB (Oxford). 2011;13(10):723-31.
3. Qin H, Luo L, Zhu Z, Huang J. Pancreaticogastrostomy has advantages over pancreaticojejunostomy on pancreatic fistula after pancreaticoduodenectomy. A meta-analysis of randomized controlled trials. Int J Surg. 2016;36:18-24.
4. Cattell RB. A technic for pancreatoduodenal resection. Surg Clin North Am. 1948;28(3):761-75.
5. Tersigni R, Capaldi M, Ialongo P, Grillo LR, Anselmo A. Surgical treatment of the pancreatic stump: preventive strategies of pancreatic fistula after pancreatoduodenectomy for cancer. G Chir. 2014;35(9-10):213-22.
6. Conzo G, Gambardella C, Tartaglia E, Sciascia V, Mauriello C, Napolitano S, et al. Pancreatic fistula following pancreatoduodenectomy. Evaluation of different surgical approaches in the management of pancreatic stump. Literature review. Int J Surg. 2015;21(1):S4-9.
7. Zhou Y, Yu J, Wu L, Li B. Meta-analysis of pancreaticogastrostomy versus pancreaticojejunostomy on occurrences of postoperative pancreatic fistula after pancreaticoduodenectomy. Asian J Surg. 2015;38(3):155-60.
8. Kostov DV, Kobakov G, Yankov D. Pancreatogastrostomy with one continuous seromuscular circular suture. Int J Surg Med. 2015;1(1):2-6.

9. Yeo CJ. Management of Complications Following Pancreaticoduodenectomy. *Surg Clin.* 1995;75(5):913-24.
10. Wolfgang CL, Pawlik TM. Pancreaticoduodenectomy: time to change our approach? *The Lancet Oncol.* 2013;14(7):573-5.
11. Tan WJ, Kow AW, Liao KH. Moving towards the New International Study Group for Pancreatic Surgery (ISGPS) definitions in pancreaticoduodenectomy: a comparison between the old and new. *HPB (Oxford).* 2011;13(8):566-72.
12. Lei P, Fang J, Huang Y, Zheng Z, Wei B, Wei H. Pancreaticogastrostomy or pancreaticojejunostomy? Methods of digestive continuity reconstruction after pancreaticoduodenectomy: a meta-analysis of randomized controlled trials. *Int J Surg.* 2014;12(12):1444-9.
13. Hosotani R, Doi R, Imamura M. Duct-to-mucosa pancreaticojejunostomy reduces the risk of pancreatic leakage after pancreatoduodenectomy. *World J Surg.* 2002;26(1):99-104.
14. Marcus SG, Cohen H, Ranson JH. Optimal management of the pancreatic remnant after pancreaticoduodenectomy. *Ann Surg.* 1995;221(6):635-48.
15. Yeo CJ, Cameron JL, Maher MM, Sauter PK, Zahurak ML, Talamini MA, et al. A prospective randomized trial of pancreaticogastrostomy versus pancreaticojejunostomy after pancreaticoduodenectomy. *Ann Surg.* 1995;222(4):580-92.
16. Fang WL, Shyr YM, Su CH, Chen TH, Wu CW, Lui WY. Comparison between pancreaticojejunostomy and pancreaticogastrostomy after pancreaticoduodenectomy. *J Formosan Med Assoc.* 2007;106(9):717-27.
17. Amutha P, Lakshminarayanan M, Muppalla NVN. Pancreaticogastrostomy Versus Binding Pancreaticojejunostomy after Pancreaticoduodenectomy: A Comparative study (Doctoral dissertation, Madurai Medical College, Madurai). *IOSR J Dent Med Sci.* 2017;16(8):48-52.
18. Menahem B, Guittet L, Mulliri A, Alves A, Lubrano J. Pancreaticogastrostomy is superior to pancreaticojejunostomy for prevention of pancreatic fistula after pancreaticoduodenectomy: an updated meta-analysis of randomized controlled trials. *Ann Surg.* 2015;261(5):882-7.
19. Aroori S, Puneet P, Bramhall SR, Muiesan P, Mayer AD, Mirza DF, et al. Outcomes comparing a pancreaticogastrostomy (PG) and a pancreaticojejunostomy (PJ) after apancreaticoduodenectomy (PD). *HPB.* 2011;13(10):723-31.

Cite this article as: Mahmud R, Ahsan SMM, Rahman MM, Quiyum MA, Islam MZ, Rahman MM, et al. Comparison between the outcome of pancreaticogastrostomy and pancreaticojejunostomy after pancreaticoduodenectomy – a cross-sectional study. *Int Surg J* 2024;11:1223-7.