

Transgastric pancreaticogastrostomy: Our experience

Manash Ranjan Sahoo M.S.¹Suyash Bajoria M.S.²Jyotirmay Nayak M.S.³

Bhubaneswar, India.

Original Article

GENERAL SURGERY



Abstract: Introduction: Pancreaticoduodenectomy is a complex procedure done for pancreatic diseases. Pancreatico-enteric anastomosis is a technically challenging part. Failed pancreatico-enteric anastomoses can be devastating. The choice and technique of pancreatico-enteric anastomoses has eluded the surgical community.

Methods: Ours is a retrospective study across two tertiary health care centers, spanning twenty years. The study involves 120 patients undergoing pancreaticoduodenectomy. The technique of pancreatico-enteric anastomosis has been studied and results documented. Pancreatico-gastrostomy was performed in a transgastric fashion using full thickness U mattress sutures with placement of an internal stent.

Results: A total of 120 patients underwent PD with our technique of PG with an internal stent. There were 70 men (58.33%) and 50 women (41.67%) with a median age of 50.8 years (range, 33–72 years). The median blood loss was 390 mL (range, 250–1,000 ml). The mean operation time was 4.5 h (range, 3.7–6.5 hrs). Overall, complications occurred in 39 patients (32.5%). Clinically significant post-operative pancreatic fistula (POPF) occurred in 5% (n=6) patients. The most frequent complication in our study was DGE (12.5%).

Conclusion: Pancreatico-gastrostomy is a favourable way of maintaining pancreatico-enteric continuity after pancreaticoduodenectomy. Our technique of transgastric pancreaticogastrostomy is simple and easily reproducible. The surgical outcomes for the technique are comparable and acceptable.

Keywords: Pancreaticoduodenectomy; Pancreaticogastrostomy; Pancreaticojejunostomy; Post-operative pancreatic fistula (POPF)

Introduction

Pancreatico-duodenectomy (PD) is a complex procedure for both benign and malignant diseases of the pancreas. After resection, gastrointestinal continuity is established by three anastomoses. The pancreatico-enteric anastomosis is by far the most problematic, as it is associated with high rates of leak and subsequent pancreatic fistula (PF). PF then drives the majority of surgical complications associated with PD, including the potential for an intra-abdominal infection, haemorrhage, the occasional need for reoperation, and possible death.

There is no consensus on the choice of pancreatico-enteric anastomotic technique, pancreaticojejunostomy (PJ) or pancreaticogastrostomy (PG).¹ Randomized trials and meta-analyses comparing PG versus PJ yield conflicting and heterogenous results and are inherently prone to bias. The analysis of the 4 RCTs^{2, 3, 4, 5} comparing PG and PJ does not allow us to conclude which one of the techniques was the most preferable in

relevant postoperative pancreatic fistula (POPF) has not been supported by high-level evidence in the existing literature.¹ However, experienced surgical skills and consistent practice of a standard surgical technique may decrease the rate of complications.

Several PG anastomotic technical modifications have been reported including twin square wrapping with duct-to-mucosa anastomosis,⁶ duct to mucosa anastomoses with internal stenting, single purse-string suture duct-to-mucosa anastomosis,⁷ full-thickness suture,⁸ and double-binding continuous hemstitch sutures.⁹ Mention has also been made about two-layer anastomosis (an external interrupted suture and an internal continuous suture) with an internal stent,¹⁰ binding pancreatico-gastrostomy,¹¹ pancreatico-gastrostomy method using only two transpancreatic sutures,¹² one binding purse-string and two transfixing mattress sutures.¹³ Nevertheless, a “gold standard” surgical technique is yet to be established.

1. Professor and head department From the Department of Surgery at All India Institute of Medical Sciences. Bhubaneswar, Odisha, India. 2. Post doctoral fellow in Minimal Access Surgery at All India Institute of Medical Sciences (AIIMS). Bhubaneswar, Odisha, India. 3. Assistant professor of Surgery at SCB Medical College, Cuttack, Odisha, India. Received on September 21, 2020. Accepted on September 25, 2020. Published on September 28, 2020.

Methods

This is a retrospective study conducted at two tertiary health care centres- SCB Medical College, Cuttack and All India Institute of Medical Sciences, Bhubaneswar between 2000 and 2020. The study included analysis of 120 patients having undergone PD for appropriate reasons. Proper consent was taken from all patients under review. The choice of pancreatico-enteric anastomosis is under review. A PG was performed as compared to conventional PJ. The PG was performed by invaginating the pancreatic stump into the gastric lumen after an anterior gastrotomy, followed by a posterior gastrotomy. The anastomosis was done using tans-fixing 'U' sutures after placement of an internal stent in the pancreatic duct.

The reviewed data included demographics (age, sex), diagnosis, blood loss during surgery, time taken for the procedure, length of post-operative hospital stay, texture of pancreas (soft or firm), post-operative complications (pancreatic fistula (POPF), delayed gastric emptying (DGE), abdominal abscess, wound infection, post-operative bleeding, wound dehiscence, pulmonary infections) and mortality.

Definitions of intra/extrabdominal complications

- Pancreatic fistula is an abnormal communication between the pancreatic ductal "system" and another epithelial surface containing pancreas-derived, enzyme-rich fluid. For the diagnosis, any measurable volume of drain fluid on or after postoperative day 3 with amylase level >3 times the upper limit of normal amylase for each specific institution is the necessary threshold. To be defined strictly as a POPF, however, this condition needs to be clinically relevant. Whenever an increased amylase activity is found in the fluid from an operatively placed drain, which does not impact on the clinical outcome of the patient, no fistula should be reported.³²
- Bile leakage is defined as bile in the drain fluid from the sub hepatic drain with the level of total bilirubin exceeding the upper limit of normal.
- Gastro/duodenal-enteric anastomosis leak is defined as a persistent discharge of digestive juice in the drain for more than 5 days' post-surgery, and leakage confirmed by the methylene blue test or by radiology.
- DGE is defined to be present when the nasogastric tube is maintained for 10 or more days, combined with at least one of the

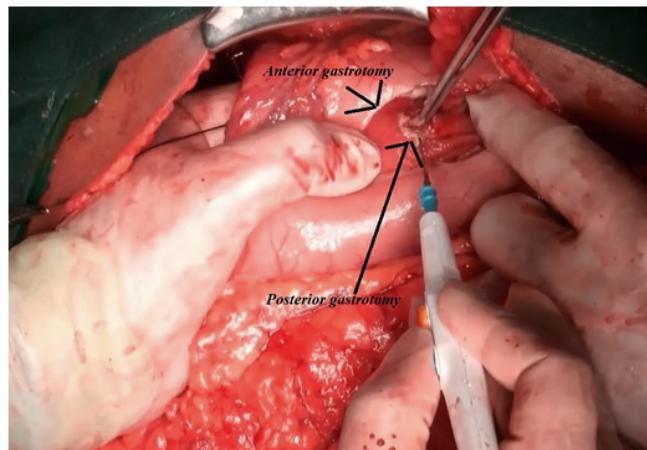


Figure 1. Anterior and posterior gastrotomy (before pancreaticogastrectomy).

- following: vomiting after removal of nasogastric tube, reinsertion of nasogastric tube, or failure to progress with oral feeding
- Intra-peritoneal hemorrhage was defined to be present when more than 3 units of blood were required in any 24 h after the operation.
 - Wound infection is defined as erythema and induration of a wound with purulent discharge and with a positive bacterial culture.
 - Wound dehiscence is defined as partial or total disruption of the fascial or all the layers of the incision.
 - Pulmonary infection is defined as the presence of pneumonia, or atelectatic changes on radiograph, and is associated with a positive sputum bacterial culture.

Surgical technique

Following extensive preoperative workup as per the standard guidelines, patients who were fit for surgery were taken up for PD. PD was performed by the standard described procedure in the literature. None of our patients required any vascular resections or reconstructions. After resection of the pancreas and duodenum, a PG was performed. The pancreatic stump was freed from retroperitoneal attachments for an adequate length. Bleeding from the surface of the pancreatic stump was controlled.

Two stay sutures were put on the pancreatic stump using silk. A 4-5 cm longitudinal gastrotomy was performed on the anterior wall of the stomach (**Figure 1**) using ultrasonic shears, while maintaining haemostasis. After the anterior gastrotomy, the posterior gastrotomy is done (**Figure 1**) - little smaller than the size of the pancreatic stump. The pancreatic stump is gently pulled into through the posterior gastrotomy with the help of the stay sutures. This maneuver was performed very gently to ensure tight wrapping of the posterior gastric wall around the

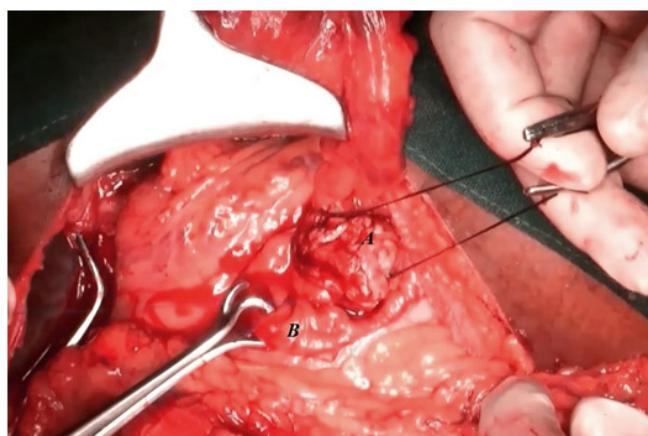


Figure 2. Pancreatic stump invaginated into the stomach lumen and sutured to posterior gastric wall; A. Pancreatic stump; B. Anterior gastric wall.

pancreatic remnant (**Figure 2**) and to avoid laceration of the pancreas.

Interrupted 'U' sutures are given including the pancreatic parenchyma with stomach wall, three on the anterior side and three on the posterior side and one each on both angles with 3-0 prolene. Care was taken to avoid repeated attempts to take bites onto the pancreatic surface. The Duct of Wirsung was identified and cannulated with an infant feeding tube, to be working as a stent (**Figure 3**). Anterior gastrotomy is sutured with extramucosal polydioxanane sutures (**Figure 4**).

An end to side Hepatico-jejunostomy (HJ) is done and finally an end to side Gastro-jejunostomy (GJ) is performed and a Ryle's tube is progressed to the efferent limb of the jejunum, thereby obviating the need for a feeding jejunostomy. Abdominal drains were placed to drain PG and HJ sites before closing the abdomen.

Results

A total of 120 patients underwent PD with the PG with an internal stent. There were 70 men (58.33%) and 50 women (41.67%) with a median age of 50.8 years (range, 33–72 years). The indications for PD were as follows: 46 pancreatic adenocarcinomas, 35 distal bile duct cancers, 25 ampulla of Vater cancers and 14 neuroendocrine tumors of the pancreas. (**Table 1**) The median blood loss was 390 mL (range, 250–1,000 mL). The mean operation time was 4.5 h (range, 3.7–6.5 h) and the median hospital stay for the patients was 8 days (range, 6–15 days).

According to the ISGPF 2005 definitions, 6 patients in our group had grade A POPF. All cases were treated conservatively without any additional intervention. Four patients had grade B POPF who underwent ultrasonic guided catheter drainage. Only two (2) of our patients had grade C POPF. Both patients with Grade C POPF required re-exploration

Total no. of patients (n)	120
Median age (range)	50.8 years (33-72)
Male : Female	1.4:1
Presenting complaints	
Surgical jaundice (n)	105 (87.5%)
Pain abdomen (n)	78 (65%)
Weight loss (n)	97 (80.83%)
Patients undergoing preoperative biliary drainage	46
Tumour characteristics	
Pancreatic adenocarcinoma	46
Bile duct cancers	35
Ampulla of Vater cancers	25
Neuroendocrine tumor of pancreas	14

Table 1. Demographic profile of patients.

but could not recover from the complication. Overall, complications occurred in 39 patients (32.5%) including haemorrhage (n=4, 3.33%), DGE (n=15, 12.5%), superficial surgical wound infection (n=8, 6.67%) and POPF (n=12, 10%). None of our patients had pulmonary infection / pleural effusion or abdominal abscess. None of our patients developed wound dehiscence. Both patients of Grade C POPF in our study group succumbed post-operatively. (**Table 2**) Patients developing DGE were treated with maintenance or reinsertion of a nasogastric tube, and delayed starting of oral feeds. Administration of prokinetic agents were used as adjuncts. None of our patients required parenteral nutrition. Four patients had haemorrhage, presenting as hematemesis. The patients were managed with continuous drainage via nasogastric tube and blood transfusions. No additional intervention was required. Patients with superficial surgical wound infections were managed by opening up of skin sutures / skin staples and daily dressings. Antibiotics were provided according to culture/sensitivity reports.

Discussion

Pancreatico-enteric anastomosis is undoubtedly the most important reconstruction step after PD. POPF is one of the leading causes of mortality after PD. The factors that lead to the usual failure of the pancreatico-enteric anastomoses are many. Disparate nature and intra-abdominal fixity of the pancreas and bowel is always a matter of concern

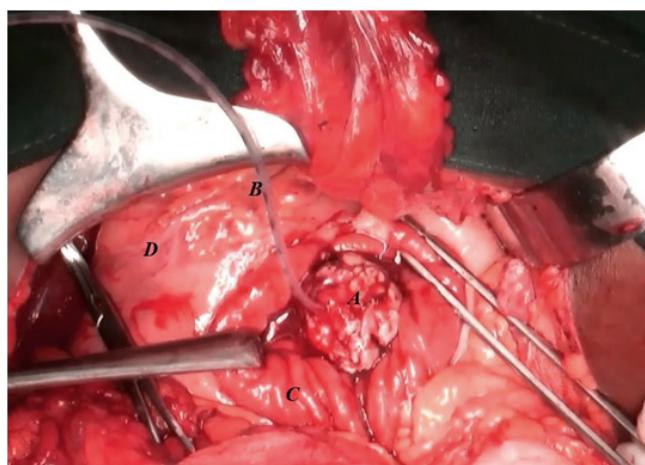


Figure 3. Internal stent in pancreatic duct. A. Pancreatic duct stump. B. Feeding tube stent. C. Anterior gastric wall. D. Stomach.

for secure anastomoses. Continuous secretion of pancreatic juice from the main and accessory ducts and the occurrence of post-operative pancreatitis contribute to anastomotic failure rates. Pancreatic texture, being soft and fragile, results in parenchymal lacerations while suturing, again contributing to dehiscence.

Pancreatico-enteric anastomoses have been described in two ways- PG or PJ. Both are time tested techniques and have been used by different surgeons differently. Various modifications to both techniques have been studied and reported. However data obtained has been heterogeneous and singling out a better technique out of the two, is difficult. Yeo et al,² Bassi et al,³ Duffas et al,⁴ and Fernandez et al⁵ all conducted RCTs comparing PG and PJ but were unable to conclude which one of the techniques was the most preferable in terms of the prevention of complications after PD.

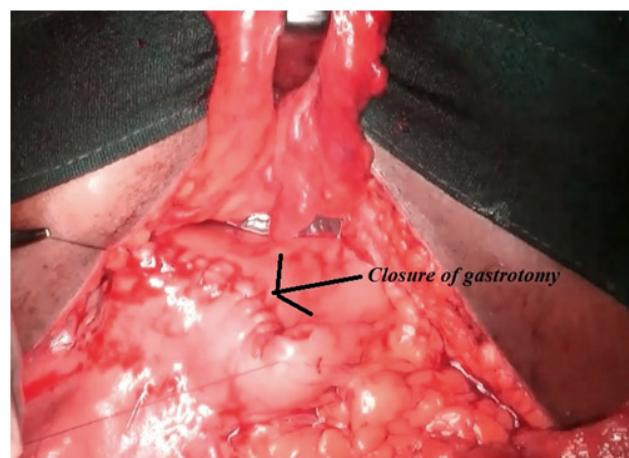


Figure 4. Closure of the anterior gastrotomy.

Several theoretical advantages to performing PG over PJ are known. Pancreatic enzymes are inactivated by the acidic gastric fluid, thus preventing auto-digestion of the anastomoses. Alkaline and pancreatic secretions prevent development of marginal ulcerations. Pancreas being close to stomach anatomically, anastomoses is easier and more secure. Stomach has a rich vascular supply which is favourable for the anastomoses. Moreover, Ryle's tube helps in decompression of the stomach and less tension on the PG site. The above explained theoretical advantages may point towards PG being a preferable option over PJ for pancreatico-enteric anastomoses. Recent RCTs and meta analyses have proved PG to be a superior option than PJ for pancreatico-enteric anastomoses.^{29, 30, 31}

Tripodi and Sherwin¹⁴ in 1934 are credited with possibly the first anastomoses between the stomach pancreas. In 1946, Waugh and Clagett¹⁵ used

Complications	Number (n)	Percentage (%)
Post-operative pancreatic fistula (POPF)	12	10
Grade A	6	5
Grade B	4	3.33
Grade C	2	1.67
Delayed gastric emptying (DGE)	15	12.5
Haemorrhage	4	3.33
Superficial wound infection	8	6.67
Pulmonary infection	0	0
Abdominal abscess	0	0
Wound dehiscence	0	0
Mortality	2	1.67

Table 2. Procedure associated post operative complications.

pancreatico-gastrostomy in the clinical setting for the first time. PG has been used frequently in the past decade or so. A large variety of modifications of the technique has been published in the literature. Nevertheless, a consensus on the best technique has not been reached.

Authors have published several techniques of PG and also their experiences with the type of anastomoses. Different authors have reported POPF rates ranging from 0% to 28%.^{5-13, 19-28} Our technique of PG involves mattress 'U' sutures for anastomoses with placement of an internal stent in the pancreatic duct. The pancreatic stump was invaginated into the stomach for adequate drainage. Our practice has been to place a short internal stent (infant feeding tube) in the pancreatic duct while doing the anastomoses.

In our series, 12 patients developed POPF. Six were grade A POPF and four were grade B and all occurred in patients with soft pancreatic parenchyma. Grade A POPF, however, is no longer considered a true pancreatic fistula or an actual complication of pancreatic surgeries.³² It may be just defined as biochemical leak (BL) and having no outcome on the postoperative course of the patient.³² Grade A POPF's resolved spontaneously whilst the drain was in-situ for 15 days postoperatively. Grade B POPF needed pig tail drainage. Both the patients did not require any reoperation. Grade C POPF patients were re-explored for the pancreatic leak, but expired post-operatively. Effectively our POPF complication rate was 5% (n=6). The most frequent complication in our study was DGE (12.5%).

The proposed advantages of the procedure followed by us are mentioned. The approach via the anterior gastrotomy provides a better field of vision. Anastomoses creation is thus easier. PG from the posterior approach has a propensity to result in the protrusion of the gastric mucosa which is avoided in the anterior approach. The pancreatic stump is sufficiently invaginated into the gastric lumen, and this guarantees adequate drainage of the pancreatic juice, avoiding effects on the anastomotic site.

Conclusion

In our study, PG is performed through an anterior gastrotomy under direct visualisation. The pancreas is invaginated into the stomach lumen and fixed with full thickness sutures to the stomach wall. We believe that this technique is simple, secure, and reproducible. It possesses several advantages over the conventional PG: it is easy to perform, it is less traumatic to the pancreatic stump, can be performed in all types of pancreatic stump irrespective of the texture and diameter of the pancreatic duct. This operative technique should be more comprehensively evaluated in larger studies to evaluate its superiority over other

techniques. Collaborative trials from high-volume centres will provide high-level data to allow tailoring of operative techniques.

Conflicts of interest

The authors declare no potential conflict of interest or copyright infringement relevant to this article.

References

1. Fernández-Cruz L. Pancreaticojejunostomy versus pancreaticogastrostomy. *J Hepatobiliary Pancreat Sci*. 2011; 18: 762–768
2. Yeo CJ, Cameron JL, Maher MM, et al. A prospective randomized trial of pancreatogastronomy or pancreaticojejunostomy after pancreaticoduodenectomy. *Ann Surg*. 1995; 222: 580–8.
3. Bassi C, Falconi M, Molinari E, et al. Reconstruction by pancreaticojejunostomy versus pancreaticogastrostomy following pancreatectomy: results of a comparative study. *Ann Surg*. 2005; 242: 767–71.
4. Duffas JP, Suc B, Msika S, et al. A controlled randomized multicenter trial of pancreatogastronomy or pancreaticojejunostomy after pancreaticoduodenectomy. *Am J Surg*. 2005; 189: 720–9.
5. Fernández-Cruz L, Cosa R, Blanco L, López-Boado MA, Astudillo E. Pancreatogastronomy with gastric partition after pylorus-preserving pancreateoduodenectomy versus conventional pancreaticojejunostomy. *Ann Surg*. 2008; 248: 930–8.
6. Maemura K, Mataki Y, Kurahara H, et al. Pancreaticogastrostomy after pancreaticoduodenectomy using twin square wrapping with duct-to-mucosa anastomosis. *Eur Surg Res*. 2015; 55: 109-118.
7. Wang XA, Wu XS, Cai Y, et al. Single purse-string duct to mucosa pancreaticogastrostomy: a safe, easy, and useful technique after pancreaticoduodenectomy. *J Am Coll Surg*. 2015; 220
8. Fatih O, Adil B, Cengiz A, et al. No mortality or pancreatic fistula after full-thickness suture pancreaticogastrostomy in 39 patients who underwent pancreaticoduodenectomy. *Int Surg*. 2015; 100: 275-280.
9. Zhu F, Wang M, Wang X, et al. Modified technique of pancreaticogastrostomy for soft pancreas with two continuous hemstitch sutures: a single-center prospective study. *J Gastrointest Surg*. 2013; 17: 1306-1311.
10. Pei YY, Hwang JS, Bong JJ. A modified technique of pancreaticogastrostomy with short internal stent: A single surgeon's experience *Asian Journal of Surgery*. 2018;41: 250-256
11. Routh D, Pathak N, Naidu CS, Singh AK, Rao PP, Ranjan P. A study on outcome of binding pancreaticogastrostomy following pancreaticoduodenectomy: A prospective observational study *Int J Surg*. 2018; 50: 104–109
12. Lee JY, Kim EY, Lee JS, et al. A novel pancreaticogastrostomy method using only two transpancreatic sutures: early postoperative surgical results compared with conventional pancreaticojejunostomy. *Ann Surg Treat Res* 2015; 88(6): 299-305
13. Bartsch DK, Langer P, Kanngieber, Fendrich V, Dietzel K. A Simple and Safe Anastomosis for Pancreatogastronomy Using One Binding Purse-String and Two Transfixing Mattress Sutures. *Int J of Surg Oncol*. 2012; 718637

14. Tripodi AM, Sherwin CF. Experimental transplantation of the pancreas into the stomach. *Arch Surg.* 1934; 28: 345-346.
15. Waugh JM, Clagett OT. Resection of the duodenum and head of pancreas for carcinoma: an analysis of thirty cases. *Surgery.* 1946; 20: 224-232.
16. Mackie JA, Rhoads JE, Park D. Pancreaticogastrectomy: a further evaluation. *Ann Surg.* 1975; 181: 541-545.
17. Ohigashi H, Ishikawa O, Eguchi H, et al. "A simple and safe anastomosis in pancreaticogastrectomy using mattress sutures," *Am J Surg.* 2008; 196 (1): 130–134.
18. Peng SY, Hong DF, Liu YB, Li JT, Tao F, Tan ZJ. "A pancreas suture-less type II binding pancreaticogastrectomy," *Zhonghua Wai Ke Za Zhi.* 2009; 47(23): 1764-66
19. Andivot T, Cardoso J, Dousset B, Soubrane O, Bonnichon P, Chapuis Y. "Complications of two types of pancreatic anastomoses after pancreaticoduodenectomy," *Annales de Chirurgie.* 1996; 50(6): 431-7
20. Kim SW, Youk EG, Park YH. "Comparison of pancreatogastronomy and pancreateojejunostomy after pancreateoduodenectomy performed by one surgeon," *World Journal of Surgery.* 1997; 21(6): 640-3.
21. Kapur BML, Misra MC, Seenu V, Goel AK. "Pancreaticogastrectomy for reconstruction of pancreatic stump after pancreaticoduodenectomy for ampullary carcinoma," *Am J Surg.* 1998; 176(3): 274-8.
22. Fabre JM, Arnaud JP, Navarro F, et al. "Results of pancreatogastronomy after pancreateoduodenectomy in 160 consecutive patients," *Br J Surg.* 1998; 85(6): 751-4.
23. Arnaud JP, Tuech JJ, Cervi C, Bergamaschi R. "Pancreaticogastrectomy compared with pancreateojejunostomy after pancreateoduodenectomy," *Eur J Surg.* 1999; 165(4): 357-62.
24. Schlitt HJ, Schmidt U, Simunec D, et al. "Morbidity and mortality associated with pancreatogastronomy and pancreateojejunostomy following partial pancreateoduodenectomy," *Br J Surg.* 2002; 89(10): 1245-52.
25. Munoz-Bongrand N, Sauvanet A, Denys A, Sibert A, Vilgrain V, Belghiti J. "Conservative management of pancreatic fistula after pancreateoduodenectomy with pancreaticogastrectomy," *J Am Col Surg.* 2004; 199(2): 198-203.
26. Oussoultzoglou E, Bachellier P, Bigourdan JM, Weber JC, Nakano H, Jaeck D. "Pancreaticogastrectomy decreased relaparotomy caused by pancreatic fistula after pancreaticoduodenectomy compared with pancreateojejunostomy," *Arch Surg.* 2004; 139(3): 327-335
27. Hoshal VL, Benedict MB, David LR, Kulick J. "Personal experience with the whipple operation: outcomes and lessons learned," *American Surgeon.* 2004; 70(2): 121-25.
28. Takano S, Ito Y, Oishi H, et al. "A retrospective analysis of 88 patients with pancreaticogastrectomy after pancreateoduodenectomy," *Hepato-Gastroenterology.* 2000; 47(35): 1454-57.
29. Liu FB, Chen JM, Geng W, et al. Pancreaticogastrectomy is associated with significantly less pancreatic fistula than pancreateojejunostomy reconstruction after pancreateoduodenectomy: a meta-analysis of seven randomized controlled trials. *HPB* 2015; 17(2): 123–130.
30. Xiong JJ, Tan CL, Szatmary P, et al. Meta-analysis of pancreaticogastrectomy versus pancreateojejunostomy after pancreateicoduodenectomy. *Br J Surg.* 2014; 101(10): 1196–1208
31. Que W, Fang H, Yan B, Li J, et al. Pancreaticogastrectomy versus pancreateicojejunostomy after pancreateicoduodenectomy: a meta-analysis of randomized controlled trials. *Am J Surg.* 2015; 209(6): 1074–1082
32. Bassi C, Marchegiani G, Dervenis C, et al. The 2016 update of the International Study Group (ISGUPS) definition and grading of postoperative pancreatic fistula: 11 years after. *Pancreas.* 2017; 161(3): 584-591

Manash Ranjan Sahoo
All India Institute of Medical Sciences (AIIMS)
Bhubaneswar, India.
manash67@gmail.com