## **Original Research Article**

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# Addition of Braun enteroenterostomy to standard reconstruction in pancreaticoduodenectomy: impact on early outcomes

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#### **ABSTRACT**

**Background:** Morbidity following Pancreaticoduodenectomy still remains high. Few studies have shown decrease in morbidity with the addition of Braun Enteroenterostomy (BEE). Aim of the present study was to determine any possible benefit with addition of BE to the standard reconstruction after pancreaticoduodenectomy.

**Methods:** In this prospective randomized controlled study, all patients who underwent Pancreaticoduodenectomy from June 2012 to July 2016 were included. They were randomized to undergo either standard reconstruction (Group A) or with addition of Braun Enteroenterostomy to standard reconstruction (Group B). Outcomes were compared between 2 groups and the results were analyzed. P value of <0.05 was considered significant.

**Results:** 104 patients were included in the study. Group A included 56 patients who underwent standard reconstruction and Group B had 48 patients who had addition of BEE to standard reconstruction. The demographic profile, tumour characteristics, and biochemical profile were similar in 2 groups. Mean operating time and Intra operative blood loss were similar. The incidence of pancreatic fistula (POPF) did not differ significantly in 2 groups (14/56, 25% in group A versus 8/48, 16.6% in group B; p = 0.42). The incidence of Delayed Gastric Emptying (DGE) was not statistically different in 2 groups (20/56, 35.7% in group A versus 12/48, 25% in group B; p = 0.77). Infection rates were similar in two groups. Mean hospital stay was similar in both groups (11.2 days versus 10.7 days; p = 0.68).

**Conclusions:** The outcomes of patients after pancreaticoduodenectomy were not altered by addition of Braun Enteroenterostomy to standard reconstruction.

Keywords: BEE, Pancreaticoduodenectomy, Pancreatic fistula, Delayed gastric emptying

## INTRODUCTION

Pancreaticoduodenectomy (Whipple procedure) is the standard treatment for operable carcinomas of the head of the pancreas, periampullary tumors and in some cases of chronic pancreatitis. Advances in surgical skills and postoperative care have resulted in mortality rates of less than 5%. Despite significant improvements in the safety and efficacy of pancreatic surgery, morbidity still remains high in the range of 30% to 65%. Delayed gastric

emptying (DGE) and Postoperative Pancreatic fistula (POPF) remains the major causes of morbidity.

The exact cause of DGE following pancreaticoduodenectomy is not known. It appears to be multifactorial.<sup>3-5</sup> Technical factors in the construction of gastroenterostomy have been implicated in the development of DGE. Significant edema or kinking at this anastomosis may be a factor in the development of DGE.<sup>6</sup>

Also, any potential obstruction at the level of this anastomosis would increase biliary and pancreatic anastomotic outflow pressures which could translate to an increased risk of pancreatic and biliary fistula and intraabdominal sepsis.

Few studies have shown to decrease in the morbidity with the addition of Braun enteroenterostomy (BEE) to the standard reconstruction by decreasing POPF and DGE. The proponents have postulated possible mechanism by which BEE decreases POPF and DGE. BEE potentially stabilizes and reduces kinking at the gastroenterostomy site.

In case of edema or kinking at gastroenterotomy site, food can progress distally through the Braun Enteroenterostomy. It also directs pancreatic and biliary secretions without increase in pressure in the biliopancreatic limb, which could translate into reduction in the incidence of pancreatic fistula. In addition, it diverts pancreatic and biliary secretions away from the stomach, reducing exposure of the gastric mucosa to potentially irritating effects of bile.

Nikfarjam et al and Hochwald et al reported a decrease in DGE after addition of BEE. <sup>7,8</sup> In a study by Wayne M et al an uncut Roux en y was added to standard reconstruction and concluded that there was a decrease in the incidence of DGE. <sup>9</sup> But in a study by Zhang et al, there was no decrease in DGE after addition of BEE. <sup>10</sup> Hence a prospective randomized study was done to evaluate the possible benefits of adding BEE to the standard reconstruction after Pancreaticoduodenectomy.

#### **METHODS**

It is a prospective randomized controlled study conducted after approval by Institutional Research and Ethics Committee. It included all patients who were planned for Pancreaticoduodenectomy from June 2012 to July 2016. Study excluded patients who underwent previous gastric or small bowel surgery, adjacent organ resection (colon / mesocolon), and those requiring vascular resection and reconstruction. Pre-operative details like demographic data, laboratory tests and indications for surgery were recorded for all patients.

After resection patients were randomized by sealed envelope technique to undergo either standard reconstruction (Group A) or standard reconstruction with addition of Braun Enteroenterostomy (Group B). Pancreaticojejunostomy was done using a retrocolic Roux limb of jejunum. It is an end to side duct to mucosal anastomosis in two layers.

Outer layer is done using 3/0 polypropylene suture and inner layer with 4/0 polydiaxanone (PDS) suture. Anastomosis is stented if pancreatic duct diameter is less than 3 mm. An end-to-side hepaticojejunostomy was done 10 to 15 cm distal to the pancreatic anastomosis in a

single layer using 4/0 polydioxanone interrupted sutures. An antecolic limb of intestine is brought up to the stomach to create a gastroenterostomy approximately 45 cm from hepaticojejunostomy in two-layer fashion spanning 5 to 6 cm (2/0 polyglactin 910 and 2/0 Polypropylene).

For patients in group B, BEE is constructed approximately 25 cm distal to the gastroenterostomy by a side to side anastomosis in two layers (3/0 polyglactin 910 and 3/0 polypropylene sutures) spanning 4 cm. Two 28 Fr drains are placed, one in subhepatic space and other close to pancreaticojejunostomy. Feeding jejunostomy was done in all cases.

Postoperatively nasogastric tube was removed on day 1/2. Feeds through jejunostomy tube are started on day 2. Drain fluid amylase was assessed on day 3 and day 5. Liquids are started on day 3 and solids started once patient tolerates liquids. The outcomes were predefined and measured. Outcomes measured in terms of delayed gastric emptying (DGE), pancreatic fistula (POPF), wound infection, hospital stay and mortality. DGE was assessed based on the 2007 International Study Group of Pancreatic Surgery (ISGPS) definition and grading. POPF was assessed based on 2016 update of the International Study Group (ISGPS) definition and grading of postoperative pancreatic fistula. 12,13

Wound infection was defined as infection less than 30 days after surgery involving skin, subcutaneous tissue, deep soft tissues (fascia and muscle) plus one of following purulent discharge, diagnosis of infection by pus for culture and sensitivity and symptoms of local pain, erythema, oedema, and fever.<sup>14</sup>

Intrabdominal collections were defined as collections within the peritoneal cavity on imaging with deviation from normal clinical recovery requiring intervention either image guided percutaneous or surgical. Patients were considered fit for discharge if they were able to tolerate oral diet, passing stools, afebrile and no wound complications requiring hospital stay. Data was recorded in a predesigned proforma and analyzed. P value <0.05 was considered as significant.

#### **RESULTS**

112 patients were included during the study period. Of these, 8 patients were excluded. Reasons for exclusion are previous triple bypass in one patient, previous gastric surgery in 2 patients, portal vein resection with reconstruction in 3 patients, and 2 patients had resection of colon with mesocolon.

After exclusion, 104 patients were included for analysis. Of 104 patients, Group A included 56 patients who underwent standard reconstruction and Group B had 48 patients who had addition of BEE.

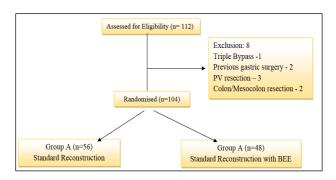


Figure 1: Consort diagram.

#### Patient characteristics

The characteristics of the patient treated in each group are shown in Table 1. There were no significant differences in demographic characteristics. Percentage of patients who were diabetic and those underwent preoperative biliary drainage were similar in two groups. Platelet counts were significantly more in the Braun's group (p=0.0054). Serum creatinine levels were more in the Braun's group (p=0.0003). Other preoperative parameters were similar in 2 groups.

**Table 1: Patient characteristics.** 

	Group A (Std) (n=56)	Group B (Std +BEE) (n=48)	P value
Patient characteristics			
Male	36 (64.3%)	28 (58.3%)	0.78
Age (years)	52.60±10.28	55.21±9.90	0.36
Diabetes	24 (42.84%)	18 (37.5%)	0.76
Preoperative biliary drainage	8 (14.28%)	8 (16.67%)	1.00
Preoperative investigations			
Haemoglobin (g/dl) (Mean±SD)	10.29±2.18	10±1.84	0.60
Leucocyte count (x10 <sup>9</sup> /L)	11.2 (6.2-14.8)	10.3 (5.7-15.2)	0.15
Platelet count (x10 <sup>9</sup> /L)	243.21 (152-374)	282.08 (162-328)	0.0054
Bilirubin (mg/dl)	10.8±7.21	11.6±6.04	0.843
Albumin (g/dl)	3.5±1.48	3.2±1.21	0.814
Creatinine (mg/dl)	1.09±0.34	1.45±0.32	0.0003

Table 2: Intraoperative variables.

	Group A (Std) (n=56)	Group B (Std +BEE) (n=48)	P value
Malignancy	54 (96.4%)	44 (91.6%)	
Location of tumour			
Ampullary	22 (40.7%)	20 (41.6%)	
Head of pancreas	20 (37.1%)	16 (36.4%)	0.69
Distal CCA	10 (18.5%)	6 (13.6%)	
Duodenal	2 (3.7%)	2 (4.5%)	
Pancreas status			
Soft pancreas	28 (50.0%)	22 (45.8%)	0.79
Duct diameter (mm)	6.17 (3-9mm)	6.21 (3-8mm)	0.92
Operative variables			
Duration of surgery (minutes)	345 (230-420)	360 (240-450)	0.47
Blood loss (ml)	430 (150-940)	410 (130-720)	0.17

#### Intraoperative variables

Intra operative variables in 2 groups are summarized in Table 2. Most of the cases were malignancies in both groups.

Location of tumour and status of pancreas was similar in 2 groups. Duration of surgery and intraoperative blood loss was similar in 2 groups.

#### **Complications**

Postoperative complications are depicted in Table 3. Overall complications between the groups were similar. Delayed gastric emptying and post-operative pancreatic fistula rates were similar in 2 groups. Infectious complications, reoperation rates, length of hospital stay and mortality were similar in 2 groups.

There were 5 (4.81%) patients with intra-abdominal collections in 2 groups.

All patients initially underwent image guided percutaneous drainage. Only one of these patients required reoperation. 3 (5.35%) patients in standard

reconstruction group expired. Causes of mortality in the group include myocardial infarction, post-operative pancreatic fistula and pulmonary embolism. 2 (4.16%) patients expired in Braun's group due to myocardial infarction and pulmonary infection with acute respiratory distress syndrome.

**Table 3: Postoperative complications.** 

	Group A (Std) (n=56)	Group B (Std +BEE) (n=48)	P value
Delayed gastric emptying	19 (33.93%)	15 (31.25%)	
Grade A	12 (63.2%)	10 (66.6%)	0.772
Grade B	4 (21.1%)	4 (26.6%)	
Grade C	2 (10.5%)	1 (6.6%)	
Pancreatic fistula	18 (32.14%)	15 (31.25%)	
Grade A	14 (77.7%)	11 (73.4%)	
Grade B	3 (16.6%)	4 (26.6%)	0.421
Grade C	1 (5.5%)	0 (0.0%)	
Infectious complications	12 (21.4%)	10 (20.8%)	
Wound infection	9 (75.0%)	7 (70.0%)	1.00
Intraabdominal collections	3 (25.0%)	3 (30.0%)	1.00
Reoperation	1 (1.78%)	0 (0.00%)	1.00
Length of hospital stay (days)	11.21 (8-21)	10.75 (7-17)	0.52
Mortality	3 (5.35%)	2 (4.16%)	1.00

### **DISCUSSION**

During the past 3 decades, the incidence of colorectal Delayed gastric emptying (DGE) and Postoperative pancreatic fistula (POPF) are the major causes of morbidity following pancreaticoduodenectomy. <sup>1,15</sup> Theories regarding the etiology of these complications are multifactorial but still not clearly known. <sup>3-5</sup> Many variations in operative techniques were considered to decrease the incidence of these complications. <sup>16-20</sup>

One such variation is addition of Braun's Enteroenterostomy (BEE) to the standard reconstruction. Few published series have shown to reduce the morbidity with the addition of BEE to the standard reconstruction by decreasing DGE and some have shown even decrease in POPF rates.<sup>7-9</sup>

Based in these studies, we have modified our reconstruction technique by adding BEE to the standard reconstruction following classical Whipple's pancreaticoduodenectomy. We have excluded 8 patients before randomization due to previous gastric and small bowel surgery, portal vein resection, and additional organ resection, as these can affect the postoperative outcomes. Patients were randomized intraoperatively by sealed opaque envelope technique. Patient characteristics and preoperative investigations were similar in two groups except for platelet counts and serum creatinine. Mean platelet counts were higher in the group with BEE

(243.21 versus 282.08 (x109/L); p= 0.0054) and mean serum creatinine levels were also higher in BEE group (1.09 versus 1.45 mg/dl; p=0.0003). But this variation had no impact on outcomes in the two groups.

Most of the cases were operated for malignancy in both the groups and the distribution of tumour location was similar. Intraoperatively pancreas status was subjectively assessed by a single surgeon in all cases and they were similar in two groups. Mean duration of surgery was prolonged by 15 minutes in the BEE group with no additional blood loss compared to standard group. Postoperative outcomes were similar in 2 groups.

The overall incidence of DGE in the present study was 32.69%. There was no difference in the incidence of DGE in 2 groups (33.93% versus 31.25%; p=0.772), in contrary to other published series. <sup>7-9</sup> Overall POPF rates in the study were 31.73%. POPF was similar in 2 groups (32.1% versus 31.25%; p=0.421). The postulated benefits of BEE were not evident in the study. Infectious complications, reoperation rates and mortality were similar in both groups.

## **CONCLUSION**

Present study concludes that the outcomes of patients after pancreaticoduodenectomy were not altered by addition of Braun Enteroenterostomy to the standard reconstruction.

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Ethical approval: The study was approved by the

institutional ethics committee

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