

**Comparative study between pancreatico-gastrostomy and pancreatico-jejunostomy in Whipple's resection operation**

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**Surgical resection of pancreatic cancer was established in 1935 by Whipple's and associates, for tumors includes adenocarcinoma of the head, neck, and uncinate process of the pancreas; ampulla; distal common bile duct; and ampullary duodenum.**

*(Whipple, 1941 & Yen, 1997)*

**PD resection comprises an en bloc resection of the duodenum, the distal bile duct, and gastric antrum, and the procedure has many technical variations, dealing with the extent of dissection, or the details of reconstruction after the resection.**

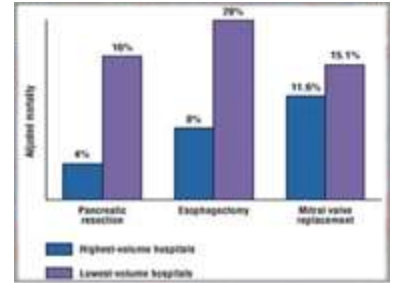
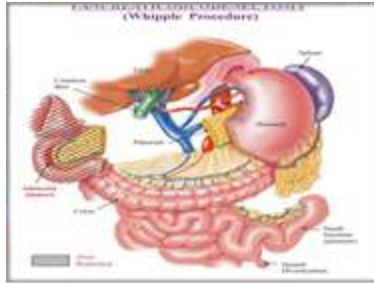
*(Nikolaos & Konstantinos, 2003)*

**PD may results in significant morbidity and mortality in a small fraction of patients. (Santoro, 2001) Fortunately, a dramatic reduction has been seen over the last decade in mortality and morbidity rates, and this can be attributed to growing surgical experience, improved anesthesia, better pre operative imaging, and better post operative management. (Pankaj, 2005)**

**Complications are significant, because pancreatico-enteric anastomosis is technically difficult to be performed and it is the most frequent site for complications as leakage, peri-pancreatic fluid collection, abscess, and pancreatic fistula that may be a corresponding factor for considerable morbidity and mortality. (Curtis et al, 2005 & Bassi et al, 2005)**

**Dealing with the residual pancreatic cuff has always been a major problem in PD (Nikolaos & Konstantinos, 2003), so several approaches described (Nakakura & Lee, 2007), and even total pancreatectomy in some instance (Bassi, 2005). Options includes end-to-end, and end-to-side pancreatico-jejunostomy, either stented or unstented, or end-to-side pancreatico-gastrostomy by anastomosing the pancreatic remnant to the posterior gastric wall midway between the lesser and greater curvature, at least 7 cm proximal to the pylorus or distal end. (Reim et al, 2004)**

Nonrandomized reports suggested that PG is less likely than PJ to be associated with complications (Joshi et al 2003, Elie et al 2004). However, some factors seems to be a major risk as soft texture of pancreas and small sized of pancreatic duct, as well as the higher output of pancreatic enzymes from pancreatic remnant, moreover the difficult surgical technique on performing anastomosis. Thus, the ideal choice of anastomosis remains a matter of debate. (Morita et al, 2007)



## Patients and methods

30 cases of PD were included in this prospective study at Assuit University hospitals; all were randomized to undergo pancreato-intestinal reconstruction with either PG or PJ. Diagnostic workup was performed, with evaluation of the operative risk by routine tests; all patients were treated with prophylactic antibiotics, prophylaxis for deep venous thrombosis, and treatment of associated co-morbidity diseases. Pre-operative biliary drainage was routinely performed in most of cases using ERCP and stents.

PD was performed (include distal gastrectomy), however 2 cases were operated upon by pylorus preserving PD (PPPD), then patients were randomly assigned to PG or PJ after completion of the resection using random numbers table. all anastomosis were hand sewn and performed in two layers (3-0 silk for outer layer, and 3-0 polygalactin for inner layer), sometimes with pancreatic duct stent and with two tubal drains nearby pancreatic anastomosis.

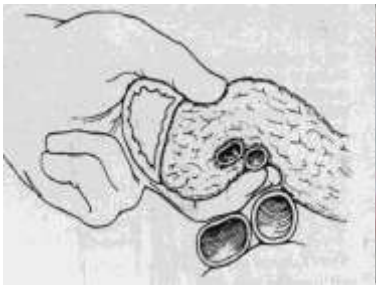
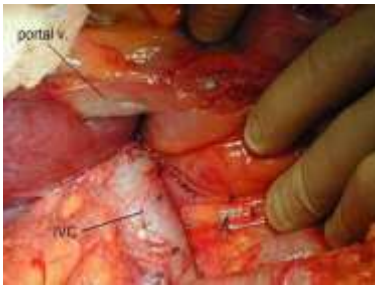
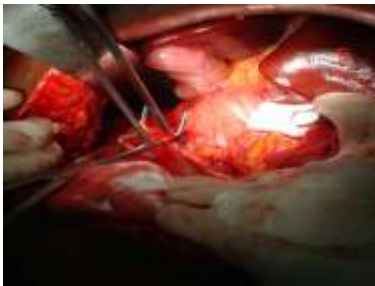
All patients were followed up with appropriate treatment and care, somatostatine was not used prophylactically, but was used post-operatively in some cases with suspected leakage. An abdominal US was performed before discharge, and data were collected included detailed operative procedure, pancreatic texture, duct diameter, any difficulties or problem, the extent of the disease in the resected specimen, and post operative course and complications.

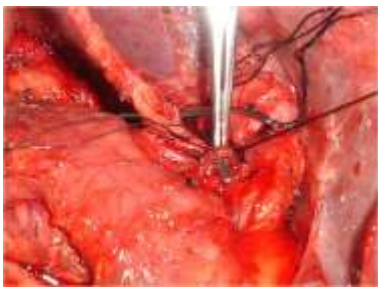
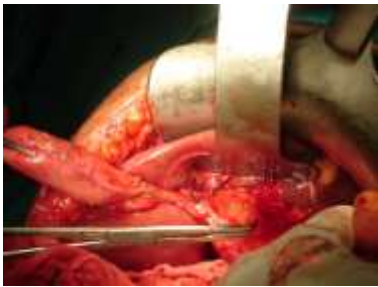
## Results

The study population consisted of 30 patients with the mean age of 53 years, 19 patients were male (63%), and 11 patients were female (37%). No differences were observed between the PG and PJ groups on comparison of multiple patient characteristics and pre-operative parameters. The mean bilirubine level observed was about 16 mg/dL, and pre-operative biliary decompression was done for 23 patients (76.7%) using ERCP& stenting in 20 cases, and PDT catheter in the other 3 cases.

The item	PG Group (n=18)	PG Device (n=24)	Total (n=42)	P-Value
Age (yr)	31	33	32	0.423*
Gender	20-M	20-M	40-M	—
Diagnosis	16 (88.9%)	26 (108.3%)	42 (100%)	0.373*
- Male	16 (88.9%)	26 (108.3%)	42 (100%)	—
- Female	0 (0%)	0 (0%)	0 (0%)	—
Pre-operative history	14 (77.8%)	17 (69.6%)	31 (73.8%)	0.321*
- Ascites	11 (61.1%)	10 (41.7%)	21 (50%)	0.223*
- Abdominal pain	10 (55.6%)	9 (37.5%)	19 (45%)	0.284*
- Anorexia	8 (44.4%)	8 (33.3%)	16 (37.8%)	0.223*
- Weight loss	8 (44.4%)	8 (33.3%)	16 (37.8%)	0.223*
- Hemorrhage	8 (44.4%)	8 (33.3%)	16 (37.8%)	0.223*
- Prior abdominal surgery	1 (5.6%)	4 (16.7%)	5 (11.9%)	0.381*
- Hypertension	8 (44.4%)	11 (45.8%)	19 (45.2%)	0.792*
- Diabetes mellitus	8 (44.4%)	11 (45.8%)	19 (45.2%)	—
- Others	1 (5.6%)	2 (8.3%)	3 (7.1%)	0.41*
Pre-operative lab. tests	17.1 ± 0.6	16.8 ± 0.8	—	0.213*
- Hemoglobin (%)	—	—	—	—
- White blood cell count (10 <sup>9</sup> /L)	8.3 ± 0.3	8.1 ± 0.4	—	0.493*
- Platelet count (10 <sup>9</sup> /L)	13.4 ± 0.5	11.4 ± 0.1	—	0.274*
- Total bilirubin (mg/dL)	11.4 ± 1.5	15.5 ± 1.2	—	0.108*
- Albumin (g/dL)	3.2 ± 0.1	3.2 ± 0.2	—	0.772*
Pre-operative hospital stay	—	—	—	—
- In days	3.2 ± 1.1	3.9 ± 0.93	—	0.41*
Pre-operative diagnosis of the study (Child-Pugh, MELD)	11 (61.1%)	11 (45.8%)	22 (52.4%)	0.284*

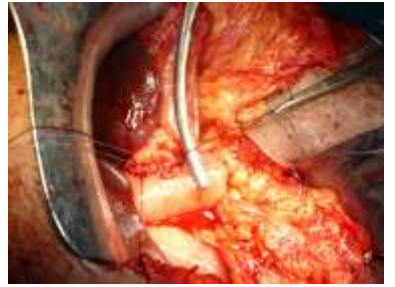
PG = Percutaneous gastrostomy; PG = Percutaneous gastrostomy; \* = 0.05 significance

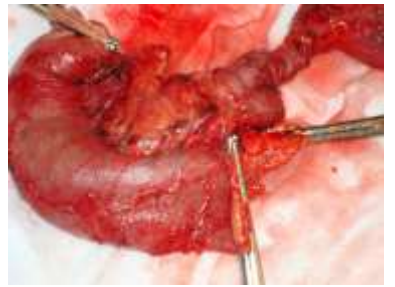
















Parameter	PG (n=16)	PJ (n=14)	P Value
Type of resection			
- Classic resection	13 (81.2%)	13 (92.9%)	0.425*
- Pancreas preserving resection	3 (18.8%)	1 (7.1%)	
Operative time and blood needed			
- Operative time (hr)	242 ± 1.2	4.33 ± 0.8	
- Average blood loss (mL)	488 ± 87	481 ± 182	0.372*
- Blood replacement (units)	3.7 ± 1.1	3.1 ± 0.9	
Pathologic resection margins			
- Hard tumor	4 (25%)	3 (21.4%)	
- Intermediate texture	8 (50%)	7 (50%)	0.830*
- Soft tumor	4 (25%)	4 (28.6%)	
Postoperative also diseases at the resected cycle			
- Mean diameter (mm)	2.53 ± 1.2	3.49 ± 0.9	0.321*
Postoperative death in the same layer of anastomosis (%)	0%	0%	
Pathology			
- Pancreatic malignancy	4 (25%)	7 (50%)	
- Lower bile duct malignancy	3 (18.8%)	3 (21.4%)	0.580*
- Secondary malignancy	4 (25%)	3 (21.4%)	
- Non-vascular malignancy	1 (6.3%)	1 (7.1%)	

PG = Pancreaticoduodenectomy, PJ = Pancreaticojejunostomy, \* = No significant

Standard PD procedure was done removing the peri-pancreatic lymph node en bloc with the resected specimen, no aggressive lymphadenectomy attended as the past reports have suggested that more extensive resection is attended by negative functional outcomes, and poorer quality of life diminishing the impact of any possible survival advantage, moreover the functional status including the physical, social, emotional, and functional well being will not significantly improved

Classical PD was done in 28 patients and PPPD was only performed in 2 patients, the pancreatic cuff was anastomosed as PG in 16 patients (53.3%), or PJ in 14 patients (46.6%).

No statistical significant difference were observed on comparing intraoperative parameters. The pathologic findings of the resected specimen revealed malignant pancreatic disease in 15 patients (50%), in comparison with 6 patients with lower cholangiocarcinoma (20%), 7 patients with ampullary carcinoma (23%), and 2 patients with duodenal malignancy (7%).

the two groups were homogenous as regard the vital statistics, underlying diseases, and operative techniques of resection. Moreover, the pancreatic texture which is an important variable with virtually all authors, the diameter of the inner layer of the pancreatic duct and its entanglement in the inner layer of anastomosis which is a contributory factor for complications, and the pathologic report of the resected specimen were comparable for both groups with no statistical significant difference to eliminate the effect of these variables on the causation of complications.

Complications observed including: wound infection in 2 patients (6.6%) and pancreatic fistula in 2 patients (6.6%). The next most common complications were bleeding from gastric margin in 1 patient (3.3%), delayed gastric emptying in 1 patient (3.3%), cholangitis in 1 patient (3.3%), abdominal collection in 1 patients (3.3%) bile leakage in 1 patient (3.3%), post operative pancreatitis in 1 patient (3.3%), and peptic ulceration in 1 patient (3.3%). Fortunately, no mortality encountered, however the overall morbidity was 36.6% (11/30 patients).

The item	PG (n=13)	PJ (n=14)	P Value
Internal fistula	1 (8.3%)	1 (7.1%)	0.7914*
External fistula	0	1 (7.1%)	
Bleeding from gastric anastomosis	1 (8.3%)	1 (7.1%)	
Delayed gastric emptying	1 (8.3%)	1 (7.1%)	
Cholangitis	1 (8.3%)	1 (7.1%)	
Abdominal collection	1 (8.3%)	1 (7.1%)	
Bile leakage	0	1 (7.1%)	
Post-operative pancreatitis	1 (8.3%)	1 (7.1%)	
Post-operative pancreatic fistula	1 (8.3%)	1 (7.1%)	
Total number of patients with complications	6 (46.2%)	6 (42.9%)	0.8229*
Number of cases needed total parenteral nutrition post-operatively	1 (8.3%)	1 (7.1%)	0.7717*
Total expense from the disease	1200 ± 100	1400 ± 100	0.8811*
Average hospital stay (days)	13 ± 3	14 ± 3	0.7914*
Reoperation	0	1 (7.1%)	

\* = not statistically significant. \*\* = statistically significant.

Pancreatic fistula was defined by (1) abnormal CT scan of pancreas not fluid or granular mass formation observed when appear immediately or several days after surgery, (2) drainage of pancreatic juice from the pancreaticojejunostomy or (3) pancreaticojejunostomy disruption demonstrated radiographically.

Delayed gastric emptying was defined by: (1) anastomotic leakage (2) 14 days after the end of the following: the gastric anastomosis tube removal, (3) the occurrence of nonoperative cholecystitis or (4) detection of pancreatitis without an (5) anastomotic tube in place. P: Days after the end of stay in the ward.

On comparison, pancreatic fistula was encountered in 2 cases in the PJ group (2/14), also one patient with pancreatitis, and another patient with bile leakage belonged to PJ group. Moreover, the total number of patients with complications was 6 patients in PJ group (43%), versus 5 patients in PG group (31.3%), which was a statistically significant difference (P = 0.02). However, the study revealed no significant differences for other parameters as drain output and the length of hospital stay that was comparable in both groups.

PG has the advantage that pancreatic juice is neutralized by gastric juice, and PG divides the flow of pancreatic juice and bile. The pancreas secretes in the stomach which represent a large reservoir that is additionally decompressed by gastric tube causing no risk of internal pressure on pancreatic anastomosis, also the proximity of the stomach to the pancreas and its large lumen makes obstruction less likely, the gastric wall is thick with better blood supply than the intestine, even if leak occurs it does not lead to life threatening complications because pancreatic enzymes are not activated.

one patient suffers from pancreatitis belong to PJ group, and this was previously observed that PG lowers the incidence of complications, as the gastric acid environment inhibit the activation of pancreatic enzymes, with the lower tendency for ischemia, probably justifies the trend toward a lower rate of pancreatitis in PG group.

Despite this major conclusion, when examining the single complications reported in this study, another significant difference can be found that favor PG. Biliary leakage was not found in PG group while it was detected in PJ group. This difference might be related to the presence in a nearby area of a double (jejunal-pancreatic and biliary) anastomosis in PJ versus a single biliary anastomosis in PG (39). This justification appears to be confirmed by the observation that in one patient with biliary leakage also had concomitant pancreatic fistula

All complications were treated conservatively or with minimal access techniques (aspiration of collection under radiologic guidance in 2 cases), unfortunately, two patients needed re-operation in the PJ group (6.7%), for fistula complication, and recovered later on without further complications. It is worthy to mention that major morbidity after PD is often managed by the aid of interventional radiologist, and re-exploration is sometimes needed to manage complications especially pancreatic fistula.

So, a significant reduction in the overall rate of complications may be reached by PG, taken together all the aforementioned factors (lower rate of biliary fistula, pancreatitis, delayed gastric emptying, and pancreatic fistula) contribute to a significantly lower incidence of total cases complications (31.3% for PG group versus 43% for PJ group, P= 0.02), and it was evident by analysis of nonrandomized studies that showed significant results in favor of PG, with a reduction of pancreatic fistula and mortality.

Another reproducible factor may significantly reduce morbidity and mortality rate in PD appears to be the establishment of high-volume regional center and surgeons. In specialized centers, the knowhow for both PG and PJ should be available and the technique to be adopted should be chosen based on the characteristics of individual cases. PG should be always considered whenever the circumstances requires easier, safer, tension free, suitable anastomosis with low incidence of morbidity and mortality.

