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Original Research Article

A comparative study between Blumgart versus conventional anastomosis for pancreatojejunostomy after pancreaticoduodenectomy

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ABSTRACT

Background: Pancreatic leakage is a major cause of postoperative mortality and morbidity after pancreaticoduodenectomy (PD). A recent study introduced Blumgart anastomosis (BA), which minimizes severe complications after PD. This study compares BA with conventional anastomosis (CA) for pancreaticojejunostomy (PJ) after PD.
Methods: This prospective observational study includes 50 patients who underwent PD between November 2022 to November 2024 were enrolled in this study in the Hepatobiliary Surgery department of Dhaka Medical College and Hospital, Dhaka, Bangladesh. The patients were divided into two groups according to the anastomosis type. 25 patients underwent anastomosis using CA (group A, conventional anastomosis) and 25 underwent anastomosis using BA (group B, Blumgart anastomosis). The methods were compared in context of postoperative pancreatic fistula (POPF), post pancreatectomy hemorrhage (PPH), and delayed gastric emptying (DGE) to see the overall outcomes of the two techniques.
Results: Median duration of operation time was significantly shorter in group B (373.1±102.0 versus 256.4±58.5 min, p<.05), and the number of intraoperative transfusion units was significantly smaller in group B (3.2±2.7 versus 1.7±1.5 units, p<0.05). Statistically significant differences were also observed between group A and B regarding incidence of postoperative pancreatic fistula (POPF) (40.0% versus 20.0%, p=031.) and delayed gastric emptying (DGE) (32.0% versus 4.0%, p=002). There was one mortality which was observed in group-A.
Conclusions: BA after PD was associated with a decreased risk of POPF and DGE. Therefore, the results of this study suggest that BA-type PJ is superior to CA-type PJ in terms of postoperative complications.

Keywords: Blumgart, Conventional anastomosis, Pancreatojejunostomy

INTRODUCTION

Pancreaticoduodenectomy (PD) has been considered the standard surgical technique for patients with either benign or malignant illness of the pancreatic head or periampullary region since Whipple and colleagues first described this procedure in 1935.[1] PD involves removing the head of the pancreas, duodenum, and proximal jejunum along with the distal stomach (Whipple's) or with or without the pylorus (pylorus preserving/resecting), as well as the local lymph nodes.[1] This surgical technique was regarded as one of the trickiest and most intricate abdominal procedures.

One of the most important tasks during the reconstruction phase of PD is managing the pancreatic stump.

Anastomosis of the pancreatic remnant, either with the stomach pancreaticogastrostomy (PG) or the jejunum pancreatojejunostomy (PJ), is the most difficult part of PD reconstruction.[3] A common source of postoperative complications following PD is pancreatic fistula (PF), a potentially dangerous and life-threatening event that can result in hemorrhage, intra-abdominal fluid collection or abscess, the occasional need for reoperation, and even death. The mortality rate following pancreatic resection has lately dropped to less than 5% at high-volume hospitals, but the morbidity rate is still significant, ranging from 30% to 50%, particularly for delayed gastric emptying (DGE) and postoperative pancreatic fistulas (POPF).[4]

There have been several initiatives to lower the incidence post-PJ complications. These include research on the application of fibrin or octreotide sealants to the pancreatic remnant, duct-to-mucosa (DTM), pancreaticogastrostomy (PG), pancreaticojejunostomy (PJ) anastomosis, internal or external pancreatic duct stenting, and invagination dunking techniques.[5] The optimal anastomosis technique for pancreatic duct repair remains debatable despite these efforts; most surgeons favor DTM anastomosis with an internal stent at the PJ anastomosis.[6]

Blumgart was the first to report a novel approach in 2000 where four transpancreatic U-sutures and duct-to-mucosa anastomosis are part of the procedure.[7] Grobmyer et al at Memorial Sloan Kettering Cancer Center reported regarding the positive outcome about this new approach. It is crucial to realize that a tension-free anastomosis, good vascularity, no laceration of the pancreatic parenchyma, and a good approximation of the pancreas and jejunum are the four most crucial elements in the construction of a PJ. Blumgart's method, which aids in achieving the four aforementioned goals, has been observed to produce excellent outcomes.[8]

The anterior and posterior layers are sutured through the pancreatic capsule and the seromuscular layer of the jejunum during an interrupted or continuous in conventional anastomosis. The Blumgart approach, on the other hand, uses transpancreatic sutures that are tensioned with the jejunum's seromuscular layer. This technique lessens harm to the pancreatic parenchyma by using fewer stitches. With a DTM anastomosis placed on the antimesenteric side of the colon, the Blumgart technique seeks to induce an invagination within the small bowel, enclosing the remaining pancreas.[9] This method relieves tension on the DTM anastomosis and stops pancreatic tears.

According to a recent study by Kleespies et al., BA reduces post-PD complications upto 20%.[10] Blumgart et al is applied to all patients in whom the pancreatic duct is found, according to Lee et al, and is linked to a notably low rate of postoperative morbidity and mortality.[11] In the modified Blumgart anastomosis group, which employed only one to three sutures, the incidence of POPF was lower than in the conventional anastomosis group, according to research by Fujii et al.[12] That's why the current study was conducted to compare BA with conventional anastomosis (CA) for pancreaticojejunostomy (PJ) after PD.

METHODS

Study design

This was a prospective observational study where purposing sampling technique was used. The study population was divided into two groups. Group A- The conventional anastomotic (CA) group and Group-B the Blumgart group (BA). Each group had 25 patients. All PD were performed by a single experienced surgeon in the Department of Hepatobiliary Surgery of Dhaka Medical College and Hospital, Dhaka, Bangladesh from November 2022 to November 2024.The two groups were compared in terms of POPF, PPH and DGE to see the overall outcome of two techniques. Furthermore, the duration of the operation, the hospital mortality and length of stay on the intermediate care units were analyzed between two groups. An enhanced recovery (ERAS) protocol was followed for all the patients.

This retrospective study was conducted in accordance with the Helsinki Declaration and International Ethical Guidelines for Biomedical Research Involving Humans. The study was approved by the Medical Ethics Committee of Dhaka Medical College and Hospital, Dhaka. Bangladesh. An informed written consent was also taken from patients for participating in the current study.

Inclusion criteria

Age>18 years, and all patients underwent PD for malignant and benign diseases of pancreas were included.

Exclusion criteria

Unresectable pancreatic malignant lesion, patients who were unfit for surgery and had uncontrolled severe comorbidities and distant metastasis were excluded.

Anastomosis technique

Conventional Anastomosis (CA)

The pancreatic capsule is continuously sutured at the cranial border of the resection surface to the seromuscular layer of the jejunum using 4-0 vicryl to begin the outer layer of the PJ on the dorsal side. Until the suture reaches the caudal margin, it is continued in that direction. After that, the jejunum is opened, and a DTM anastomosis is carried out Continuous 4-0 vicryl sutures are used to close the anterior side of the jejunum and the ventral layer of the pancreatic capsule.

Blumgart Anastomosis (BA)

The initial step of this procedure involves inserting interrupted 3-0 polypropylene sutures anteroposteriorly through the pancreatic entire thickness and the jejunum's seromuscular layer, parallel to the long axis of the jejunum. The needle is then left in place as the suture is advanced back through the entire thickness of the pancreas and secured. Usually, one or two transpancreatic U-sutures are made on the cranial side of the pancreatic duct. Due to restricted exposure, the DTM anastomosis is therefore carried out prior to putting transpancreatic sutures caudal to the pancreatic duct. An enterotomy is made in the jejunum, just opposite to the pancreatic duct. The pancreatic duct, pancreatic parenchyma, and the entire thickness of the jejunum are all included in the DTM anastomosis. Four to six interrupted 4-0 vicryl sutures are usually utilized, starting at the nine, three, and six o'clock positions. As the anastomosis goes on, each posterior suture is knotted and snipped. A stent is put into the pancreatic duct and jejunum depending on the size of the pancreatic duct. The anterior side of the duct-to-mucosa anastomosis is finished when the stent is secured with a suture at the six o'clock position. One or two more transpancreatic sutures are positioned caudal to the major pancreatic duct and knotted once the DTM anastomosis is complete. The front side of the jejunum is sutured using the posterior wall needles, being careful not to damage the pancreatic duct. The jejunum completely encloses the pancreatic stump. Lastly, to guarantee a safe anastomosis, interrupted reinforcing sutures are positioned.

Operational definitions

Major complications after PD included postoperative pancreatic fistula (POPF), post pancreatectomy hemorrhage (PPH), and delayed gastric emptying (DGE). POPF was defined and graded according to the International Study Group on Pancreatic Fistulas (ISGPF).[13] The ISGPF proposed the clinical grading system of POPF by severity grades A, B, and C), with grade A being least severe and grade C being most severe (Table 1). This grading system of POPF was based on parameters, such as clinical condition, treatment used, imaging study results, persistent drainage, reoperation, death, infection signs, and readmission.

Table 1: POPF grade according to ISGPF.

No fistula	Drainage amylase on or after postoperative day 3 is not three times than upper normal serum amylase value
Grade-A	No specific treatment was required even though drainage amylase on or after postoperative day 3 is three times than upper normal serum amylase value
Grade-B	Requires a change management or adjustment of clinical pathway (antibiotics, total parenteral nutrition, or repositioning of drainage tubes)
Grade-C	Requires major charge in the clinical pathway; clinical intervention is aggressive and often in the ICU setting

Table 2: DGE grading according to ISGPS.

ISGPS DGE grade	Nasogastric tube needed	Unable to tolerate solid diet by pod
A	4-7 d or reinsertion after pod 3	7
B	8-14 d or reinsertion after pod 7	14
C	>14 d or reinsertion after pod 14	21

Table 3: PPH grading according to ISGPS.

Grade	Timing, location and severity of bleeding	Clinical condition	Investigation
A	Early, intra- or extraluminal mild	Well	Observation, blood count, ultrasonography, CT scan
B	Early, intra- or extraluminal, severe or late, intra- or extraluminal, mild	Often well/ intermediate, very rarely life-threatening	Observation, blood count, ultrasonography, CT scan
C	Late, intra- or extraluminal, severe	Severely impaired, life-threatening	Angiography CT scan Endoscopy

PPH and DGE were defined and graded according to the International Study Group on Pancreatic Surgery (ISGPS).[14,15] The mild, moderate, and severe forms of DGE after pancreatic resection were classified into grades A, B, and C, respectively, based on their clinical effect on the clinical course and on postoperative management (Table 2). Three different grades of PPH (grades A, B, and C) were defined according to the time of onset, site of bleeding, severity, and clinical effect (Table 3).

Postoperative management

Each patient had two drain tubes positioned routinely; one at hepatorenal pouch of Morrison and one at the level of the PJ anastomosis. The drainage fluid's color and

volume were noted in every post-operative day. If no abnormal fluid collection was observed around the PJ anastomosis, the drainage tube was withdrawn. Sips of water was initiated on the fifth postoperative day considering patient's tolerability and state of recovery. The oral diet was subsequently progressed to a liquid diet and finally to a soft diet according to the recovery of gastrointestinal function.

Statistical analysis

Comparisons between the two groups were made using the t- test for continuous variables and the X^2 test for categorical variables, which are presented as frequency or percentage. Continuous variables are presented as mean±SD. Statistical significance was set at $p<0.05$. Statistical data were calculated by SPSS version 23.0 (IBM SPSS Statistics, IBM Corporation, Chicago, IL, USA).

RESULTS

A total of 50 patients were included in the present study. Of these, 25 underwent CA (group A) and 25 patients underwent BA (group B). The clinical and demographic characteristics of patients in both groups are shown in Table 4. The mean age was 57±3.4 years of the study population. Most of the patients were male with a male female ratio of 1:4. Carcinoma (CA) head of pancreas was the main pathology for which most of the patients underwent PD in Group A (80%) while periampullary carcinoma was the most prevalent disease in Group B (60%). Mean American Society of Anesthesiologists (ASA) scores of CA and BA groups were 2.11±0.62 and 2.35±0.65 respectively. There was no significant difference in the clinical and demographic characteristics (Table 4).

Table 4: Demographic characteristics of study population.

	Conventional Anastomosis (CA), N (%) (n=25)	Blumgart Anastomosis (BA), N (%) (n=25)
Mean age (years)	56±10.67	59±8.06
Sex		
Male	20 (80.00)	18 (72.00)
Female	5 (20.00)	7 (28.00)
ASA score (mean)	2.11±0.62	2.35±0.65
Diagnosis		
Ca head of pancreas	20 (80.00)	3 (12.00)
Periampullary carcinoma	2 (8.00)	15 (60.00)
Distal cholangiocarcinoma	3 (12.00)	7 (28.00)
Previous intervention (biliary stenting, PTBD)	4 (16.0)	2 (8.00)

All the cases were malignant diseases. There were significant differences in median duration of operation and in intraoperative transfusion between the two groups. Median duration of operation was significantly shorter in group B (473.1±102.0 versus 386.4±58.5 min, $p<.05$), and the number of intraoperative transfusion units was significantly smaller in group B (3.2±2.7 versus 1.7±1.5-unit, $p<.05$). The lengths of postoperative hospital stay were not statistically different between groups B and A (9.0±6.3 versus 7.4±7.2 days, $p=0.08$) (Table 5).

Table 5: Operative data between two groups.

	Group-A	Group-B	P value
Duration of operation (min)	373.1±102.0	256.4±58.5	0.032
Intraoperative transfusion (unit)	3.2±2.7	1.7±1.5	0.003
Length of post-operative hospital stay (Days)	12.0±6.3	10±7.2	0.08

Table 6: Post-operative complications between two groups.

	Group-A (n=25), N (%)	Group-B (n=25), N (%)	P value
POPF			
A	5 (20.0)	3 (12.0)	
B	3 (12.0)	2 (8.00)	0.031
C	2 (8.00)	0 (0.00)	
Total	10 (40.0)	5 (20.0)	
PPH			
A	4 (16.0)	2 (8.00)	
B	1 (4.0)	2 (8.00)	
C	1 (4.00)	0 (0.00)	0.0643
Total	6 (24.0)	4 (16.0)	

Continued.

	Group-A (n=25), N (%)	Group-B (n=25), N (%)	P value
DGE			
A	2 (8.0)	3 (12.0)	0.002
B	5 (20.0)	1 (4.0)	
C	1 (4.00)	0 (0.00)	
Total	8 (32.0)	4 (4.00)	

There were 10 patients who developed various degrees of POPF in CA group while 5 patients had POPF in BA group. Occurrence of DGE was more in group-A (32% vs 4%).6 patients from CA group had PPH. On the other hand, only 4 patients experienced post-operative PPH in BA group. A statistically significant difference was found in the incidence of POPF (40.0% versus 20.0%, p=0.031) and DGE (p=0.002). There was no significant difference in the between groups B and A in terms of PPH (24.0% versus 16.0%, p=0.063) (Table 6). There was one mortality which was observed in Group-A.

DISCUSSION

The primary challenge for hepatobiliary surgeons is still the pancreatic anastomosis following pancreaticoduodenectomy (PD). PJ and pancreati-cogastrostomy are two of the various varieties of pancreaticoenterostomies. There are also other variations of PJ, including duct-to-mucosa anastomosis, a "dunking" approach akin to invagination, and others. The method of choice for reconstruction following PD is often PJ. But according to Topal et al, pancreaticogastrostomy lowers the likelihood of related issues such DGE, postoperative fluid collection, and biliary fistula.[16]

Reducing POPF is mostly accomplished by applying the best PJ technique for management of pancreatic stump after PD. An optimal anastomosis should have the jejunal serosa at the surface of the pancreatic stump, completely divert the pancreatic juice, maintain the pancreatic blood flow, and prevent pancreatic parenchymal laceration.[17,18]

Surgeons have been trying to find the "optimal" technical methods for managing pancreatic remnant over the past 30 years, which has led to many studies regarding the best option for PJ. Despite this, a lot of surgeons still search optimum technique for pancreatic anastomosis in an effort to manage pancreatic stump after PD. A somewhat "novel" kind of duct to mucosa anastomosis known as "Blumgart anastomosis" (BA) has become more and more popular recently. BA has been shown to be effective in preventing clinically significant pancreatic fistulas (POPF) in a number of retrospective studies.[19,20]

There are numerous anastomosis strategies for the pancreatojejunostomy following pancreatic head excision in the literature; Chromik explains that each facility has a unique anastomosis technique, making comparisons challenging.[21] There is no perfect method, as seen by the variety of methods proposed to lower the rate of POPF.

According to several studies, the Blumgart approach is preferable over the traditional pancreatojejunostomy and may lower the incidence of clinically significant POPF and unfavorable postoperative sequelae.[22,23]

Fearsome side effects such intraperitoneal sepsis, surgical bleeding, and death might result from a pancreatic fistula. Surgeons are now concentrating most of their research on ways to lower the prevalence of pancreatic fistula.[24]

The first article on the Blumgart anastomosis looked at 187 individuals who had their pancreatic heads removed. The exceptionally low POPF rate (grade B + grade C) of 6.9% and 1.6% mortality were reported by the authors.[25] Mendoza et al contrasted the modified Cattel-Warren anastomosis with the Blumgart method. The study demonstrates a much lower risk of postoperative bleeding, a shorter time of surgery, a shorter length of stay on intermediate care units, a significantly lower rate of POPF (4%), and less surgical and general problems following Blumgart anastomosis.[26] Using the Blumgart anastomosis, Lai et al found comparable outcomes with a decreased risk of POPF and general complications.[27] According to a recent study, the Blumgart anastomosis has the potential to lower 90-day mortality and unfavorable sequelae as well as POPF "grade C" compared to the duct-to-mucosa anastomosis and the invagination pancreatojejunostomy (Dunking) approach.[28] In addition, Z'graggen et al found that 2.1% of 331 patients who had pancreatic head resection and traditional duct-to-mucosa anastomosis, experienced POPF.[29]According to the study's data analysis, the Blumgart anastomosis may lower the incidence of POPF. The technique's simplicity, shorter operating time, and superiority are especially evident in soft pancreatic parenchyma.

In addition to lowering POPF, this surgical technique has the benefits of preserving gut physiology, reducing stent-associated problems, conserving time, and being easy to learn.

The incidence of DGE and PPH was also lower in the BA group in our study. Similar to our results, in the study by Vallance et al and Callery et al where is DGE and PPH rate was 21% and 12% respectively in the BA group proving the superiority of this technique.[30,31]

This study had several limitations. First, it was a single-center study with a short study period. Second, it was based on a small sample size. Third, these patients were not homogenously distributed.

CONCLUSION

This study demonstrates that BA anastomoses may lower the risk of POPF, despite having several limitations. Reconstruction using this approach might reduce overall morbidity rates such as DGE, PPH, or prolonged postoperative stay. These findings must, however, be validated by more, carefully planned research in the future.

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