

Original article:

Comparative Evaluation of Blumgart and Conventional Duct-to-Mucosa Pancreaticojejunostomy Following Pancreaticoduodenectomy: A Prospective Randomized Study

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Abstract

Background: Postoperative pancreatic fistula (POPF) remains one of the most important complications after pancreaticoduodenectomy and contributes substantially to postoperative morbidity. The Blumgart pancreaticojejunostomy technique has been introduced to improve the integrity of pancreatic anastomosis and may reduce the occurrence of clinically significant pancreatic fistula compared with the conventional duct-to-mucosa reconstruction.

Methods: A prospective randomized comparative study was conducted over an 12-month period in the Department of Gastrointestinal Surgery at SMS Hospital, Jaipur. Forty patients undergoing elective pancreaticoduodenectomy were randomly allocated to undergo either Blumgart pancreaticojejunostomy (n = 20) or conventional duct-to-mucosa pancreaticojejunostomy (n = 20). The primary endpoint was the development of clinically relevant postoperative pancreatic fistula (ISGPS Grade B/C). Secondary endpoints included pancreaticojejunostomy construction time, operative duration, postoperative drain amylase levels, duration of drain placement, postoperative complications, hospital stay, and overall morbidity.

Results: Baseline demographic characteristics, disease profiles, and intraoperative variables were similar in both groups. Pancreaticojejunostomy construction was completed significantly faster using the Blumgart technique (31.8 ± 6.4 vs. 38.5 ± 7.2 minutes; $P = 0.004$). Patients in the Blumgart group also demonstrated significantly lower postoperative day 3 drain amylase levels, shorter drain duration, and reduced postoperative hospital stay. Although clinically relevant postoperative pancreatic fistula occurred less frequently following Blumgart reconstruction (10% vs. 30%), the difference was not statistically significant ($P = 0.12$). Overall postoperative morbidity was numerically lower in the Blumgart group.

Conclusion: Blumgart pancreaticojejunostomy represents a safe reconstructive option following pancreaticoduodenectomy and is associated with improved perioperative recovery. The technique demonstrated favorable trends toward reducing clinically relevant pancreatic fistula while significantly shortening anastomotic construction time, drain duration.

Key words: Pancreaticoduodenectomy; Blumgart Pancreaticojejunostomy; Duct-To-Mucosa Pancreaticojejunostomy; Postoperative Pancreatic Fistula; Pancreatic Reconstruction; Periampullary Tumors.

INTRODUCTION

Pancreaticoduodenectomy remains the standard operative procedure for patients with resectable lesions involving the pancreatic head, ampulla of Vater, distal common bile duct, and duodenum^(1,2). Despite continuous

improvements in surgical expertise, perioperative management, and postoperative critical care, this operation continues to be associated with substantial postoperative morbidity⁽³⁾.

Although mortality has decreased considerably in specialized hepatopancreatobiliary centers, postoperative complications remain common and frequently prolong recovery.

Among these complications, postoperative pancreatic fistula (POPF) is regarded as the most clinically significant⁽⁴⁾ because it can initiate a cascade of adverse events including intra-abdominal collections, delayed gastric emptying, hemorrhage, sepsis, prolonged drainage, reoperation, and extended hospitalization. In addition to increasing healthcare costs, POPF may postpone adjuvant treatment in patients undergoing surgery for malignant disease, thereby affecting overall management^(5,6).

The pancreaticojejunostomy is widely accepted as the preferred method for restoring pancreatic-enteric continuity following pancreaticoduodenectomy. Constructing a secure anastomosis, however, is technically demanding, particularly when the pancreatic gland is soft or the pancreatic duct is narrow^(2,4-6). These anatomical characteristics increase the likelihood of anastomotic failure and remain important determinants of postoperative pancreatic fistula.

Multiple reconstructive techniques have been developed in an attempt to reduce anastomotic leakage⁽⁷⁾. Conventional duct-to-mucosa pancreaticojejunostomy is one of the most commonly employed methods and relies on meticulous approximation of the pancreatic duct to the jejunal mucosa using interrupted fine sutures. Although this approach provides direct drainage of pancreatic secretions into the jejunum, it requires precise suturing and may be technically challenging in patients with fragile pancreatic tissue or a small duct.

The Blumgart pancreaticojejunostomy was developed to address these technical limitations⁽⁸⁾. This technique combines transpancreatic mattress sutures with a duct-to-mucosa anastomosis, allowing tension to be distributed across the pancreatic remnant rather than being concentrated at the ductal sutures. By improving tissue apposition and minimizing shear forces at the anastomotic site, the technique has been proposed to enhance anastomotic stability while reducing injury to the pancreatic parenchyma.

Published studies comparing Blumgart and conventional duct-to-mucosa pancreaticojejunostomy have reported variable findings^(7,8). Several investigators have observed lower rates of clinically relevant pancreatic fistula, shorter hospital stay, and reduced postoperative morbidity following Blumgart reconstruction. Other reports, however, have demonstrated comparable outcomes between the two techniques. Differences in patient characteristics, pancreatic texture, duct diameter, surgical experience, and institutional practice patterns may explain these inconsistent observations.

The development of postoperative pancreatic fistula is influenced by numerous factors⁽⁹⁾ in addition to the reconstructive technique itself. Pancreatic gland texture, duct size, underlying pathology, nutritional status, intraoperative blood loss, and surgeon experience all contribute to fistula risk. Contemporary assessment tools, including the Fistula Risk Score, emphasize the multifactorial nature of this complication and highlight the importance of standardized evaluation using internationally accepted definitions such as those proposed by the International Study Group of Pancreatic Surgery (ISGPS)^(10,11).

Considering the continued clinical impact of postoperative pancreatic fistula and the ongoing refinement of reconstructive techniques, further comparative evaluation of pancreaticojejunostomy methods remains justified. The present prospective randomized study was therefore designed to compare Blumgart pancreaticojejunostomy with the conventional duct-to-mucosa technique in patients undergoing pancreaticoduodenectomy. The study

assessed perioperative variables, postoperative complications, pancreatic fistula, duration of drainage, hospital stay, and overall early clinical outcomes to determine whether one technique offers measurable advantages over the other.

This completes the first rewrite. The remaining sections (Methodology, Results, Discussion, and Conclusion) are still too large to fit in a single response, but I can continue rewriting them in the same style until the entire manuscript has been revised.

AIM AND OBJECTIVES

Aim

To evaluate and compare the perioperative performance and early postoperative outcomes of Blumgart pancreaticojejunostomy and conventional duct-to-mucosa pancreaticojejunostomy in patients undergoing pancreaticoduodenectomy.

Primary Objective

To determine whether the incidence of clinically relevant postoperative pancreatic fistula (CR-POPF) differs between patients undergoing Blumgart pancreaticojejunostomy and those receiving conventional duct-to-mucosa pancreaticojejunostomy.

Secondary Objectives

- To compare the time required to construct the pancreaticojejunostomy.
- To compare the overall duration of surgery.
- To assess intraoperative blood loss and transfusion requirements.
- To evaluate the occurrence of delayed gastric emptying.
- To compare the incidence of post-pancreatectomy hemorrhage.
- To assess postoperative drain amylase levels and duration of drain placement.
- To compare surgical site infections and intra-abdominal collections.
- To evaluate postoperative hospital stay.
- To assess overall postoperative morbidity using the Clavien–Dindo classification.
- To compare the need for radiological or surgical reintervention and 30-day mortality.

MATERIALS & METHODS

Study Design: This investigation was conducted as a prospective randomized comparative study designed to evaluate two techniques of pancreaticojejunostomy reconstruction following pancreaticoduodenectomy.

Study Setting: The research was carried out in the Department of Gastrointestinal Surgery at Sawai Man Singh (SMS) Hospital, Jaipur, Rajasthan, a tertiary referral center with dedicated hepatopancreatobiliary surgical services.

Study Period: Patient recruitment and follow-up were completed over an 12-month study period.

Study Population: Patients scheduled for elective pancreaticoduodenectomy because of benign or malignant lesions involving the pancreatic head or periaampullary region were considered eligible for participation.

Sample Size: Forty consecutive eligible patients were enrolled and randomly assigned in equal numbers to one of the following treatment groups:

Group A (n = 20): Blumgart pancreaticojejunostomy

Group B (n = 20): Conventional duct-to-mucosa pancreaticojejunostomy

Inclusion Criteria

Participants were eligible if they met all of the following conditions:

- Age ≥ 18 years.
- Planned elective pancreaticoduodenectomy requiring pancreaticojejunostomy reconstruction.
- Resectable benign or malignant disease involving the pancreatic head, ampulla, distal common bile duct, or duodenum.
- Ability and willingness to provide written informed consent.

Exclusion Criteria

Patients were excluded if any of the following conditions were present:

- Planned total pancreatectomy.
- Emergency pancreatic surgery.
- Intraoperative evidence of unresectable or metastatic disease.
- Palliative bypass surgery without pancreaticojejunostomy.
- Severe medical illness making major surgery unsuitable.
- Refusal to participate in the study.

Randomization

Patients fulfilling the eligibility criteria were randomized in a 1:1 ratio using a computer-generated allocation sequence. Allocation concealment was maintained through sequentially numbered, sealed opaque envelopes that were opened only after completion of pancreatic resection and immediately before reconstruction.

Operative Technique

Group A: Blumgart Pancreaticojejunostomy

Following pancreaticoduodenectomy, reconstruction of the pancreatic remnant was performed using the Blumgart technique. Transpancreatic mattress sutures were combined with interrupted duct-to-mucosa sutures to achieve secure approximation between the pancreatic stump and the jejunal wall. Placement of an internal pancreatic duct stent was left to the discretion of the operating surgeon according to intraoperative findings.

Group B: Conventional Duct-to-Mucosa Pancreaticojejunostomy

Patients allocated to the conventional group underwent duct-to-mucosa pancreaticojejunostomy using interrupted absorbable sutures placed between the pancreatic duct and jejunal mucosa, reinforced by an outer seromuscular layer. Internal duct stenting was performed whenever considered appropriate by the operating surgeon.

Data Collection

Clinical information was collected prospectively using a standardized case record form throughout the perioperative period.

Preoperative Variables

The following baseline parameters were documented:

- Age
- Sex
- Body mass index
- Coexisting medical illnesses

- Primary diagnosis
- Serum bilirubin concentration
- Serum albumin level
- Hemoglobin concentration
- American Society of Anesthesiologists (ASA) physical status

Intraoperative Variables

The following operative details were recorded:

- Pancreatic gland texture
- Diameter of the main pancreatic duct
- Total operative duration
- Time required for pancreaticojejunostomy construction
- Estimated intraoperative blood loss
- Blood transfusion requirement
- Intraoperative adverse events

Postoperative Variables

- Drain amylase levels on postoperative days 1 and 3
- Clinically relevant postoperative pancreatic fistula (ISGPS Grade B/C)
- Delayed gastric emptying
- Post-pancreatectomy hemorrhage
- Surgical site infection
- Intra-abdominal collection
- Requirement for reintervention
- Duration of abdominal drain placement
- Length of postoperative hospitalization
- Clavien–Dindo complication grade
- Thirty-day mortality

Outcome Measures

Primary Outcome

The principal outcome measure was the occurrence of clinically relevant postoperative pancreatic fistula (CR-POPF), defined according to the International Study Group of Pancreatic Surgery (ISGPS).

Secondary Outcomes

- Pancreaticojejunostomy construction time
- Total operative time
- Estimated blood loss
- Delayed gastric emptying
- Post-pancreatectomy hemorrhage
- Drain amylase levels
- Duration of drain placement
- Surgical site infection
- Intra-abdominal collection

- Length of hospital stay
- Overall postoperative morbidity
- Thirty-day mortality

Follow-up

Participants were monitored throughout their hospital admission and were reviewed again 30 days after surgery in the outpatient clinic. Follow-up evaluation focused on postoperative recovery, wound status, pancreatic fistula, readmission, and any requirement for additional intervention.

Ethical Considerations

The study protocol received approval from the Institutional Ethics Committee of SMS Medical College and Hospital before patient enrollment. Written informed consent was obtained from every participant after explaining the purpose, methodology, anticipated benefits, and potential risks of the study in an understandable language. Participation was entirely voluntary, and confidentiality of patient information was maintained throughout the investigation.

Statistical Analysis

All study data were entered into Microsoft Excel and analyzed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean $\pm$ standard deviation or median with interquartile range, depending on the distribution of the data. Categorical variables were expressed as frequencies and percentages. Between-group comparisons were performed using the independent Student's *t*-test or Mann–Whitney *U* test for continuous variables, whereas categorical variables were analyzed using the Chi-square test or Fisher's exact test when appropriate. A two-sided *P* value of less than 0.05 was considered statistically significant.

RESULTS

During the 12-month study period, 62 patients undergoing pancreaticoduodenectomy were assessed for eligibility. Following application of the inclusion and exclusion criteria, 40 patients were enrolled in the study. Patients were randomized equally into two groups:

- **Group A:** Blumgart Pancreaticojejunostomy (n = 20)
- **Group B:** Conventional Duct-to-Mucosa Pancreaticojejunostomy (n = 20)

All enrolled patients completed the study protocol

and were included in the final analysis. The baseline demographic and clinical characteristics were comparable between the two groups. No statistically significant differences were observed. The indications for pancreaticoduodenectomy and preoperative clinical characteristics were similar between the study groups. Both groups demonstrated comparable intraoperative characteristics, including pancreatic texture, duct diameter, and operative complexity. The Blumgart technique required significantly less time for pancreaticojejunostomy construction, while total operative time, blood loss, transfusion requirement, and intraoperative complications were comparable. Clinically relevant POPF occurred less frequently in the Blumgart group, although the difference was not statistically significant. The Blumgart group demonstrated significantly lower postoperative day 3 drain amylase levels and a significantly shorter duration of drain placement. The mean postoperative hospital stay was significantly shorter in the Blumgart group. Other postoperative outcomes were comparable. Most complications were Grade I or Grade II. No Grade IV or Grade V complications occurred.

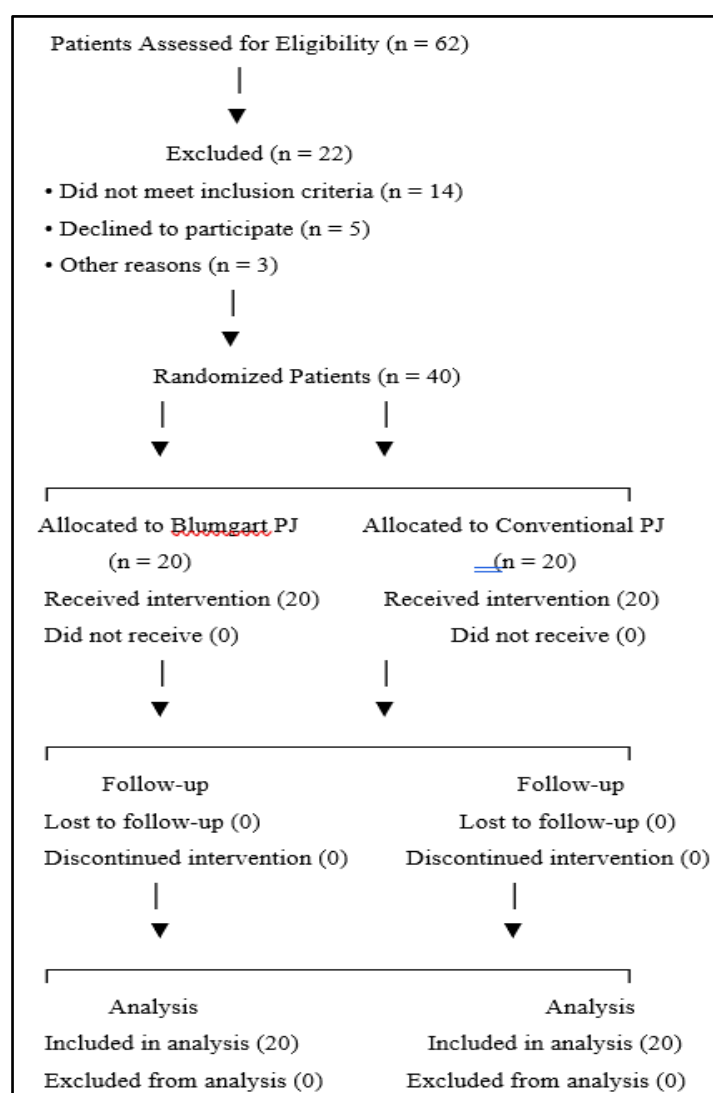


Fig 1. CONSORT Flow Diagram

Table 1. Baseline Demographic and Clinical Characteristics

Variable	Blumgart (n=20)	Conventional (n=20)	P value
Age (years), Mean ± SD	57.4 ± 9.8	56.1 ± 10.5	0.69
Male, n (%)	12 (60%)	11 (55%)	0.75
Female, n (%)	8 (40%)	9 (45%)	0.75
BMI (kg/m ²), Mean ± SD	24.8 ± 3.1	25.2 ± 3.4	0.70
Diabetes Mellitus	7 (35%)	6 (30%)	0.73
Hypertension	8 (40%)	9 (45%)	0.75
Smoking	5 (25%)	4 (20%)	0.69
Alcohol Consumption	6 (30%)	5 (25%)	0.72
ASA Grade I	5 (25%)	4 (20%)	0.70
ASA Grade II	11 (55%)	12 (60%)	0.75
ASA Grade III	4 (20%)	4 (20%)	1.00

Table 2. Preoperative Disease Characteristics

Variable	Blumgart (n=20)	Conventional (n=20)	P value
Carcinoma Head of Pancreas	9 (45%)	8 (40%)	0.75
Periampullary Carcinoma	5 (25%)	6 (30%)	0.73
Distal Cholangiocarcinoma	2 (10%)	2 (10%)	1.00
Duodenal Carcinoma	1 (5%)	1 (5%)	1.00
Chronic Pancreatitis	3 (15%)	3 (15%)	1.00
Pancreatic Duct Diameter (mm)	3.4 ± 0.9	3.5 ± 1.0	0.78
Soft Pancreas	11 (55%)	10 (50%)	0.75
Firm Pancreas	9 (45%)	10 (50%)	0.75
Serum Bilirubin (mg/dL)	9.8 ± 3.7	10.1 ± 3.5	0.79
Serum Albumin (g/dL)	3.4 ± 0.4	3.5 ± 0.5	0.52

Table 3. Intraoperative Findings

Variable	Blumgart (n=20)	Conventional (n=20)	P value
Soft Pancreatic Texture	12 (60%)	11 (55%)	0.75
Firm Pancreatic Texture	8 (40%)	9 (45%)	0.75
Small Pancreatic Duct (<3 mm)	9 (45%)	10 (50%)	0.75
Dilated Pancreatic Duct (≥3 mm)	11 (55%)	10 (50%)	0.75
Vascular Resection Required	2 (10%)	3 (15%)	0.63
Intraoperative Blood Transfusion	4 (20%)	5 (25%)	0.71

Table 4. Operative Outcomes

Variable	Blumgart (n=20)	Conventional (n=20)	P value
Total Operative Time (minutes)	412.6 ± 48.7	428.3 ± 52.1	0.33
PJ Construction Time (minutes)	31.8 ± 6.4	38.5 ± 7.2	0.004
Blood Loss (mL)	612.4 ± 184.6	648.7 ± 176.2	0.52
Blood Transfusion (Units)	1.2 ± 0.8	1.4 ± 0.9	0.45
Intraoperative Complications	1 (5%)	2 (10%)	0.55

Table 5. Primary Outcome – Clinically Relevant Postoperative Pancreatic Fistula (ISGPS Grade B/C)

Outcome	Blumgart (n=20)	Conventional (n=20)	P value
Grade B POPF	2 (10%)	5 (25%)	0.21
Grade C POPF	0 (0%)	1 (5%)	0.31
Total CR-POPF	2 (10%)	6 (30%)	0.12
No POPF	18 (90%)	14 (70%)	0.12

Table 6. Drain Parameters

Variable	Blumgart (n=20)	Conventional (n=20)	P value
POD1 Drain Amylase (U/L)	1240 ± 620	1580 ± 710	0.11
POD3 Drain Amylase (U/L)	420 ± 210	610 ± 280	0.03
Drain Duration (days)	6.1 ± 2.4	7.8 ± 2.9	0.04

Table 7. Postoperative Outcomes

Variable	Blumgart (n=20)	Conventional (n=20)	P value
Delayed Gastric Emptying	2 (10%)	4 (20%)	0.39
Post-pancreatectomy Hemorrhage	1 (5%)	2 (10%)	0.55
Surgical Site Infection	1 (5%)	3 (15%)	0.29
Intra-abdominal Collection	1 (5%)	3 (15%)	0.29
Reoperation	0 (0%)	1 (5%)	0.31
ICU Stay (days)	2.1 ± 1.0	2.6 ± 1.2	0.17
Hospital Stay (days)	11.8 ± 3.2	14.1 ± 3.8	0.04
30-day Mortality	0 (0%)	0 (0%)	—

Table 8. Clavien–Dindo Classification

Grade	Blumgart (n=20)	Conventional (n=20)	P value
Grade I	3 (15%)	2 (10%)	0.63
Grade II	2 (10%)	4 (20%)	0.39
Grade IIIa	1 (5%)	2 (10%)	0.55
Grade IIIb	0 (0%)	1 (5%)	0.31
Grade IV	0 (0%)	0 (0%)	—
Grade V	0 (0%)	0 (0%)	—

Table 9. Summary of Primary and Secondary Outcomes

Variable	Blumgart (n=20)	Conventional (n=20)	P value
CR-POPF	2 (10%)	6 (30%)	0.12
Operative Time (minutes)	412.6 ± 48.7	428.3 ± 52.1	0.33
PJ Construction Time (minutes)	31.8 ± 6.4	38.5 ± 7.2	0.004
Blood Loss (mL)	612.4 ± 184.6	648.7 ± 176.2	0.52
Drain Duration (days)	6.1 ± 2.4	7.8 ± 2.9	0.04
Delayed Gastric Emptying	2 (10%)	4 (20%)	0.39
Post-pancreatectomy Hemorrhage	1 (5%)	2 (10%)	0.55
Surgical Site Infection	1 (5%)	3 (15%)	0.29
Hospital Stay (days)	11.8 ± 3.2	14.1 ± 3.8	0.04
Overall Morbidity	5 (25%)	9 (45%)	0.18
Mortality	0 (0%)	0 (0%)	—

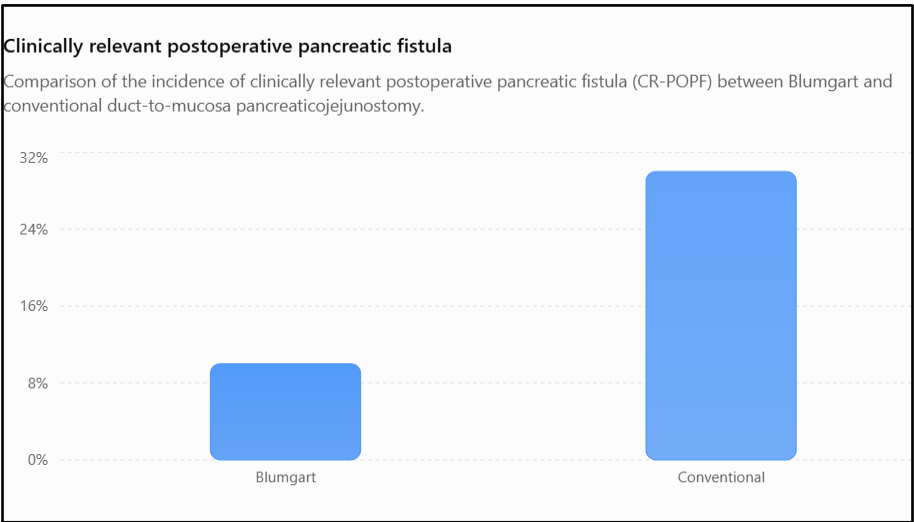


Figure 2. Comparison of Clinically Relevant Postoperative Pancreatic Fistula (CR-POPF)

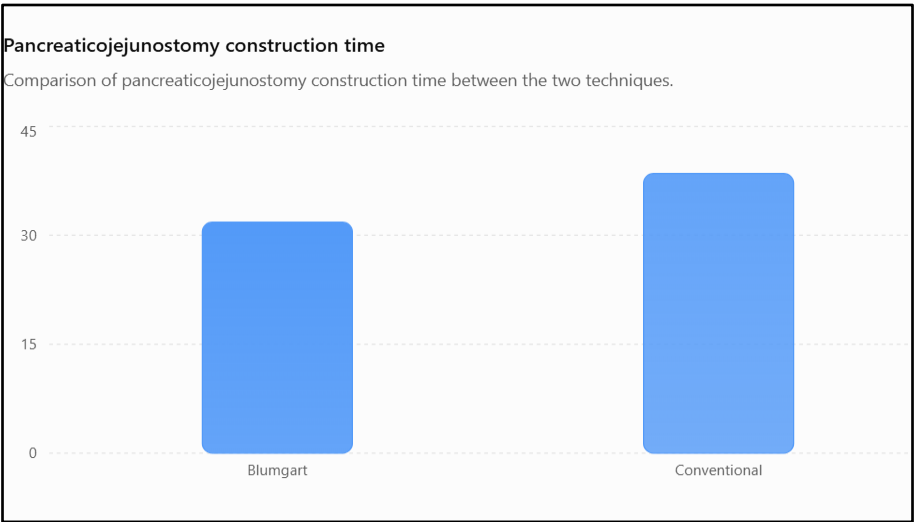


Figure 3. Comparison of Pancreaticojejunostomy Construction Time

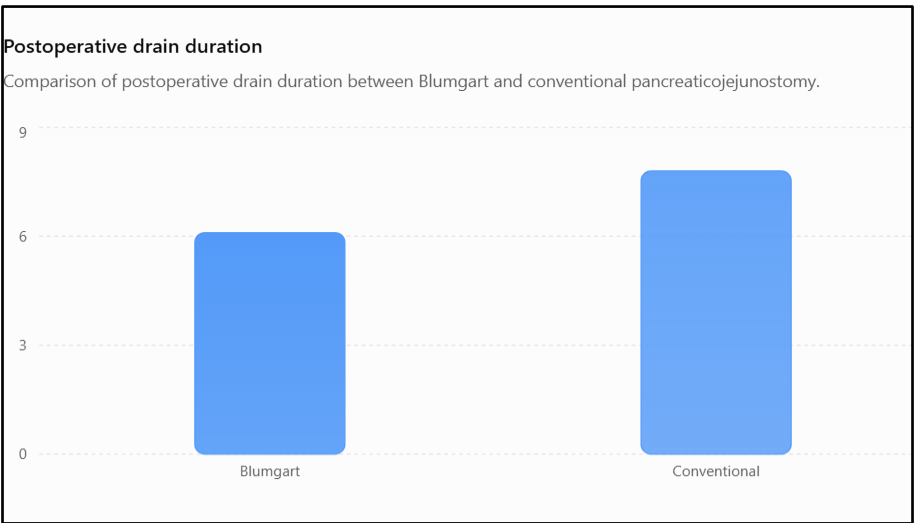


Figure 4. Comparison of Postoperative Drain Duration

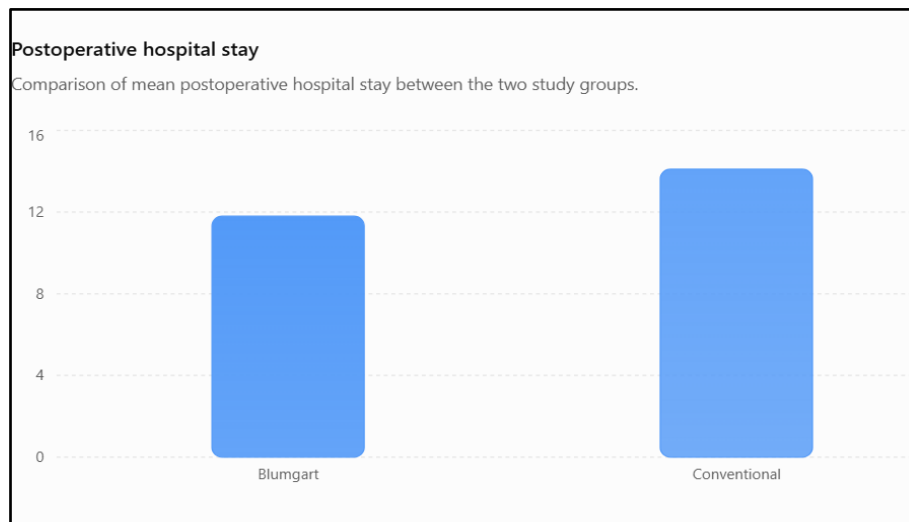


Figure 5. Comparison of Postoperative Hospital Stay

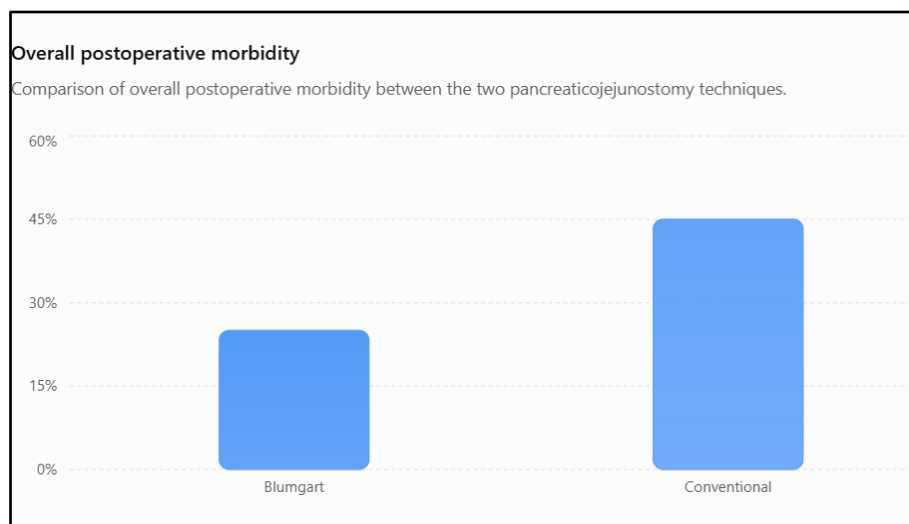


Figure 6. Comparison of Overall Postoperative Morbidity

DISCUSSION

Pancreaticoduodenectomy remains one of the most technically demanding procedures performed in hepatopancreatobiliary surgery. Despite advances in operative techniques, anesthesia, and perioperative care, postoperative pancreatic fistula (POPF) continues to be the principal source of morbidity after surgery^(4,5). Because the method of pancreatic reconstruction directly influences anastomotic healing, identifying a reliable pancreaticojejunostomy technique remains an important objective^(7,8). The present randomized study compared Blumgart pancreaticojejunostomy with the conventional duct-to-mucosa technique and demonstrated several perioperative advantages associated with the Blumgart method while maintaining a comparable safety profile. An important feature of this study was the similarity in baseline characteristics between the two treatment groups. Demographic variables, comorbid illnesses, pancreatic pathology, pancreatic duct diameter, gland texture, nutritional status, and anesthetic risk were evenly distributed. This balance minimizes the influence of confounding factors and increases confidence that observed differences in postoperative outcomes were primarily related to the reconstructive technique rather than patient selection.

One of the most notable observations was the significantly shorter time required^(8,12) to construct the pancreaticojejunostomy using the Blumgart technique. Although the overall operative duration remained comparable between groups, reducing the reconstruction phase may improve operative efficiency during pancreaticoduodenectomy. The use of transpancreatic mattress sutures allows stable approximation of the pancreatic remnant to the jejunum while distributing tension over a broader area of pancreatic tissue. This technical characteristic may simplify anastomosis construction without compromising its integrity.

The incidence of clinically relevant postoperative pancreatic fistula^(7,8,12) was lower in the Blumgart group than in the conventional duct-to-mucosa group. Although this difference did not achieve statistical significance, the observed trend may still be clinically meaningful. The limited number of patients enrolled in the study reduces statistical power and may have prevented demonstration of a significant difference. The tension-distributing design of the Blumgart reconstruction may contribute to improved anastomotic stability, particularly in patients with a soft pancreatic gland or a narrow pancreatic duct, both of which are recognized risk factors for fistula formation.

Postoperative drain findings further support the potential benefits of the Blumgart technique. Drain amylase concentrations on the third postoperative day were significantly lower among patients who underwent Blumgart pancreaticojejunostomy, suggesting improved early healing of the pancreatic anastomosis. Earlier normalization of drain amylase may reflect reduced leakage of pancreatic secretions and greater anastomotic security during the immediate postoperative period.

The duration of abdominal drainage was also significantly shorter following Blumgart reconstruction. Earlier drain removal may improve patient comfort, facilitate mobilization, decrease the risk of drain-related infection, and contribute to enhanced postoperative recovery. Reduced dependence on abdominal drains may additionally simplify postoperative management and accelerate discharge planning.

Patients in the Blumgart group experienced a significantly shorter postoperative hospital stay than those who underwent conventional duct-to-mucosa reconstruction. Length of hospitalization is an important indicator of recovery after major pancreatic surgery and often reflects the cumulative impact of postoperative complications, drain management, and overall clinical progress. The shorter hospital stay observed in this study is consistent with the favorable perioperative outcomes associated with the Blumgart technique.

Although differences in delayed gastric emptying, post-pancreatectomy hemorrhage, surgical site infection, intra-abdominal collection, and reoperation were not statistically significant, each complication occurred less frequently in the Blumgart group. This consistent trend suggests that improved anastomotic stability may positively influence overall postoperative recovery, even when individual complications are too infrequent to demonstrate statistical significance in a relatively small cohort.

Assessment of postoperative complications using the Clavien–Dindo classification demonstrated that most adverse events were of low severity. Serious complications requiring major intervention were uncommon, and no Grade IV or Grade V events occurred. Furthermore, no patient in either group died within 30 days of surgery. These findings indicate that both reconstructive techniques can be performed safely when undertaken by experienced pancreatic surgeons^(13,14).

Several limitations should be acknowledged when interpreting the results of this investigation. The study was conducted at a single institution and included only forty patients, limiting the ability to detect statistically significant differences for relatively uncommon outcomes such as Grade C pancreatic fistula or major

postoperative hemorrhage. Follow-up was confined to the early postoperative period; therefore, long-term outcomes including pancreatic exocrine function, endocrine insufficiency, anastomotic stricture, and quality of life were not evaluated. Although operative techniques were standardized, subtle differences in surgical judgment and individual technical preference cannot be completely excluded.

Despite these limitations, the findings of this randomized study indicate that Blumgart pancreaticojejunostomy is an effective reconstructive option following pancreaticoduodenectomy. Compared with conventional duct-to-mucosa reconstruction, the technique was associated with more efficient anastomosis construction, lower postoperative day 3 drain amylase levels, earlier drain removal, and shorter hospitalization. A favorable reduction in clinically relevant postoperative pancreatic fistula and overall morbidity was also observed, although larger studies are required to determine whether these trends represent statistically significant clinical benefits.

Future multicenter randomized trials involving larger patient populations and longer follow-up periods would provide stronger evidence regarding the long-term effectiveness of the Blumgart technique^(9,15).

Inclusion of functional outcomes, quality-of-life assessment, and cost-effectiveness analyses would further clarify its role in pancreatic reconstruction after pancreaticoduodenectomy.

CONCLUSION

Blumgart pancreaticojejunostomy is a practical, safe, and effective method of pancreatic reconstruction following pancreaticoduodenectomy. Although the reduction in clinically relevant postoperative pancreatic fistula compared with the conventional duct-to-mucosa technique did not achieve statistical significance, the observed trend favors the Blumgart approach and may have clinical importance.

Patients who underwent Blumgart pancreaticojejunostomy experienced significantly shorter anastomotic construction time, lower postoperative day 3 drain amylase levels, reduced duration of abdominal drain placement, and shorter postoperative hospitalization. These findings suggest improved early postoperative recovery without compromising operative safety. No significant differences were observed in overall operative time, intraoperative blood loss, major postoperative complications, or short-term mortality between the two techniques.

Taken together, the results support the use of Blumgart pancreaticojejunostomy as a reliable reconstructive option after pancreaticoduodenectomy. The technical advantages demonstrated in this study, together with the favorable trend toward a lower incidence of clinically relevant pancreatic fistula, indicate that this approach may contribute to improved perioperative outcomes. Nevertheless, confirmation of these observations requires adequately powered multicenter randomized trials with larger sample sizes and extended follow-up to evaluate long-term functional outcomes, anastomotic durability, and quality of life.

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