

## TOTALLY LAPAROSCOPIC BLUMGART PANCREATICOJEJUNOSTOMY IN PANCREATODUODENECTOMY: INITIAL EXPERIENCE FROM A TERTIARY CENTER

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### ABSTRACT

**Background:** Postoperative pancreatic fistula (POPF) remains the most critical complication following pancreaticoduodenectomy, particularly in minimally invasive pancreaticoduodenectomy (MIPD), where reconstruction is technically demanding. The Blumgart pancreaticojejunostomy has been increasingly adopted due to its potential advantages in reducing anastomotic tension and improving stability. This study aimed to describe a standardized totally laparoscopic Blumgart pancreaticojejunostomy technique and evaluate its early outcomes.

**Methods:** A retrospective descriptive study was conducted including all consecutive patients who underwent MIPD with laparoscopic Blumgart pancreaticojejunostomy at University Medical Center in Ho Chi Minh City between January 2024 and March 2026. Clinical data were obtained from a prospectively maintained database. Perioperative outcomes and postoperative complications were analyzed, with POPF defined according to the International Study Group of Pancreatic Surgery (ISGPS) criteria.

**Results:** A total of 40 patients were included. The cohort consisted predominantly of middle-aged patients with acceptable preoperative status, and most were classified as low risk for POPF. The laparoscopic Blumgart pancreaticojejunostomy was successfully completed in all cases. The median pancreaticojejunostomy time was 85 minutes within a median overall operative time of 346 minutes. Postoperative recovery was generally favorable, with early resumption of oral intake and a median hospital stay of 10 days. Major complications occurred in 5.0% of patients. Clinically relevant POPF was observed in 7.5% of cases, with no reoperation required.

**Conclusions:** A standardized totally laparoscopic Blumgart pancreaticojejunostomy appears to be feasible and safe, with favorable short-term outcomes, supporting its potential role in minimally invasive pancreaticoduodenectomy in appropriately selected patients.

**Keywords:** Laparoscopic pancreaticoduodenectomy, Blumgart pancreaticojejunostomy, Minimally invasive surgery.

### I. INTRODUCTION

Postoperative pancreatic fistula (POPF) remains the most critical complication following pancreaticoduodenectomy (PD), significantly contributing to postoperative morbidity and mortality. Despite advances in surgical techniques, the incidence of clinically relevant POPF remains a major concern, particularly in minimally invasive pancreaticoduodenectomy (MIPD), where

reconstruction is technically demanding [1, 2].

Among various pancreaticojejunostomy techniques, the Blumgart anastomosis has gained increasing attention due to its ability to reduce tension on the pancreatic remnant while maintaining secure fixation. Previous studies have suggested that Blumgart anastomosis may be associated with lower rates of clinically relevant POPF compared with conventional techniques [3].

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With the growing adoption of laparoscopic pancreaticoduodenectomy, the pancreaticojejunostomy remains the most challenging step due to the need for precise intracorporeal suturing. Several modified Blumgart techniques have been proposed to facilitate its application in minimally invasive settings, with encouraging results from single-center experiences [1, 4-6]. However, technical variations remain heterogeneous, and a standardized approach has not been well established.

Therefore, this study aimed to describe our standardized laparoscopic Blumgart pancreaticojejunostomy technique, incorporating a reduced number of transpancreatic U-sutures, and to report our early clinical outcomes at a single center.

## **II. METHODS AND MATERIALS**

### **2.1. Subjects**

**Inclusion criteria:** All consecutive patients undergoing minimally invasive pancreaticoduodenectomy with laparoscopic Blumgart pancreaticojejunostomy were included, regardless of underlying pathology.

**Exclusion criteria:** Patients were excluded if conversion to open surgery occurred before completion of the reconstruction phase. Given that the primary aim of this study was to evaluate the feasibility of the reconstruction phase, only patients who successfully completed the laparoscopic resection phase were included. Patients with incomplete operative or postoperative data were also excluded.

### **2.2. Study methods**

**Study design:** retrospective study

**Sample size and sampling method:** All consecutive patients who met the inclusion and exclusion criteria and underwent laparoscopic pancreaticoduodenectomy applying Blumgart technique in reconstruction at the University Medical Center in Ho Chi Minh City (UMC) between January 2024 and March 2026 were included in the study.

**Study procedures:**

Clinical data were obtained from a prospectively maintained institutional database and electronic medical records. Baseline characteristics included age, sex, body mass index (BMI), comorbidities, and preoperative laboratory parameters.

All patients underwent minimally invasive pancreaticoduodenectomy following a standardized

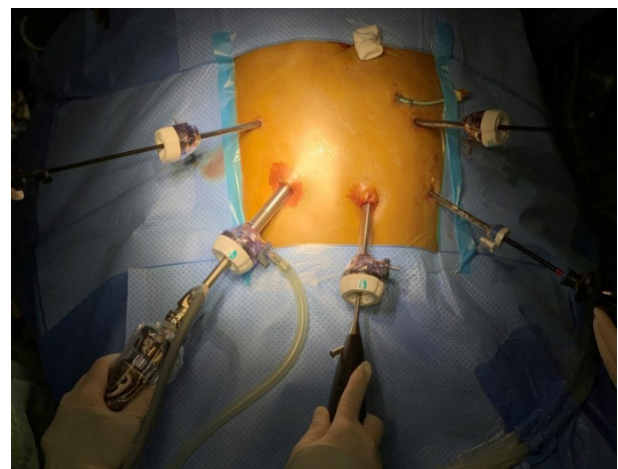
operative workflow. The resection phase was performed laparoscopically in accordance with conventional surgical principles, and reconstruction was subsequently carried out using a laparoscopic Blumgart pancreaticojejunostomy applied consistently across all cases.

Perioperative data, including operative details and postoperative outcomes, were prospectively recorded and retrospectively analyzed. Postoperative complications were graded according to the Clavien–Dindo classification, with major complications defined as grade IIIA or higher. Complications related to pancreaticojejunostomy, particularly postoperative pancreatic fistula, were specifically evaluated and defined according to the International Study Group of Pancreatic Surgery (ISGPS) criteria.

### **Surgical technique**

The laparoscopic Blumgart pancreaticojejunostomy was performed using a standardized modified three-step approach, including transpancreatic U-sutures, duct-to-mucosa anastomosis, and anterior fixation. The technique aims to provide stable anchorage of the pancreatic remnant while minimizing tension on the duct-to-mucosa layer.

The patient is placed in a supine reverse Trendelenburg position. A standard laparoscopic setup was used, with the camera positioned centrally through a trocar placed just to the right of the umbilicus. The primary surgeon operated using the left hand through the right subcostal trocar and the right hand through the umbilical port, while the assistant stood on the patient's left side to provide exposure.



**Figure 1:** Port placement for totally laparoscopic pancreaticojejunostomy.

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After completion of the resection phase, the pancreatic remnant is mobilized approximately 2-3 cm from the cut surface to facilitate tension-free anastomosis. The anastomosis was performed using a standardized three-step Blumgart technique as below:

### Step 1: Transpancreatic U-sutures

Two to three transpancreatic U-sutures were placed through the pancreatic remnant and the seromuscular layer of the jejunum. Compared with the classical Blumgart technique, which typically uses a greater number of U-sutures, this modification aims to simplify the procedure while

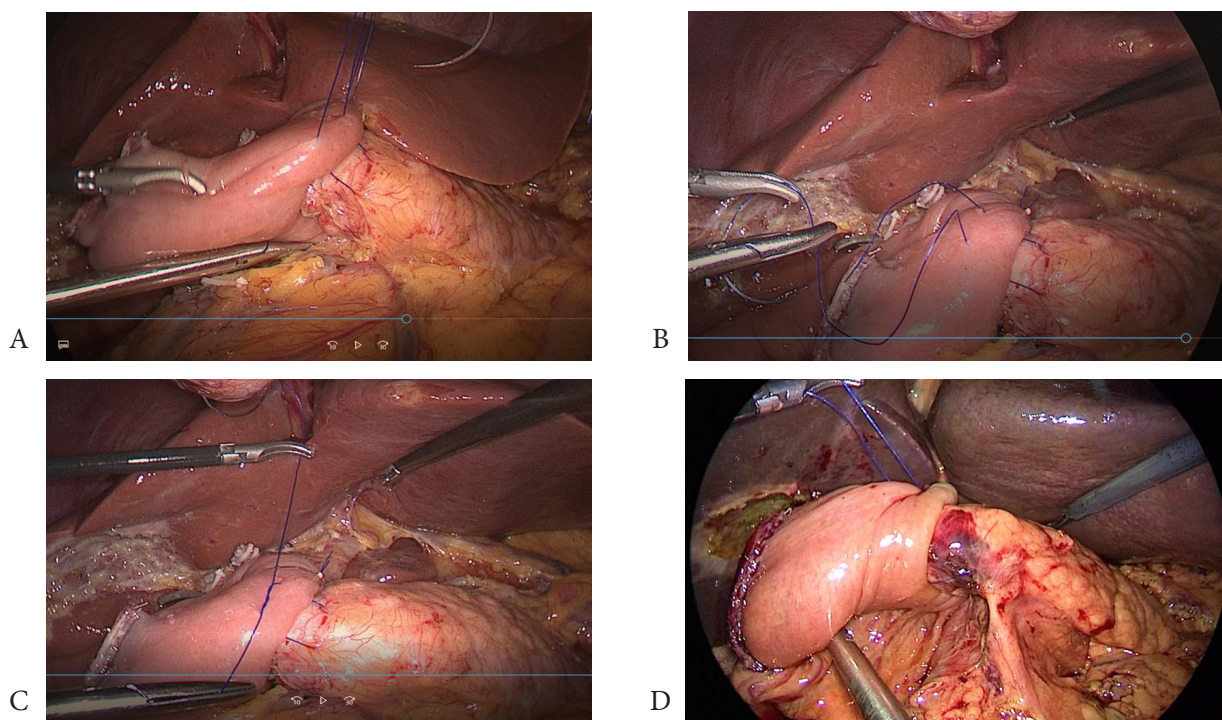
maintaining adequate fixation. The sutures were left untied to allow proper alignment.

### Step 2: Duct-to-mucosa anastomosis

A duct-to-mucosa anastomosis was constructed using interrupted fine absorbable sutures. The posterior layer was completed first, followed by the anterior layer under direct visualization.

### Step 3: Completion of anterior fixation

The U-sutures were then tied sequentially to secure the pancreatic remnant to the jejunum, covering and reinforcing the duct-to-mucosa anastomosis.



**Figure 2:** Laparoscopic modified Blumgart pancreaticojejunostomy: (A) Elevation of the transpancreatic U-suture to facilitate controlled tightening and approximation of the pancreatic stump to the jejunum. (B) Initiation of intracorporeal knot tying of the U-suture. (C) Completion of knot tying with secure approximation of the pancreatic remnant to the jejunal seromuscular layer. (D) Final configuration after completion of transpancreatic U-sutures.

### 2.3. Statistical analysis

Continuous variables were expressed as median (interquartile range), while categorical variables were presented as frequencies and percentages. Statistical analyses were performed using SPSS software (version 26.0, IBM Corp., Armonk, NY, USA).

## III. RESULTS

A total of 40 patients underwent minimally invasive pancreaticoduodenectomy with laparoscopic Blumgart pancreaticojejunostomy during the study period.

### 3.1. Patient characteristics

The cohort consisted predominantly of middle-

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aged patients with acceptable preoperative clinical and nutritional status (table 1).

The median pancreatic duct diameter was 3.0 mm (range, 1.0-12.0). According to the fistula risk score, most patients were classified as low risk (77.5%), followed by intermediate risk (17.5%), while negligible-risk cases accounted for 5.0%; no patients were categorized as high risk.

Underlying pathologies were heterogeneous, including both malignant and benign lesions. Periampullary malignancies accounted for the majority of cases, most commonly pancreatic ductal adenocarcinoma and ampullary carcinoma, while other indications such as IPMN, SPN, and neuroendocrine tumors were also represented.

**Table 1:** Baseline patient characteristics and perioperative risk profile

	Result (n = 40)
Age	58 (46 - 73)
Male, % (n)	35.0 (14)
BMI (kg/m <sup>2</sup> )	22.5 (17.6 - 24.0)
Hb (g/L)	115 (101.0 - 127.0)
Albumin (g/L)	35.7 (29.2 - 40.3)
Pre-albumin (g/L)	0.17 (0.05 - 0.36)
Amylase (U/L)	95.1 (17.0 - 915.0)
Lipase (U/L)	143.9 (0.3 - 920.0)
Pancreatic duct (mm)	3.0 (1.0 - 12.0)
Fistula Risk Score classification, % (n)	
- Negligible	5.0 (2)
- Low	77.5 (31)
- Intermediate	17.5 (7)
- High	0.0 (0)
Diagnosis, % (n)	
Peri-ampullary cancer	
PDAC	37.5 (15)
dCCA	7.5 (3)
AAC	22.5 (9)
DA	5.0 (2)
IPMN	10.0 (4)
NET	5.0 (2)
SPN	10.0 (4)
Chronic pancreatitis	2.5 (1)

### 3.2. Perioperative and postoperative outcomes

The laparoscopic Blumgart pancreaticojejunostomy was successfully completed in all cases. The median pancreaticojejunostomy time was 85 minutes (range: 45 – 100 minutes), within the context of a median overall operative time of 346 minutes (range: 302 – 419 minutes), reflecting a consistent and reproducible reconstruction process (table 2).

Postoperative recovery was uneventful in most patients, with early resumption of oral intake at a median of 2.5 days (range: 2 - 7 days) and return of bowel function at 3 days (range: 1 - 5 days). The median length of hospital stay was 10 days (range: 8-23 days).

Major complications (Clavien-Dindo  $\geq$  III) were infrequent (5.0%). One patient developed clinically relevant postoperative pancreatic fistula (CR-POPF) associated with a subhepatic fluid collection, which was successfully managed with percutaneous drainage. Another patient experienced delayed gastric emptying requiring laparoscopic intervention.

With regard to postoperative pancreatic fistula, three patients developed clinically relevant POPF. Two cases were managed conservatively with prolonged antibiotic therapy and maintenance of the surgical drains for more than 21 days, without the need for additional invasive intervention. The remaining case, corresponding to the major complication described above, developed a subhepatic fluid collection detected on postoperative day 8, which required percutaneous drainage using a pigtail catheter under ultrasound guidance. All cases were successfully managed without reoperation, and patients recovered well during follow-up.

**Table 2:** Postoperative outcomes

	Result (n = 40)
Major complication (Clavien $\geq$ III), % (n)	5.0 (2)
POPF, % (n)	27.5 (11)
• Biochemical leak	7.5 (3)
• CR-POPF	
Re-operation due to POPF, % (n)	0.0 (0)
Hospital stay (days)	10 (8 - 23)
Discharged with drain, % (n)	17.5 (5)

#### IV. DISCUSSION

This study describes a standardized laparoscopic Blumgart pancreaticojejunostomy technique and demonstrates its feasibility and safety in minimally invasive pancreaticoduodenectomy. The main findings include a consistent reconstruction process, acceptable operative time, and favorable short-term outcomes, particularly with a low rate of CR-POPF.

Postoperative pancreatic fistula remains the most critical complication following pancreaticoduodenectomy and is closely related to the technique of pancreaticojejunostomy. Among various reconstruction methods, the Blumgart anastomosis has gained increasing acceptance due to its ability to reduce tension and shear stress on the pancreatic remnant. Casadei et al. demonstrated that Blumgart anastomosis was associated with lower rates of CR-POPF compared with conventional duct-to-mucosa and invagination techniques [3]. Similarly, modified Blumgart techniques have been shown to improve postoperative outcomes, including reduced fistula rates [4].

In the context of minimally invasive surgery, the reconstruction phase—particularly pancreaticojejunostomy—remains the most technically demanding step. The lack of tactile feedback and the requirement for advanced intracorporeal suturing skills present significant challenges. Several studies have therefore focused on simplifying and standardizing the Blumgart technique for laparoscopic application. Liu et al. reported that a simplified Blumgart technique could be safely implemented during the early learning phase of laparoscopic pancreaticoduodenectomy, with favorable outcomes [1]. Likewise, Lee et al. demonstrated that a modified Blumgart approach could significantly reduce pancreaticojejunostomy time while maintaining comparable complication rates [5].

Our results are consistent with these findings. The pancreaticojejunostomy time in our series was within an acceptable range relative to the overall operative time, suggesting that the standardized three-step approach can be reproducibly applied. Importantly, the low rate of CR-POPF and absence of reoperation due to pancreatic fistula further support the safety of this technique.

An important consideration when interpreting these results is the baseline fistula risk profile of our cohort. Most patients were classified as negligible or low risk according to the fistula risk score, and no high-risk cases were identified. This distribution likely contributed to the relatively low rate of clinically relevant POPF observed. Therefore, although our findings support the feasibility and safety of this technique, they should be interpreted with caution, as outcomes may differ in higher-risk populations, particularly in patients with small pancreatic ducts or soft gland texture. Moreover, this study was not designed to evaluate independent risk factors for POPF, and the sample size was not sufficient to support subgroup analyses based on important factors, such as pancreatic duct size, gland texture, or fistula risk score.

Recent evidence underscores the importance of standardization in pancreaticojejunostomy rather than reliance on specific technical variations. In a large prospective multicenter study, Hong et al. demonstrated that the use of a defined anastomotic technique was associated with improved outcomes and reduced inter-center variability [2]. Various technical adaptations have been proposed to address specific challenges, particularly in patients with small pancreatic ducts. For instance, Huang et al. described a simplified approach without ductal suturing in ducts  $\leq 3$  mm, with acceptable results [7]. In contrast, the Blumgart technique preserves duct-to-mucosa precision while incorporating transpancreatic U-sutures to enhance mechanical stability.

In this context, our findings suggest that successful implementation of laparoscopic Blumgart pancreaticojejunostomy relies primarily on a standardized, reproducible workflow and a dedicated surgical team, especially during the early adoption phase of minimally invasive pancreaticoduodenectomy.

This study has several limitations. First, the sample size was relatively small and derived from a single center, which may limit generalizability. Second, the retrospective design may introduce inherent selection bias. Third, the follow-up period was limited to short-term outcomes, and long-term results were not evaluated.

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Despite these limitations, this study provides valuable insight into the practical implementation of a standardized laparoscopic Blumgart pancreaticojejunostomy in a real-world setting. Overall, the early outcomes were favorable, with low rates of clinically relevant POPF and major complications. However, these findings should be interpreted in the context of a predominantly low-risk patient cohort.

### **V. CONCLUSION**

A standardized modified laparoscopic Blumgart pancreaticojejunostomy using a reduced number of transpancreatic U-sutures is feasible and reproducible in minimally invasive pancreaticoduodenectomy. The technique demonstrated acceptable operative time and favorable short-term outcomes, with a low rate of clinically relevant postoperative pancreatic fistula. These findings should be interpreted in the context of a predominantly low-risk patient cohort.

### **Disclosure**

The authors declare that there is no conflict of interest regarding the publication of this article. All authors have read and approved the final version of the manuscript

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