

# Blumgart method using LAPRA-TY clips facilitates pancreaticojejunostomy in laparoscopic pancreaticoduodenectomy

Yuichi Nagakawa, MD, PhD\*, Chie Takishita, MD, Yosuke Hijikata, MD, Hiroaki Osakabe, MD, Hitoe Nishino, MD, PhD, Masanori Akashi, MD, Tetsushi Nakajima, MD, Tomoki Shirota, MD, PhD, Yatsuka Sahara, MD, Yuichi Hosokawa, MD, Tetsuo Ishizaki, MD, PhD, Kenji Katsumata, MD, PhD, Akihiko Tsuchida, MD, PhD

## Abstract

The modified Blumgart method for pancreaticojejunostomy has been shown to reduce the rate of postoperative pancreatic fistula (POPF) in open surgery. We describe a modified Blumgart method using LAPRA-TY suture clips to facilitate laparoscopic pancreaticojejunostomy.

We prepared a double-armed 4-0 nonabsorbable monofilament, which was ligated using the LAPRA-TY clip at the tail end, 12-cm in length. Next, the U-suture was placed through the pancreatic stump and the seromuscular layer of the jejunum. We performed duct-to-mucosa suturing with a 5-0 absorbable monofilament. After completing the duct-to-mucosa suturing, as a final step we placed the sutures through the seromuscular layer of the jejunum on the ventral side and tightly secured the thread with the LAPRA-TY clips. We performed laparoscopic Blumgart pancreaticojejunostomy during pancreaticoduodenectomy in 39 patients. We compared the surgical outcomes of 19 patients who underwent Blumgart pancreaticojejunostomy using the LAPRA-TY clips (LAPRA-TY group) with 20 patients undergoing surgery not using the LAPRA-TY clips (conventional group).

The rate of clinically relevant postoperative pancreatic fistula in the LAPRA-TY group was 21.1%, which did not differ significantly from the rate of the conventional group. However, the mean time of pancreaticojejunostomy in the LAPRA-TY group was 56.2 min (range, 39–79 min), which was significantly shorter than that of the conventional group (69.7 min; range, 53–105 min,  $P < .001$ ).

Although the modified Blumgart pancreaticojejunostomy using LAPRA-TY suture clips did not improve the pancreatic fistula rate, it allowed for shorter operative times. Thus, this procedure lends itself to positive surgical and patient outcomes.

**Abbreviations:** ISGPF = International Study Group of Pancreatic Fistula, LPD = laparoscopic pancreaticoduodenectomy, POPF = postoperative pancreatic fistula.

**Keywords:** Blumgart method, laparoscopic pancreaticoduodenectomy, laparoscopic surgery, LAPRA-TY, minimally invasive pancreatic surgery, pancreatic fistula, pancreaticojejunostomy

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The authors have no conflicts of interest to disclose.

Department of Gastrointestinal and Pediatric Surgery, Tokyo Medical University, Tokyo, Japan.

\* Correspondence: Yuichi Nagakawa, Tokyo Medical University, 6-7-1 Nishi-shinjuku, Shinjuku-ku, Tokyo, Japan, 160-0023, Tokyo, Japan (e-mail: naga@tokyo-med.ac.jp).

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## 1. Introduction

Although laparoscopic pancreaticoduodenectomy (LPD) has recently been used as a novel minimally invasive surgery,<sup>[1–6]</sup> it requires advanced laparoscopic skills.<sup>[7,8]</sup> Safe and reliable reconstruction is needed to prevent postoperative complications. However, laparoscopic pancreaticojejunostomy requires a long operative time to complete the procedure. Therefore, techniques that reduce procedural times are needed.

Recently, it has been reported that the Baumgart method reduced the incidence rate of postoperative pancreatic fistula (POPF) by increasing adhesion between the pancreatic parenchyma and the intestine.<sup>[9–13]</sup> In this method, the pancreatic parenchyma and the jejunal seromuscular layer are sutured in a U-shape with appropriate adhesion. It is important to tightly secure the U shaped-thread under proper tension; however, it is more difficult to reliably ligate threads in laparoscopic surgery than in open surgery. Here, we attempted a modified Blumgart method to tightly secure the structures with appropriate adhesion using LAPRA-TY suture clips. This study aimed to investigate the feasibility of a modified Blumgart method using LAPRA-TY clips in laparoscopic pancreaticojejunostomy.

**Table 1**  
**Characteristics of patients who underwent laparoscopic Blumgart pancreatojejunostomy with and without the LAPRA-TY clips.**

	Conventional Blumgart PJ (n=20)	Blumgart PJ with the LAPRA-TY clips (n=19)	P value
Age (years)	62.1 ± 16.8	60.4 ± 17.3	.792
Sex			
Male	12 (60.0%)	9 (47.4%)	.423
Female	8 (40.0%)	10 (52.6%)	
Disease			
Intraductal papillary mucinous neoplasm	8	10	
Ampullary tumor	7	4	
Solid-pseudopapillary neoplasm	2	3	
Distal cholangiocarcinoma	1	1	
Pancreatic neuroendocrine tumor	1	1	
Pancreatic cancer	1	0	
Pancreatic texture			
Soft	19 (95.0%)	19 (100%)	.323
Hard	1 (5.0%)	0 (0%)	

Data are expressed as mean ± standard deviation.  
 PJ = pancreatojejunostomy.

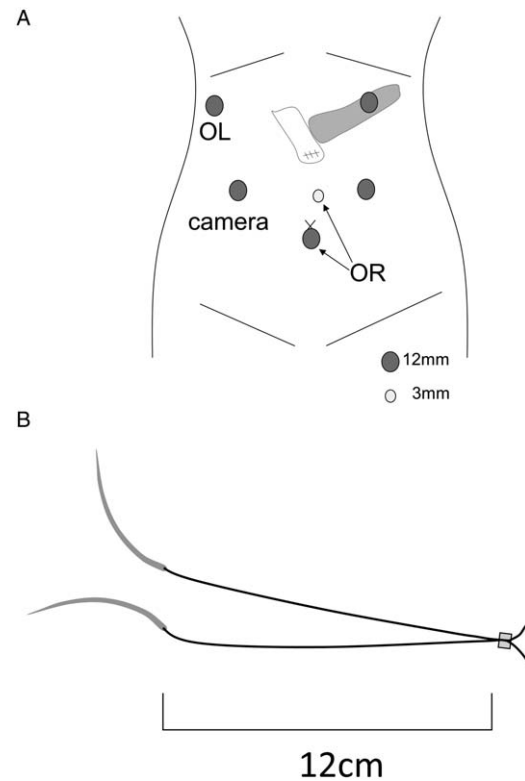
## 2. Materials and Methods

### 2.1. Patients

We first began performing LPD for pancreatic head tumors in November 2011 at the Department of Gastrointestinal and Pediatric Surgery at Tokyo Medical University; 46 patients underwent LPD up to September 2016. Subsequently, we introduced laparoscopic Blumgart pancreatojejunostomy in October 2016, and a total of 39 patients underwent Blumgart pancreatojejunostomy until March 2019. Of the latter 39 patients, 18 had an intraductal papillary mucinous neoplasm, 11 had an ampullary tumor, 5 had a solid-pseudopapillary neoplasm, 2 had a distal cholangiocarcinoma, 2 had a pancreatic neuroendocrine tumor, and 1 had a pancreatic adenocarcinoma (Table 1). From October 2016 to December 2017, a total of 20 consecutive patients underwent laparoscopic Blumgart pancreatojejunostomy without the LAPRA-TY clips (conventional group). In this group, U-shape suturing for the Blumgart method was secured by tying. From January 2017 to March 2019, a total of 19 consecutive patients underwent Blumgart pancreatojejunostomy using LAPRA-TY (LAPRA-TY group).

### 2.2. Surgical procedures

Five 12-mm trocars were used, including 2 trocars positioned at the right and left midclavicular lines, 1 trocar at the umbilical level, and 2 trocars at the level of the right and left anterior axillary lines. The procedure was performed as follows. The surgeon stood on the left side of the patient while performing the pancreatojejunostomy reconstruction and the camera was inserted through the trocar in the right anterior axillary line. Pancreatojejunostomy was performed using the trocar placed at the level of the right midclavicular line and the trocar placed at the umbilical level. When the axis of the needle driver did not align with the pancreatic duct, a 3-mm port was added to the upper part of the umbilicus (Fig. 1A). Pancreatojejunostomy was performed using the 3-mm needle driver. Pancreatojejunostomy

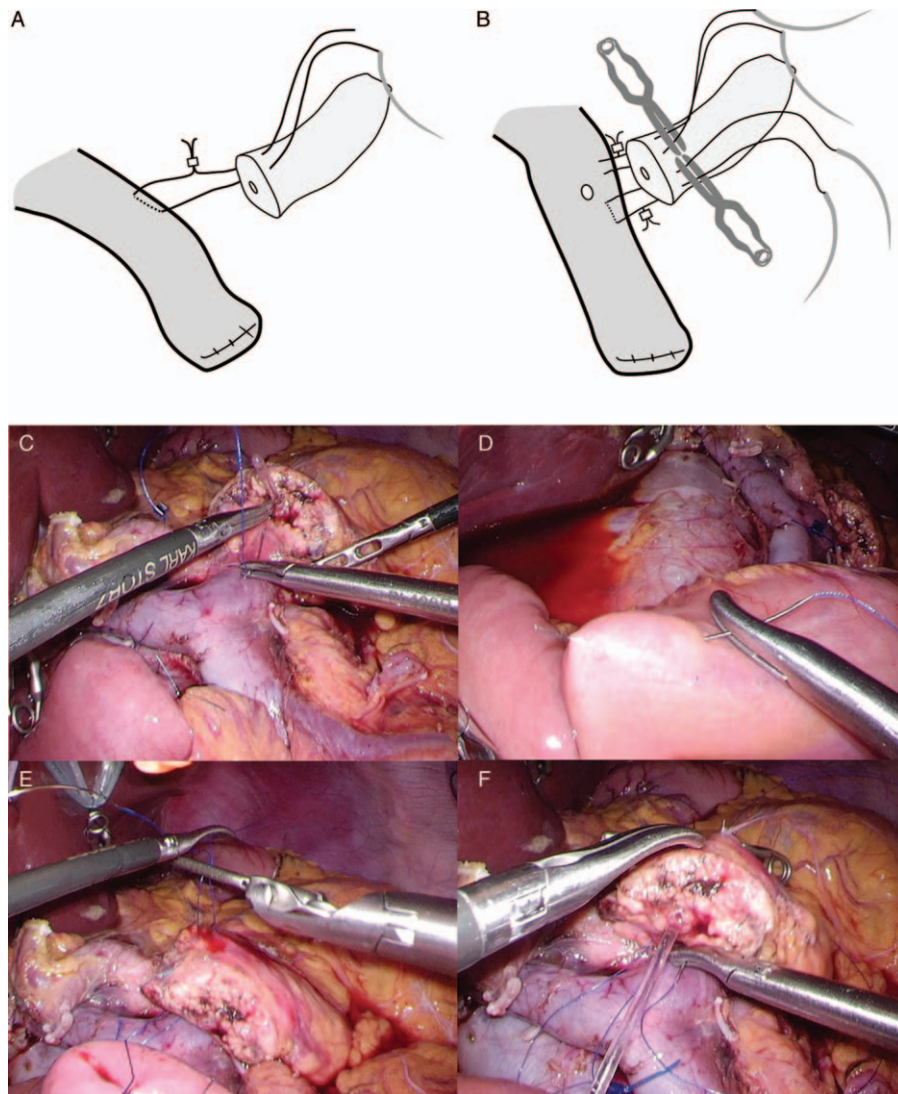


**Figure 1.** A, Port placement. OR; the trocar for the operator's right hand. OL; the trocar for the operator's left hand. B, Double-ended needle ligated with 12-cm length using LAPRA-TY suture clips.

was performed duct-to-mucosa with pancreatic-jejunum seromuscular layer suturing using the modified Blumgart method. We previously prepared a double-armed 4-0 Nespiren (nonabsorbable monofilament; Alfresa Pharma Corporation, Osaka, Tokyo), which was ligated using LAPRA-TY clip (Ethicon Endo-Surgery, Cincinnati, OH) at the tail, 12cm in length, for Blumgart anastomosis (Fig. 1B).

First, the pancreatic parenchyma 1 cm from the transected surface of the pancreas and the dorsal side of the jejunal seromuscular layer was sutured in a U-shape at 2 places on the superior and posterior side of the main pancreatic duct. Suturing of the pancreatic parenchyma was performed through the posterior side and anterior side and the threads were clipped using bulldog forceps (Fig. 2).

Suturing of the posterior semicircle of the duct-to-mucosa anastomosis was performed at 8, 6, and 4 o'clock positions using 5-0 PDS II C-1 or RB-2 sutures (Ethicon Endo-Surgery, Cincinnati, OH). Suturing at the 8 and 6 o'clock positions was performed in the in-out-out-in direction, and at the 4 o'clock position suturing was performed in the out-in-in-out direction. After ligating the 8 and 6 o'clock position sutures, a pancreatic duct stent was placed, and it was fixed using 6 o'clock position suturing. The 4 o'clock position suturing was clipped using bulldog forceps. Next, suturing of the anterior semicircle of the duct-to-mucosa anastomosis was performed at 10, 12, and 2 o'clock positions in the out-in-in-out direction. Subsequently, the 10, 12, and 2 o'clock position sutures were secured by ligation (Fig. 3).



**Figure 2.** A, B, U-shaped sutures on the pancreatic parenchyma and dorsal side of the jejunal seromuscular layer at 2 points. C, Stitching from the dorsal to ventral side of the pancreas. D, Stitching on the dorsal side of the jejunal seromuscular layer. E, Threads are clipped using bulldog forceps. F, The pancreatic duct stent is placed to confirm the direction of the main pancreatic duct.

Seromuscular layer sutures were placed along the short axes of the jejunum using 4 needles that were previously sutured. After stitching, each thread was pulled under an appropriate tension and secured using the LAPRA-TY clip while ensuring proper adhesion between the jejunal wall and the pancreatic parenchyma (Fig. 4).

### 2.3. Statistical analysis

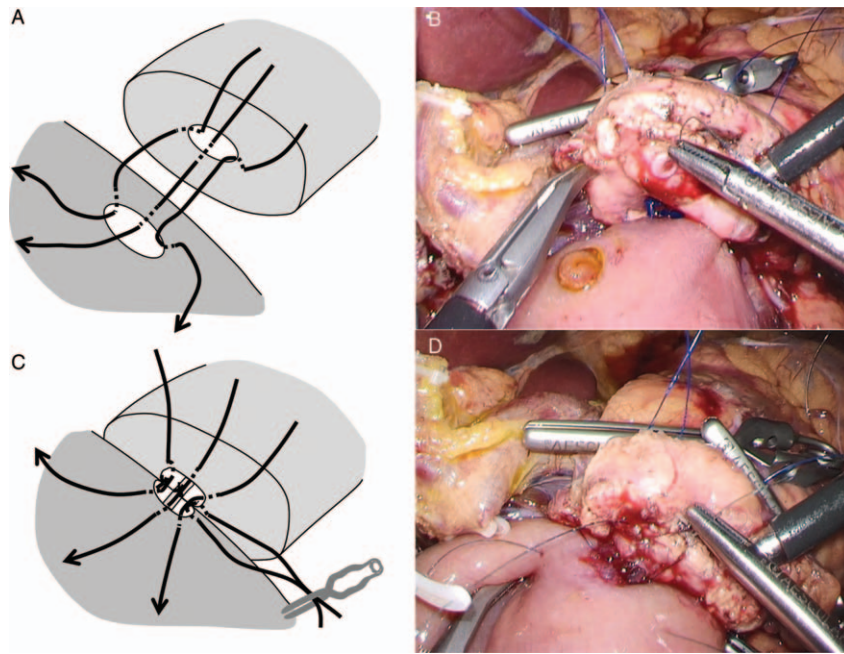
Patient characteristics were examined retrospectively. Surgical results (operative time, POPF rate, postoperative complication rate, and postoperative hospital stay duration) of the LAPRA-TY clip group were compared to those of the conventional technique group. POPF was defined on the basis of the International Study Group of Pancreatic Fistula (ISGPF) definition.<sup>[14]</sup> Other postoperative complications were defined according to the Clavien–Dindo classification.<sup>[15]</sup> Data were expressed as the mean and standard deviation. Differences between means were

compared using the Mann–Whitney *U* test and chi-square tests.  $P < .05$  was considered to indicate statistical significance. All statistical analyses were performed using SPSS version 24 (IBM, Armonk, NY).

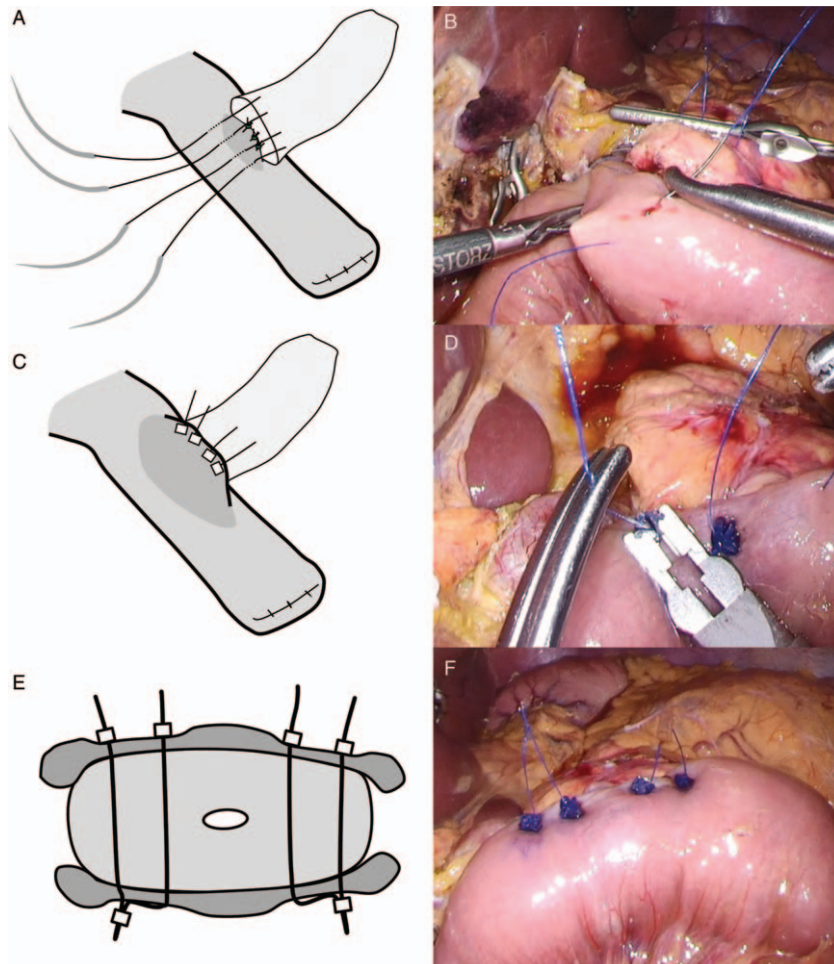
### 3. Results

No significant differences were identified in terms of patient characteristics between the groups (Table 1). In this series, 97.4% of patients had a soft pancreas. The overall mean operative time for pancreaticojejunostomy was 64.6 min (range, 39–116 min); however, the operative time required to perform the pancreatojejunostomy in the LAPRA-TY clip group was significantly shorter than that of the conventional technique group (56.2 vs 69.7 min,  $P < .001$ ). The mean total operative time of the LPD was 446.0 min (range, 344–624 min); however, the time required in the LAPRA-TY clip group was significantly shorter than that in the conventional group (419.3 vs 471.5 min,  $P = .002$ ). The rate





**Figure 3.** A, B, Suturing of the posterior semicircle of the duct-to-mucosa anastomosis. C, D, Anterior semicircle of the duct-to-mucosa anastomosis.



**Figure 4.** A, B, Stitching on the ventral side of the jejunal seromuscular layer. C, D, These sutures are ligated using the LAPRA-TYclip. E, F, The pancreas and the jejunum are tightly secured.

**Table 2**  
**Comparison between laparoscopic Blumgart pancreatojejunostomy with and without the LAPRA-TY.**

	Conventional Blumgart PJ (n=20)	Blumgart PJ with LAPRA-TY (n=19)	P value
Mean total operating time (min)	471.5±57.7	419.3±41.4	.002
Mean operation time of pancreatojejunostomy (min)	69.7±13.1	56.2±10.5	<.001
Postoperative complication (>CD IIIa)	5 (25.0%)	5 (26.3%)	.925
Postoperative pancreatic fistula (ISGPF grade B/C)	4 (20.0%)	4 (21.1%)	.935
Mean postoperative hospital stay (days)	23.9±15.6	22.1±12.1	.967

Data are expressed as mean±standard deviation.

CD = Clavien–Dindo classification, ISGPF = The International Study Group for Pancreatic Fistula, PJ = pancreatojejunostomy.

of clinically relevant POPF (ISGPF grades B and C) in the LAPRA-TY clip group was 21.1%, which was not significantly different from that of the conventional technique group. The rate of overall morbidity was 25.6%, with no significant differences between groups (Table 2).

#### 4. Discussion

In our modified Blumgart method using LAPRA-TY, the U-shaped thread was tightly secured under proper tension. The operative time for the pancreatojejunostomy was shorter using this modified approach than using the conventional method.

When suturing the pancreatic parenchyma during laparoscopic surgery using the Blumgart method, suturing from the pancreatic dorsal side to the ventral side using backhand stitching is easier than suturing from the ventral side to the dorsal side using forehand stitching. Thus, it requires a double-armed needle; yet, a double-armed needle consisting of an appropriate length of monofilament thread is not commercially available. Therefore, we clipped the tail of the thread at a suitable length (12 cm) using the LAPRA-TY clip. Furthermore, the LAPRA-TY clip became a hook preventing the thread from loosening when ligating the pancreatic parenchyma and jejunum.

Prevention of thread entanglement is also important in order to obtain reliable pancreatic reconstruction in laparoscopic surgery, and various methods have been reported to prevent thread entanglement.<sup>[16,17]</sup> In this method, a U-shaped thread sutured on the pancreatic parenchyma and posterior wall of the jejunum was fixed using bulldog forceps before starting the duct-to-mucosa anastomosis, which creates a good surgical field. This fixation facilitates duct-to-mucosa anastomosis while maintaining an appropriate distance between the pancreatic main duct and jejunum. This method can also be applied to robotic surgery for the prevention of thread entanglement.

The incidence of POPF was 21.1% in the LAPRA-TY clip group, and was higher than that reported for Blumgart anastomosis in open surgery.<sup>[10,13]</sup> In this study, most patients indicated for LPD had periampullary tumors except for patients with pancreatic cancer; the former presented with a soft pancreas without pancreatic duct dilatation. This may explain the high incidence of POPF.

Herein, we described a modified Blumgart method using LAPRA-TY clips which resulted in reduction in the overall time required for laparoscopic pancreatojejunostomy. However, the incidence rate of POPF did not improve. Thus, further investigation is necessary to reduce the incidence rate.

#### Author contributions

**Conceptualization:** Hiroaki Osakabe.

**Data curation:** Yuichi Nagakawa, Chie Takishita, Yosuke Hijikata, Hitoe Nishino, Masanori Akashi, Tetsushi Nakajima, Tomoki Shirota, Yatsuka Sahara, Yuichi Hosokawa.

**Formal analysis:** Yuichi Nagakawa, Tomoki Shirota.

**Investigation:** Yuichi Nagakawa.

**Methodology:** Yuichi Nagakawa.

**Project administration:** Yuichi Nagakawa.

**Writing – original draft:** Yuichi Nagakawa.

**Writing – review & editing:** Tetsuo Ishizaki, Kenji Katsumata, Akihiko Tsuchida.

Yuichi Nagakawa orcid: 0000-0003-1169-8160.

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