

A single institution experience with robotic and laparoscopic distal pancreatectomies

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Backgrounds/Aims: This study aims to describe our experience with minimally-invasive distal pancreatectomies, with emphasis on the comparison between robotic distal pancreatectomy (RDP) and laparoscopic distal pancreatectomy (LDP). **Methods:** Retrospective review of 102 consecutive RDP and LDP from 2006 to 2019 was performed. **Results:** There were 27 and 75 patients who underwent RDP and LDP, respectively. There were 12 (11.8%) open conversions and 16 (15.7%) patients had major (>grade 2) morbidities. Patients who underwent RDP had significantly higher rates of splenic preservation (44.4% vs. 13.3%, $p=0.002$), higher rates of splenic-vessel preservation (40.7% vs. 9.3%, $p=0.001$), higher median difficulty score (5 vs. 3, $p=0.002$) but longer operation time (385 vs. 245 minutes, $p<0.001$). The rate of open conversion tended to be lower with RDP (3.7% vs. 14.7%, $p=0.175$). **Conclusions:** In our institution practice, both RDP and LDP were safe and effective. The use of RDP appeared to be complementary to LDP, allowing us to perform more difficult procedures with comparable postoperative outcomes. (*Ann Hepatobiliary Pancreat Surg* 2020;24:283-291)

Key Words: Laparoscopic distal pancreatectomy; Minimally-invasive distal pancreatectomy; Robotic distal pancreatectomy; Left pancreatectomy

INTRODUCTION

Minimally invasive distal pancreatectomy (MIDP) has become increasingly popular over the last decade cause of its many advantages over the open approach such as the shorter hospital stay, reduced analgesic requirement, and reduced postoperative morbidity.¹⁻³ Laparoscopic surgery confers many benefits such as smaller surgical scars, reduced blood loss, and faster recovery times.⁴⁻⁶ Nonetheless, its widespread adoption remains restricted due to the technically demanding nature of the MIDP especially with the straight rigid instruments used in conventional laparoscopy.

Presently, with the introduction of the da Vinci Robotic Surgical System (Intuitive Surgical, Inc., Sunnyvale, CA),

surgeons can potentially overcome the limitations of traditional laparoscopy due to better dexterity from the patented endo-wrist, three-dimensional (3D) visualization, and better ergonomics.⁷⁻¹² Some studies have shown that robotic surgery is a safe and feasible approach to DP but requires a longer operative time.^{1,5} However, presently there is no consensus on which approach (robotic or laparoscopic) is better as both techniques appear equivalent.¹⁰⁻¹⁵ This study summarizes our experience with robotic (RDP) and laparoscopic distal pancreatectomies (LDP), comparing between the clinical outcomes of RDP versus LDP.

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MATERIALS AND METHODS

Patients

We identified 102 consecutive patients from our prospectively maintained database who underwent RDP or LDP at our institution from 2006 to 2019. This study was approved by our institution review board. All patient data were collected retrospectively from the patients' clinical, radiological, and pathological records. The choice of surgical approach was based on multiple factors such as surgeon's and patient's preference, patient's overall fitness, and tumor characteristics. Ultimately, the final decision for a particular treatment approach was made after extensive discussions between the managing clinician and the patient. Cost was a major factor in the decision-making as patients who elected to undergo RDP had to pay additional charges.

Surgical technique

The operative technique at our institution has been described in detail previously.^{5,16-18} Briefly, at present, RDP was performed using three robotic arms (2 left, 1 right) and the robotic camera system (Da Vinci Si, Intuitive Surgical). The robotic instruments used included a combination of some of the following instruments: harmonic scalpel, cardiere forceps, fenestrated bipolar, hemolok applicator and large needle driver. The bedside assistant used conventional laparoscopic suckers, bowel graspers and endostaplers via a 12-mm assistant ports placed in the left iliac fossa.

LDP was performed using various laparoscopic energy devices over the study period depending on the individual surgeon preference including the Harmonic Scalpel (Ethicon Endo-Surgery, Cincinnati, OH, USA), ENSEAL (Ethicon Endo-Surgery, Cincinnati, OH, USA), LigaSure (Covidien, Boulder, CO, USA) or Thunderbeat (Olympus, Tokyo, Japan). In general, dissection of the pancreas proceeded from the medial to lateral position in most cases except for distal lesions in the pancreatic tail. Endoscopic staplers were used to transect the pancreas and in selected cases these were reinforced with sutures.

Definitions

We defined subtotal pancreatectomy as when the transection of the pancreas was at neck either at or to the right

of the portal vein/splenic vein junction. The definition adopted for an extended pancreatectomy was according to the 2014 International Study Group for Pancreatic Surgery (ISGPS) definition which included any DP with adjacent organ resection such as the stomach, colon, mesocolon, or vascular resection due to local tumor involvement.¹⁹

The latest 2016 ISGPS classification system for Pancreatic Fistula system²⁰ was used to define and grade pancreatic fistulas. A clinically relevant postoperative pancreatic fistula (POPF) is defined as a drain output of any measurable volume of fluid with amylase level greater than 3 times the upper institutional normal serum amylase level, associated with a clinically relevant development/condition related directly to the POPF. Postoperative complications were graded according to the Clavien-Dindo grading system.²¹ All postoperative morbidity was recorded up to as 30 days from surgery or within the same hospital stay regardless of the length of stay. 30-day and 90-day mortalities were also recorded. The difficulty of DP was also classified according to the recent difficulty scoring system (DSS) from Japan²² with some minor modifications as reported previously.²³

Statistical analysis

All statistical analyses were performed using the computer program Statistical Package for the Social Sciences for Windows, version 20.0 (SPSS Inc, Chicago, IL, USA). Analyses were performed using the Mann-Whitney *U* test, Chi-squared tests, or Fischer's exact test as appropriate. All statistical tests were 2-sided and $p < 0.05$ was considered statistically significant.

RESULTS

During the study period, 102 patients underwent MIDP at our institution. 27 (26.5%) patients underwent RDP and 75 (73.5%) patients underwent LDP. Twenty-three (22.5%) patients underwent splenic preservation and the median difficulty score was 3. A total of 12 patients (11.8%) required an open conversion to complete the procedure. There were 22 successful SS-DP of which 4 were performed via the Warshaw technique and 18 via the Kimura technique. The median operating time was 280 minutes. Thirty-four (33.3%) patients experienced a postoperative morbidity. Of these, 16 (15.7%) patients had major mor-

bidity, and 20 (19.6%) patients had a clinically significant pancreatic fistula. There was no 30-day mortality and 2 (2.0%) 90-day mortalities both in the LDP group. The median postoperative stay was 6 days.

There were 2 90-day reoperations. One was in a patient who underwent RDP and developed an incarcerated port-site hernia during the first week requiring repeat laparoscopic treatment and the other was in a patient who developed a large symptomatic pseudocyst after LDP requiring a cyst-gastrostomy. Details of the 2 90-day mortalities were as follows: The first patient was a 69-year old male with a history of previous kidney transplant on immunosuppression who underwent synchronous laparoscopic gastric resection for gastrointestinal stromal tumor,

extended right hemicolectomy for colorectal cancer and distal pancreatectomy for intraductal papillary mucinous neoplasm. He had a grade B pancreatic fistula which was well-controlled by the surgically placed drain. Unfortunately, he developed uncontrolled sepsis from nosocomial pneumonia and eventually demised on postoperative day 73. The second patient was a 70-year old male who suffered from an acute myocardial infarction 3 months before surgery. He underwent distal pancreatectomy for pancreatic adenocarcinoma. During the second week of the postoperative recovery period, he suffered from spontaneous intracranial hemorrhage followed by an acute myocardial infarction, he subsequently deteriorated and demised on postoperative day 69.

Table 1. Comparison between the baseline demographic and perioperative data of 102 patients who underwent RDP versus LDP

	Total (n=102)	RDP (n=27)	LDP (n=75)	<i>p</i> -value
Period operated, n (%)				0.001
2006-2012	20 (19.6)	0	20 (26.7)	
2013-2019	82 (80.4)	27 (100)	55 (73.3)	
Male sex, n (%)	45 (44.1)	9 (33.3)	36 (48.0)	0.188
Median age (range), years	62 (19-85)	64 (21-85)	61 (19-80)	0.196
Symptoms, n (%)	32 (31.4)	9 (33.3)	23 (30.7)	0.798
Median BMI (range), kg/m ²	23.1 (12.6-35.9)	23.1 (12.6-30.7)	23.4 (15.9-35.9)	0.921
Previous abdominal surgery, n (%)	28 (27.5)	5 (18.5)	23 (30.7)	0.225
ASA score, n (%)				0.734
1	15 (14.7)	5 (18.5)	10 (13.3)	
2	72 (70.6)	19 (70.4)	53 (70.7)	
3	15 (14.7)	3 (11.1)	12 (16.0)	
Malignant neoplasm, n (%)	21 (20.6)	4 (14.8)	17 (22.7)	0.773
Median tumor size, mm (range)	30.0 (0.0-140.0)	20.0 (0.0-75.0)	30.0 (2.2-140.0)	0.088
Splenic preservation, n (%)	22 (21.6)	12 (44.4)	10 (13.3)	0.002
Splenic vessel preservation (Kimura technique), n (%)	18 (17.6)	11 (40.7)	7 (9.3)	0.001
RAMPS, n (%)	10 (9.8)	4 (14.8)	6 (8.0)	0.449
Subtotal (resection at / right of PV), n (%)	32 (31.4)	16 (59.3)	16 (21.3)	<0.001
Extended pancreatectomy, n (%)	4 (3.9)	3 (11.1)	1 (1.3)	0.056
Concomitant surgery (non-cholecystectomy), n (%)	5 (4.9)	1 (3.7)	4 (5.3)	0.737
Left-sided portal hypertension, n (%)	7 (6.9)	1 (3.7)	6 (8.0)	0.672
Tumor extension to peripancreatic tissue, n (%)	43 (42.2)	14 (51.9)	29 (38.7)	0.234
Tumor close to major vessel, n (%)	46 (45.1)	17 (63.0)	29 (38.7)	0.030
Median difficulty score, range	3 (1-12)	5 (1-9)	3 (1-12)	0.002
Difficulty, n (%)				0.051
Low	53 (52.0)	10 (37.0)	43 (57.3)	
Intermediate	33 (32.4)	9 (33.3)	24 (32.0)	
High	16 (15.7)	8 (29.6)	8 (10.7)	

BMI, body mass index; ASA, American Society of Anesthesiologists; RAMPS, radical antegrade modular pancreatectomy; PV, portal vein

Table 2. Comparison between the perioperative outcomes of patients who underwent RPD vs. LDP

	Total (n=102)	RDP (n=27)	LDP (n=75)	p-value
Open conversion, n (%)	12 (11.8)	1 (3.7)	11 (14.7)	0.175
Median operating time (range), min	280 (85-775)	385 (215-775)	245 (85-475)	<0.001
Median blood loss (range), ml	100 (10-2000)	200 (50-1200)	100 (10-1990)	0.290
Intraoperative blood transfusion, n (%)	10 (9.8)	3 (11.1)	7 (9.3)	0.722
Postoperative morbidity, n (%)	34 (33.3)	8 (29.6)	26 (34.7)	0.634
Major morbidity (Clavien-Dindo grade >2), n (%)	16 (15.7)	3 (11.1)	13 (17.3)	0.550
Biochemical fistula, n (%)	33 (32.4)	6 (22.2)	27 (36.0)	0.189
Grade B/C pancreatic fistula, n (%)	20 (19.6)	3 (11.1)	17 (22.7)	0.195
Pancreatic fistula requiring percutaneous drainage, n (%)	15 (14.7)	2 (7.4)	13 (17.3)	0.343
Reoperation, n (%)	2 (2.0)	1 (3.7)	1 (1.3)	0.461
30-day mortality, n (%)	0 (0.0)	0 (0.0)	0 (0.0)	NC
90-day mortality, n (%)	2 (2.0)	0 (0.0)	2 (2.7)	1.000
Median postoperative stay (range), days	6 (3-73)	6 (3-26)	6 (3-73)	0.548
Readmission, n (%)	21 (20.6)	4 (14.9)	17 (22.7)	0.387

Comparison between 27 RDP and 75 LDP (Tables 1, 2)

The comparison between the baseline demographics, clinicopathological features, and outcomes of these patients are summarized in Tables 1, 2. There was no significant difference in the demographics and clinicopathological features between both groups. Patients who underwent RDP were significantly more likely to be operated during the recent time period (2013-2019) compared to LDP [27 (100%) vs. 55 (73.3%), $p=0.001$] (Table 1).

Patients who underwent RDP had a significantly higher rate of splenic preservation (44.4% vs. 13.3%, $p=0.002$), higher rate of splenic vessel preservation (40.7% vs. 9.3%, $p=0.001$), higher rate of subtotal resection (59.3% vs. 21.3%, $p<0.001$), increased frequency of tumor located close to a major vessel (63.0% vs. 38.7%, $p=0.030$), higher median difficulty score (5 vs. 3, $p=0.002$), and longer operation time (385 minutes vs. 248 minutes, $p<0.001$) compared to LDP. Patients who underwent RDP also tended to have non-statistically significant higher rate of extended pancreatectomy (11.1% vs. 1.3%, $p=0.056$) but lower open conversion rate (3.7% vs. 14.7%, $p=0.175$).

There was no significant difference in the other peri- and postoperative outcomes such as transfusion rates, postoperative length of stay, postoperative morbidity, and mortality rate.

Comparison between RDP and LDP in patients with benign or premalignant pancreatic tumors in 79 patients

A total of 79 patients had benign/premalignant tumors. 23 (29.1%) patients underwent RDP and 56 (70.9%) patients underwent LDP. The comparison between the baseline demographics, clinicopathological features, and outcomes of patients with benign or premalignant pancreatic tumors are summarized in Tables 3, 4. There was no significant difference in the demographics and clinicopathological features of both groups. However, patients who underwent RDP tended to have smaller median tumor size (18.0 mm vs. 30.5 mm, $p=0.071$).

Similarly, compared to patients who underwent LDP, patients who underwent RDP had a significantly higher rate of splenic preservation (52.2% vs. 17.9%, $p=0.005$), higher rate of splenic vessel preservation (47.8% vs. 12.5%, $p=0.004$), higher rate of subtotal resection (52.2% vs. 14.3%, $p<0.001$), and higher median difficulty score (5 vs. 2, $p=0.004$). Patients in the RDP group tended to have tumor located close to a major vessel (56.5% vs. 33.9%, $p=0.063$). There was no significant difference in the other perioperative factors between the two groups. A total of 8 patients (10.1%) had open conversion. This rate tended to be higher in patients who underwent LDP (12.5% vs. 4.3%, $p=0.426$). The operating time for patients who under RDP was significant longer than that for LDP (380 minutes vs. 230 minutes, $p<0.001$). One (1.8%)

Table 3. Comparison between the baseline demographic and perioperative data of patients who underwent RDP versus LDP for benign/premalignant tumors

	Total n=79	RDP n=23	LDP n=56	<i>p</i> -value
Male sex, n (%)	37 (46.8)	9 (39.1)	28 (50.0)	0.379
Median age (range), yrs	60 (19-80)	63 (21-79)	58.5 (19-80)	0.326
Symptoms, n (%)	24 (30.4)	6 (26.1)	18 (32.1)	0.595
Median BMI (range), kg/m ²	23.2 (15.9-35.9)	23.1 (17.1-30.7)	23.7 (15.9-35.9)	0.974
Previous abdominal surgery, n (%)	20 (25.3)	4 (17.4)	16 (28.6)	0.299
ASA score, n (%)				0.852
1	12 (15.2)	4 (17.4)	8 (14.3)	
2	58 (73.4)	17 (73.9)	41 (73.2)	
3	9 (11.4)	2 (8.7)	7 (12.5)	
Median tumor size, mm (range)	27.0 (0.0-140.0)	18.0 (0.0-75.0)	30.5 (2.2-140.0)	0.071
Splenic preservation, n (%)	22 (57.8)	12 (52.2)	10 (17.9)	0.004
Splenic vessel preservation (Kimura technique), n (%)	18 (22.8)	11 (47.8)	7 (12.5)	0.004
Subtotal (resection at/ right of PV), n (%)	20 (25.3)	12 (52.2)	8 (14.3)	<0.001
Concomitant surgery (non-cholecystectomy), n (%)	2 (2.5)	0 (0.0)	2 (3.6)	1.000
Left-sided portal hypertension, n (%)	4 (5.1)	1 (4.3)	3 (5.4)	1.000
Tumor extension to peripancreatic tissue, n (%)	32 (40.5)	11 (47.5)	21 (37.5)	0.396
Tumor close to major vessel, n (%)	32 (40.5)	13 (56.5)	19 (33.9)	0.063
Median difficulty score, (range)	3 (1-10)	5 (1-9)	2 (1-10)	0.004
Difficulty, n (%)				0.138
Low	45 (57.0)	10 (43.5)	35 (62.5)	
Intermediate	27 (34.2)	9 (39.1)	18 (32.1)	
High	7 (8.9)	4 (17.4)	3 (5.4)	

BMI, body mass index; ASA, American Society of Anesthesiologists; PV, portal vein

Table 4. Comparison between the perioperative and oncologic outcomes of patients who underwent RPD vs. LDP for benign/premalignant pancreatic tumors

	Total n=79	RDP n=23	LDP n=56	<i>p</i> -value
Open conversion, n (%)	8 (10.1)	1 (4.3)	7 (12.5)	0.426
Median operating time (range), min	250 (85-685)	380 (215-685)	230 (85-475)	<0.001
Median blood loss (range), ml	100 (10-2000)	200 (50-1200)	100 (10-2000)	0.232
Intraoperative blood transfusion, n (%)	7 (8.9)	2 (8.7)	5 (8.9)	1.000
Postoperative morbidity, n (%)	25 (31.6)	6 (26.1)	19 (33.9)	0.496
Major morbidity (Clavien-Dindo grade >2), n (%)	12 (15.2)	2 (8.7)	10 (17.9)	0.492
Biochemical fistula, n (%)	25 (31.6)	5 (21.7)	20 (35.7)	0.225
Grade B/C pancreatic fistula, n (%)	16 (20.3)	3 (13.0)	13 (23.2)	0.372
Pancreatic fistula requiring percutaneous drainage, n (%)	12 (15.2)	2 (8.7)	10 (17.9)	0.492
Reoperation, n (%)	0 (0.0)	0 (0.0)	0 (0.0)	NC
30-day mortality, n (%)	0 (0.0)	0 (0.0)	0 (0.0)	NC
90-day mortality, n (%)	1 (1.3)	0 (0.0)	1 (1.8)	1.000
Median postoperative stay (range), days	6 (3-73)	6 (3-22)	6 (3-73)	0.805
Readmission, n (%)	15 (19.0)	3 (13.0)	12 (21.4)	0.533

patient in the LDP group died within 90 days of surgery. However, there was no significant difference in the other postoperative outcomes.

DISCUSSION

Robotic surgery theoretically retains the advantages of

the laparoscopic approach in terms of smaller surgical scars, faster recovery, with the additional advantage of stable articulating instruments coupled with a magnified 3D high-definition view.^{1,9} The main theoretical advantage of the robotic arms is the increased dexterity from the patented Endowrist technology.

During MIDP, the increased dexterity of the robotic arms has been shown to facilitate suturing and fine dissection in tight spaces allowing for more precise dissection of the splenic vessels from the pancreatic parenchyma.^{2,11,12,24} These advantages have been shown to enable surgeons to perform splenic vessel preservation during MIDP.^{1,2,10,14,24-26} The results of our study also seem to support this hypothesis. In this study, patients who underwent RDP had a significantly higher splenic preservation rate and splenic vessel preservation rate. It is important to add that the decision for splenic preservation, however, is also dependent on the preoperative indications for DP and individual surgeon preference. Indications for DP associated with malignancy may necessitate splenic resection for better oncological outcomes. Nonetheless, subgroup analysis of only benign/premalignant tumors in this study still demonstrated significantly higher rates of splenic preservation and splenic vessel preservation in the RDP group. The RDP group also had a significantly higher rate of subtotal resection and tumor located close to major vessel compared to LDP. Nonetheless, it is important to highlight that selection bias whereby surgeons may have preferred the robotic platform for patients planned for splenic preservation, may have also accounted for the higher spleen-preservation rate.²⁴ Other confounding factors such as location of tumor (proximity to splenic hilum) may also affect the surgeon's decision to attempt splenic preservation.

Another postulated advantage of RDP is its lower conversion rate to open surgery compared to LDP.^{2,10,14,24,25} This is because robotic assistance potentially provides technical advantages such as motion scaling and stabilization as well as reduced operator fatigue, which facilitates hemostasis and control of the vascular structures surrounding the pancreas.²⁴ In our study, common indications for conversion to open surgery include intraoperative bleeding and tumor extension. These intraoperative complications could be better controlled with robotic surgery, reducing the need for open conversion. Nonetheless, while

our results show that the rate of conversion tended to be lower for RDP than LDP (3.7% vs. 14.7%, $p=0.175$), this difference was not statistically significant. Possible confounding factors such as different stages of learning curve and different surgeons' experience with minimally invasive surgery may also have contributed to these findings. Of note, RDP was only adopted only during the latter study period (2013-2019) whereby our institution already had prior experience with LDP. This important confounding factor likely partially contributed to the superior results observed with RDP as surgeons in our institution had already overcome part of the learning curve for MIDP via performing LDP before embarking on RDP.^{27,28} It is well-known from the literature that the open conversion rate of MIDP is higher during a surgeon's initial learning curve.²⁹

In this study, subtotal pancreatectomy was performed significantly more frequently for tumors located in the neck or body via the robotic approach. Some surgeons may propose central pancreatectomy as a parenchyma-saving approach for these tumors especially when these tumors are not suggestive of invasive cancer.^{30,31} However, in our practice we prefer to perform left-sided pancreatectomy over central pancreatectomy for tumors in these locations as despite the advantages of preserving pancreatic endocrine and exocrine function in the long-term, central pancreatectomy is associated with a higher short-term risk of major morbidity especially a clinically-significant postoperative pancreatic fistula which may potentially be life-threatening.^{30,31}

A frequent disadvantage of robotic surgery reported by many authors is the longer operation time for RDP compared to LDP.^{1,2,5,12,14,32} Similarly, our study also demonstrated that the operative time was significantly longer with RDP. The longer operation time with RDP can be attributed to the longer docking time and increased time to perform exchange of instruments which has been shown to be improve when surgeons gain increasing experience with the robotic platform.^{1,2,5,12,32} Based on current literature, it has been suggested that a surgeon would require 7 to 40 cases to overcome the learning curve for RDP when he/she had no prior experience with robotic surgery.³³⁻³⁵ In our experience, this unavoidable learning phase of RDP may have contributed to the longer operative time. Nonetheless, practice and familiarity with the

robotic platform, in conjunction with standardization of the surgical technique are likely to reduce the length of the learning curve for RDP.^{12,28,35-38} Hence, contrary to most studies, some investigators have demonstrated that RDP is associated with a shorter operating time.⁸

A significant barrier to robotic surgery today is the cost of adopting the procedure.^{18,32} In this study, cost was a major factor determining the type of minimally invasive surgery adopted as patients had to pay an additional amount of about S\$5000 for robotic assisted procedures.³² While the cost of robotic surgery varies between institutions and countries, it is uniformly higher than conventional laparoscopic surgery. As the cost of purchasing and maintain the robot is also significant, relatively few surgeons globally have regular access to the robotic technology for training, contributing to the lack of familiarity and experience with the system.^{18,24} Hence, the barrier to introduce robotic surgery to many institutions worldwide is relatively high. However, it is important to note that the costs of robotic systems will likely decrease in the near future with increasing availability and competition in the market.^{18,24,39}

Many investigators have demonstrated the safety and feasibility of RDP in comparison with LDP as the incidence of total postoperative complications were similar between the two.^{1,2} Similarly, the results of our study showed no significant difference between RDP and LDP in terms of the frequency of total complications, major morbidity, pancreatic fistula, and readmission rate. RDP also did not increase the reoperation rates and length of hospital stay.

The main limitations of the present study are its relatively small sample size and its retrospective nature. Hence, it may be subject to Type 1 or 2 errors. Similarly, various other confounding factors such as operative indications, surgeon experience, and patient preference could have also affected outcomes. Selection bias was also likely a major confounder influencing the study results. Nonetheless, the results of the present study reflect the real-world situation whereby surgeons at our institution tended to select more difficult MIDP such as spleen preserving procedures for RDP.

In conclusion, the findings of this study suggest that both RDP and LDP can be safely adopted. The use of RDP appeared to be complementary to LDP in our institution,

allowing us to expand our indications for MIDP to more technically difficult procedures such as spleen-saving pancreatectomies with comparable postoperative outcomes.

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CONFLICT OF INTEREST

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AUTHOR CONTRIBUTIONS

Conceptualization: SQL, TK, BKPG. Data curation: SQL, TK, YXK, JYT, SYL, JHK. Formal analysis: SQL, TK, YXK, BKPG. Funding acquisition: Nil. Methodology: SQL, JYT, SYL, JHK, CYC, BKPG. Project administration: PCC, PRJ, PKHC, LLO, AYFC, CYC. Visualization: PCC, PRJ, PKHC, LLO, AYFC, CYC. Writing - original draft: SQL, TK, YXK, JYT. Writing - review & editing: SYL, JHK, PCC, PRJ, PKHC, LLO, AYFC, CYC, BKPG.

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