Binding versus Conventional Pancreaticojejunostomy in Preventing Postoperative Pancreatic Fistula: A Systematic Review and Meta-Analysis

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Key Words

Binding pancreaticojejunostomy · Pancreaticojejunostomy · Pancreaticoduodenectomy · Postoperative pancreatic fistula

Abstract

Background: The aim of this study was to compare the safety and efficacy of a new technology, binding pancreaticojejunostomy (BPJ), with conventional pancreaticojejunostomy (CPJ) after pancreaticoduodenectomy in preventing postoperative pancreatic fistula (POPF). **Methods:** Randomized controlled trials and observational studies were retrieved from literature searches. Pooled OR with 95% CI for dichotomous variables and weighted mean difference with 95% CI for continuous variables were calculated. Fixed-effect and random-effect models as well as subgroup analysis were used for sensitivity analysis. **Results:** No statistically significant differences were found in the incidence of POPF, delayed gastric emptying, postpancreatectomy hemorrhage, reoperation, morbidity, mortality, operation time, intraoperative blood loss, blood transfusion, and hospital stay between 2 groups. However, the total costs of hospitalization and ordinary stay were higher in BPJ group (€10,513 ± €6,536

vs. €8,238 ± €4,687, $p = 0.002$; €7,946 ± €5,023 vs. €5,700 ± €2,902, $p = 0.015$, respectively). **Conclusions:** Our study showed BPJ was as safe as CPJ. However, no significant superiority was found in BPJ group regarding the incidence of POPF. The total costs of hospital stay were higher for patients undergoing BPJ. Surgeons can prefer to perform the digestive tract reconstruction of their choice.

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Introduction

Pancreaticoduodenectomy (PD) is a common surgical procedure to treat carcinoma of the pancreas head or periampullary region. Recent advances in surgical techniques and perioperative treatments have reduced the perioperative mortality below 5% in high volume centers [1–4]. However, PD is associated with considerable morbidity in 40–58.5% of patients manifesting postoperative pancreatic fistula (POPF), delayed gastric emptying (DGE), postpancreatectomy hemorrhage (PPH), and postoperative pulmonary complications [2, 5, 6].

POPF is a common and most important complication following PD. It not only prolongs hospital stay and in-

creases healthcare costs, but also plays a central role in the development of life-threatening events such as intra-abdominal abscess and PPH [7–10]. Several surgical techniques and perioperative care have been studied in order to prevent or decrease the incidence of POPF after PD, including digestive tract reconstruction with pancreaticogastrostomy [11], duct to mucosa or invagination pancreaticojejunostomy (PJ) [12], prophylactic somatostatin or somatostatin analogues [13], fibrin glue sealants [14], and pancreatic duct stents [15]. However, even in high-volume centers, the incidence of POPF is still in the range of 9.9–28.5% [16–18]. An ideal pancreatic reconstruction technique or perioperative treatment, which prevents POPF, is still unavailable.

Since 2002, Peng et al. [19–21] reported a series of studies to describe a new technique, binding PJ (BPJ), associated with pancreatic fistula incidence of 0%. In 2007, Peng et al. [22] presented one randomized clinical trial (RCT) and concluded that BPJ prevented POPF, thus reducing complications and hospital stay. However, a case-matched study from France showed that BPJ failed to prevent POPF and appeared to increase PPH [23]. Thus, the safety and efficacy of BPJ for the prevention of POPF after PD is still unclear.

To date, no systematic review or meta-analysis has been conducted to resolve the controversy of BPJ. Thus, the aim of the present study was to investigate the safety and efficacy of BPJ in terms of POPF.

Materials and Methods

The meta-analysis was performed according to the PRISMA statement [24] and the Cochrane Handbook for Systematic Reviews of Interventions [25].

Ethical Statement

The original data of this meta-analysis were based on previous published studies, thus no patients' consent and ethical approval are required.

Data Sources and Searches

Two authors (X.D. and P.L.) independently searched MEDLINE (Ovid SP, 1946–present), PubMed (1948–present), Embase (1947–present), Science Citation Index Expanded (1981–present), Chinese Biomedical Literature Database (1975–present), and China National Knowledge Infrastructure (1979–present) using the following search strategy (PubMed): (peng [All Fields] OR binding [All Fields]) AND (PJ [MeSH Terms] OR PJ [All Fields] OR pancreaticojejunostomies [All Fields] OR pancreatojejunostomy [All Fields] OR pancreatojejunostomies [All Fields] OR pancreatojejunal anastomosis [All Fields]). In addition, we also searched ClinicalTrials.gov, Cochrane Central Register of Controlled Trials in The Cochrane Library, and the reference lists of the identified reviews.

Study Selection

Two authors (X.Z. and X.D.) independently performed the study selection by screening the titles and abstracts according to the following inclusion and exclusion criteria. Any disagreements with respect to study selection, quality assessment, and data extraction were resolved by consensus.

Inclusion criteria: (1) human clinical studies and pre-review publications; (2) interventions of BPJ compared with conventional PJ (CPJ); (3) if there were more than 1 studies published by the same group, only the most recent one was included.

Exclusion criteria: (1) animal studies; (2) reviews, case reports, conference abstracts, letters to the editor, cohort studies only focusing on BPJ without control group; (3) studies without definition of POPF; and (4) studies without description of any of the following known risk factors of POPF after PD: body mass index (BMI) [26], pancreas texture [27], and pancreatic duct diameter [28].

Quality Assessment

The quality of included studies was assessed by 2 authors (X.Z. and X.D.). The Cochrane Risk of Bias Tool was used for quality assessment of RCT considering of random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, and selective reporting [25]. In addition, the Newcastle-Ottawa Quality Assessment Scale was used to assess the quality of non-randomized studies [29], and it was modified to suit our study (online suppl. Table 1, see www.karger.com/doi/10.1159/000453552). This modified Newcastle-Ottawa Quality Assessment Scale included 9 items to assess selection bias, comparability, and study outcomes. Stars were awarded for each high quality item and the highest quality studies were awarded up to 9 stars. A study with 6 or more than 6 stars was considered to be a high quality study, which was chosen as well in other meta-analysis [30].

Outcomes of Interest

The primary outcome of interest was the incidence of POPF in patients undergoing BPJ or CPJ. Secondary outcomes were DGE, PPH, reoperation, morbidity, mortality, operation time, intraoperative blood loss and transfusion, hospital stay, and cost.

Data Extraction

Two authors (X.D. and Y.Y.) independently extracted the following data from each study: demographic characteristics (first author, location, study period, study design, sample size, operation performed, type of resection, age, gender, BMI, pancreatic texture, and pancreatic duct diameter) and outcomes of interest described above.

Statistical Analysis

OR and 95% CIs were used to describe the results of meta-analysis for dichotomous variables and weighted mean difference (WMD) for continuous variables. The chi-square test was used to assess the heterogeneity with significance $p \leq 0.10$. I^2 statistic was used to quantitatively describe variability due to heterogeneity rather than chance. An I^2 value less than 25% suggested low heterogeneity, which might not be important. An I^2 value between 25 and 50% indicated moderate heterogeneity, 50–75% indicated substantial heterogeneity, and 75–100% represented considerable heterogeneity [25]. Fixed-effect and random-effect models as well

Fig. 1. Flow diagram for the systematic literature search and selection strategy.

as subgroup analysis based on definition of POPF and International Study Group on Pancreatic Fistula Definition (ISGPF) grades (A, B, and C) were used for sensitivity analysis [31]. All statistical analyses were performed using the STATA version 12.0 (College Station, TX, USA) and Review Manager 5.3 for Windows (Wintertree Software, Inc., Nepean, ON, Canada).

Results

Study Selection

A total 277 records were retrieved, and after deleting 88 duplicate records, 172 records were excluded according to the exclusion criteria by screening the title and abstract. The remaining 17 full-text articles were assessed. Of these, 7 articles without definition of POPF; 3 articles without data related to BMI, pancreatic texture, and pancreatic duct diameter; 1 article about expert advice; and 1 article without control group were excluded (Fig. 1).

Characteristics and Qualities of Included Studies

Finally, 5 studies including 1 RCT [22] and 4 observational studies (OBSs) [23, 32–34] were included for assessment of safety and efficacy of BPJ in preventing

POPF of patients after PD. The patient demographics and quality of each study are summarized in Table 1, 3, and 4, and the main study outcomes are defined in Table 2.

Primary Outcome

Postoperative Pancreatic Fistula

Five studies [22, 23, 32–34] involving 479 patients, 242 in the BPJ group and 237 in the CPJ group, were pooled to compare the incidence of POPF after PD. No significant differences existed between the 2 groups (OR 0.71; 95% CI 0.28–1.76). Moderate heterogeneity was observed among all studies ($I^2 = 35.2\%$, $p = 0.187$; Fig. 2).

Second Outcomes

Delayed Gastric Emptying

Four studies [22, 23, 32, 34] involving 358 patients, including 173 in the BPJ group and 185 in the CPJ group, were pooled to compare the incidence of DGE in patients undergoing PD. No significant difference existed between the 2 groups (OR 1.24; 95% CI 0.48–3.23). Low heterogeneity was observed among all studies ($I^2 = 0.0\%$, $p = 0.886$; Fig. 3a).

Table 1. Characteristics and quality of included study

Author	Location	Study period	Study design	Operation performed	Type of resection	Age, years	Gender, M:F ^c	BMI, kg/m ²	PT (S:H) ^d	PDD (>3: <3 mm)
Peng	China	2001–2004	RCT	BPJ (n = 106)	PPPD (n = 10) WPD (n = 96)	51.2±9.6 ^a	59:47	–	37:44:25 ^e	71:35
Lee	Korea	2007–2009	RBS	End-to-end PJ (n = 111)	PPPD (n = 17) WPD (n = 94)	52.6±7.7 ^a	58:53	–	39:48:24 ^e	83:28
				BPJ (n = 15)	PPPD (n = 8) WPD (n = 7)	61.9±2.4 ^a	6:9	22.2±0.8 ^a	6:7:2 ^e	2.2±0.1 ^a
				Dunking PJ (n = 16)	PPPD (n = 3) WPD (n = 13)	64.8±2.9 ^a	10:6	22.0±0.6 ^a	7:6:3 ^e	2.3±0.1 ^a
Maggiore	France	2006–2008	RCMS	BPJ (n = 22)	WPD	58 (19–77) ^b	12:10	22 (18–37) ^b	10:12	10:12
				End-to-side PJ (n = 25)	WPD	60 (20–75) ^b	13:12	22 (18–39) ^b	11:14	12:13
Casadei	Italy	2011	PBS	BPJ (n = 69)	PPPD (n = 27) WPD (n = 42)	64±12 ^a	42:27	24±3 ^a	31:38	38:31 ^f
Targarona	Peru	2007–2010	PBS	Duct-to-mucosa PJ (n = 52)	PPPD (n = 37) WPD (n = 15)	66±10 ^a	30:22	25±4 ^a	22:30	38:14 ^{f,*}
				BPJ (n = 30)	WPD	69.8±9.5 ^a	13:17	24.6±4.6 ^a	22:8	–
				End-to-side and Duct-to-mucosa PJ (n = 33)	WPD	65.7±11.5 ^a	14:19	22.9±5.8 ^a	20:13	–

^a Mean ± SD; ^b median (range); ^c male:female; ^d soft:hard; ^e soft:intermediate:hard; ^f pancreatic duct diameter (>3: ≤3 mm).

* $p = 0.003$.

RCT, randomised controlled trial; RBS, retrospective observational study; RCMS, retrospective case-matched study; PBS, prospective observational study; BPJ, binding pancreaticojejunostomy; PJ, pancreaticojejunostomy; PPPD, pylorus-preserving pancreaticoduodenectomy; WPD, whipple pancreaticoduodenectomy; BMI, body mass index; PT, pancreas texture; PDD, pancreatic duct diameter.

Table 2. Definition of main interest outcomes

Study	POPF	DGE	PPH	Mortality
Peng	Drainage >10 mL/day of fluid with an amylase level ≥ 3 times the upper limit of the normal serum from postoperative day 3	Nasogastric tube maintained for 10 or more days with at least one of the following: vomiting after nasogastric tube removal, reinsertion of nasogastric tube, or failure to progress with oral feeding	More than 3 units of blood were required in any 24 h after surgery	Any death occurring during hospitalization
Lee	Drainage >30 mL/day of fluid with an amylase level ≥ 5 times the upper limit of the normal serum on or after postoperative day 5	-	-	-
Maggiore	Drainage any measurable volume of fluid with an amylase level ≥ 3 times the upper limit of the normal serum on or after postoperative day 3 (ISGPF definition)	Either nasogastric tube maintained for 10 days, vomiting after nasogastric tube removal, or failure to progress with oral feeding at day 14	Defined by onset, location, and severity (ISGPF definition)	-
Casadei	ISGPF definition	-	ISGPF definition	Any death occurring within 30 days after surgery
Targarona	Drainage >50 mL/day of fluid with an amylase level ≥ 3 times the upper limit of the normal serum after postoperative day 10	-	-	Any death occurring during hospitalization after surgery or within 30 days after surgery

POPF, postoperative pancreatic fistula; DGE, delayed gastric emptying; PPH, postpancreatectomy hemorrhage; ISGPF, International Study Group on Pancreatic Fistula Definition.

Postpancreatectomy Hemorrhage

Four studies [22, 23, 33, 34] involving 448 patients, including 227 in the BPJ group and 221 in the CPJ group, were pooled to compare the incidence of PPH in patients after PD. There was no significant difference between the 2 groups (OR 1.20; 95% CI 0.34–4.27). Substantial heterogeneity was found among all the studies ($I^2 = 55.2\%$, $p = 0.082$; Fig. 3b).

Reoperation

Four studies [22, 23, 33, 34] involving 448 patients, including 227 in the BPJ group and 221 in the CPJ group, were pooled to compare the incidence of reoperation in patients after PD. No significant differences occurred between the 2 groups (OR 1.07; 95% CI 0.45–2.56). Low heterogeneity was found among all the studies ($I^2 = 0.0\%$, $p = 0.411$; Fig. 4a).

Morbidity

Five studies [22, 23, 32–34] involving 479 patients, including 242 in the BPJ group and 237 in the CPJ group, were pooled to compare the incidence of morbidity in patients after PD. There was no significant difference between the 2 groups (OR 0.74; 95% CI 0.49–1.14) and there was low heterogeneity among all the studies ($I^2 = 11.6\%$, $p = 0.339$; Fig. 4b).

Mortality

Four studies [22, 23, 33, 34] involving 448 patients, including 227 in the BPJ group and 221 in the CPJ group, were pooled to compare the incidence of mortality in patients after PD. No significant differences were found between the 2 groups (OR 0.64; 95% CI 0.23–1.83) and the heterogeneity among all the studies was low ($I^2 = 0.0\%$, $p = 0.469$; Fig. 5a).

Operation Time

Three studies [22, 32, 34] involving 311 patients including 151 in the BPJ group and 160 in the CPJ group were pooled to compare the operation time in patients undergoing BPJ or CPJ. There was no significant differences between the 2 groups (WMD = 0.28; 95% CI –0.97 to 1.53) and considerable heterogeneity existed among all the studies ($I^2 = 98.3\%$, $p = 0.000$; Fig. 5b).

Intraoperative Blood Loss and Transfusion

Three studies [22, 32, 34] involving 311 patients, including 151 in the BPJ group and 160 in the CPJ group, were pooled to compare intraoperative blood loss and transfusion in patients undergoing BPJ or CPJ. There was no significant difference between the 2 groups (WMD =

Fig. 2. Forest plot with RCT and OBSs showing OR of POPF for patients underwent BPJ and CPJ after pancreaticoduodenectomy (DerSimonian-Laird random-effect model). RCT, randomized controlled trial; OBS, observational study. Weights are from random effects analysis.

−16.40; 95% CI −124.96 to 92.16; WMD = −0.10; 95% CI −0.56 to 0.36, respectively). Substantial and considerable heterogeneity existed among all the studies ($I^2 = 62.9\%$, $p = 0.067$; $I^2 = 79.5\%$, $p = 0.008$, respectively; Fig. 6).

Hospital Stay

Four studies [22, 32–34] involving 432 patients, including 220 in the BPJ group and 212 in the CPJ group, were pooled to compare the patients' hospital stay. There was no significant difference between the 2 groups (WMD = −0.18; 95% CI −4.80 to 4.44). Considerable heterogeneity existed among all the studies ($I^2 = 88.9\%$, $p < 0.000$). Three studies [33–35] were pooled to compare patients' stay in the intensive care unit (ICU) following PD. No significant difference existed between the 2 groups (WMD = 0.24; 95% CI −0.57 to 1.05) and the heterogeneity among all the studies was substantial ($I^2 = 52.3\%$, $p = 0.123$; Fig. 7).

Cost

Only one study [33] mentioned cost of hospital stay. The total costs of hospital stay and ordinary stay in the BPJ group were higher than those in the control group

(€10,513 ± €6,536 vs. €8,238 ± €4,687; $p = 0.002$; €7,946 ± €5,023 vs. €5,700 ± €2,902; $p = 0.015$; respectively). However, there were no significant differences in the cost of ICU stay (€2,538 ± €3,292 vs. €2,566 ± €4885; $p = 0.156$).

Sensitivity Analysis

No significant differences were found between the 2 groups in fixed-effect and random-effect models (data not shown). Subgroup analysis of all studies based on definition and grades of POPF showed no significant difference between the BPJ and CPJ groups (Fig. 8).

Discussion

The present meta-analysis compared the outcomes of a new PJ technique with the conventional CPJ to assess the safety and efficacy of BPJ in decreasing the incidence of POPF after PD. No major differences in POPF and other secondary outcomes (DGE, PPH, reoperation, morbidity, mortality, operation time, blood loss and transfusion, and hospital stay) were found between BPJ and CPJ

Fig. 3. Forest plot with RCT and OBSs showing OR of DGE (**a**) and PPH (**b**) for patients underwent BPJ and CPJ after pancreaticoduodenectomy (DerSimonian-Laird random-effect model). RCT, randomized controlled trial; OBS, observational study. Weights are from random effects analysis.

Fig. 4. Forest plot with RCT and OBSs showing OR of reoperation (**a**) and morbidity (**b**) for patients underwent BPJ and CPJ after pancreaticoduodenectomy (DerSimonian-Laird random-effect model). RCT, randomized controlled trial; OBS, observational study. Weights are from random effects analysis.

Fig. 5. Forest plot with RCT and OBSs showing OR of mortality (**a**) and WMD of operation time (**b**) for patients underwent BPJ and CPJ after pancreaticoduodenectomy (DerSimonian-Laird random-effect model). RCT, randomized controlled trial; OBS, observational study; WMD, weighted mean difference. Weights are from random effects analysis.

Fig. 6. Forest plot with RCT and OBSs showing WMD of intraoperative blood loss (**a**) and blood transfusion (**b**) for patients underwent BPJ and CPJ after pancreaticoduodenectomy (DerSimonian-Laird random-effect model). RCT, randomized controlled trial; OBS, observational study; WMD, weighted mean difference. Weights are from random effects analysis.

Fig. 7. Forest plot with RCT and OBSs showing WMD of hospital stay (**a**) and ICU stay (**b**) for patients underwent BPJ and CPJ after pancreaticoduodenectomy (DerSimonian-Laird random-effect model). RCT, randomized controlled trial; OBS, observational study; WMD, weighted mean difference. Weights are from random effects analysis.

Fig. 8. Subgroup analysis based on definition (**a**) and grades of POPF (**b**) for patients underwent BPJ and CPJ after pancreaticoduodenectomy (DerSimonian-Laird random-effect model). Other definition defined POPF as drainage more than 10, 30, and 50 mL/day of fluid with an amylase level 3 or 5 times greater than normal serum on or after postoperative days 3, 5, and 10, respectively; ISGPF definition

defined POPF as any measurable volume of fluid with an amylase level 3 times greater than normal serum on or after postoperative day 3. Grades A, B, and C are classified according ISGPF definition. ISGPF, International Study Group on Pancreatic Fistula Definition. Weights are from random effects analysis.

Table 3. Quality assessment of included RCT using Cochrane Risk of Bias Tool

Study	Cochrane Risk of Bias Tool						
	selection bias		performance bias		detection bias	attrition bias	reporting bias
	sequence generation	allocation concealment	surgeon blinding	patients blinding	outcome assessment blinding	incomplete outcome data	selective reporting
Peng	Low risk	Low risk	High risk	Low risk	Low risk	Low risk	Unclear

following PD. However, the total hospital costs were higher in the BPJ group.

Since 2002, Peng et al. [19–21] published a series of case reports with 0% of patients manifesting POPF following BPJ after PD. In 2007, Peng et al. [22] reported a new RCT of 217 patients. The results showed that compared with CPJ, BPJ prevented POPF and also reduced the risk of overall postoperative complications and hospital stay. Therefore, several studies have been conducted to evaluate the safety and efficacy of BPJ to avoid POPF after PD. Two Korean and 1 French studies concluded that the safety of BPJ was comparable to that of CPJ [32, 35, 36], with a greater efficacy in reducing the rate of POPF and other complications related to pancreatic fistulas [32, 36], especially in case of pancreatic remnants with soft texture [36]. However, 3 other Western studies showed the BPJ anastomosis was not associated with lower POPF [23, 33, 34], and instead increased the PPH [23].

The mortality rates in our meta-analysis were not significantly different between the BPJ and CPJ groups, which is consistent with previous studies [22, 23, 32–34]. The findings also reinforce the evidence that BPJ was a safe technique [22, 32, 34]. However, the rate of POPF, morbidity, and hospital stay associated with BPJ were not superior to CPJ and the hospital costs were higher in BPJ group, which are inconsistent with the RCT results [22].

The importance of the meta-analysis can be summarized as follows. First, meta-analysis is an important statistical tool combining inconsistent results from independent but similar studies in an effort to improve the estimates of effect size to resolve uncertainty [37]. Second, low-to-moderate heterogeneity was found among all the studies regarding POPF, DGE, reoperation, morbidity, and mortality, which suggested that the heterogeneity might not affect the results. Third, no diversity existed between fixed-effect and random-effect models for all the outcomes. Subgroup analyses based on definition and

ISGPF POPF grades (A, B, and C) also did not show any significant differences between BPJ and CPJ, which indicate the stability of our results.

However, the present meta-analysis has several limitations. First, the number of patients underwent BPJ ranging from 15 to 106. A possible bias associated with the learning curve of the new technique affected the surgery, contributing to the increased heterogeneity among all the studies targeting PPH, intraoperative blood loss and transfusion, operation time, and hospital stay. Second, only one RCT was included in our meta-analysis and the other 4 studies were OBSs. The criteria in patients undergoing BPJ or CPJ in OBS are based on surgeon's discretion, which resulted in potential selection bias and heterogeneity between RCT and OBS. This limitation is also one reason for the differences between present meta-analysis and Peng's RCT study. Therefore, additional prospective RCTs are needed for future meta-analysis of this topic. Third, increased BMI, soft pancreatic texture, and pancreatic duct diameter no more than 3 mm are risk factors for POPF [26–28]. Buc et al. [36] concluded that BPJ improved the rate of POPF, especially in the case of soft pancreas without dilated main pancreatic duct. However, lack of pertinent data in the original studies hindered subgroup analysis based on BMI, pancreatic texture, and pancreatic duct diameter. It is unclear whether BPJ is potentially feasible and effective in these subgroups of patients. Fourth, the definition of POPF and other secondary outcomes is not uniform among the included studies. In 2 studies [23, 33], POPF is defined according to ISGPF criteria as any measurable volume of drain fluid on or after postoperative day 3, with amylase content greater than 3 times the upper normal serum value [31]. However, other 3 studies defined POPF as the volume of drain fluid ≥ 10 mL [22], 30 mL [33] and 50 mL [35], with amylase level more than 3 [22, 34] or 5 times [32] the upper limit of the normal amylase level after postoperative days 3 [22], 5 [33], and 10 [34], respectively, which poten-

Table 4. Quality assessment of included observational study using Modified Newcastle-Ottawa Quality Assessment Scale

Study	Modified Newcastle-Ottawa Quality Assessment Scale									
	selection		comparability			outcome		total stars *		
	definition of BPJ	definition of CPJ	representativ- eness ^a	BMI	pancreas texture	pancreas duct diameter	definition of POPF	lost to follow-up	period	
Peng	*	*	*	—	*	*	*	*	*	8
Lee	*	*	—	*	*	*	*	*	*	8
Maggiori	*	*	*	*	*	*	*	*	*	9
Casadei	*	*	*	*	*	—	*	*	*	8
Targarona	*	*	*	*	*	—	*	*	*	8

^a Consecutive series of patients at the same period.
BPJ, binding pancreaticojejunostomy; CPJ, conventional pancreaticojejunostomy; BMI, body mass index; POPF, postoperation pancreatic fistula.

^a Consecutive series of patients at the same period.

BPJ, binding pancreaticojejunostomy; CPJ, conventional pancreaticojejunostomy; BMI, body mass index; POPF, postoperation pancreatic fistula.

tially excludes a few cases of POPF with low volume output. Although subgroup analysis based on definition indicated no differences between BPJ and CPJ regarding POPF rate, this heterogeneity remains a source of bias regarding the conclusions. The various diagnostic criteria of complications after PD are a major deficiency of current clinical studies and meta-analyses to compare the effect of different surgical techniques and perioperative management in patients who underwent PD. Since 2005, the ISGPF developed novel definition and classification approaches for PF, DEG, and PPH which proved to be useful schemes to decrease the inter-observer variability and these approaches could be used in future studies [31, 38, 39]. Fifth, there was considerable heterogeneity among included studies regarding operation time, intraoperative blood transfusion, and hospital stay and, therefore, might be misleading to quote these pooled results in the present study. Finally, only 5 studies were included in our meta-analysis. The funnel plot cannot be used to test publication bias because of its low statistical power to distinguish chance from real asymmetry [40].

Conclusion

Our study showed that BPJ is a safe anastomosis method comparable to CPJ. However, no significant differences were found in terms of the incidence of POPF, DGE, PPH, morbidity, mortality, operation time, intraoperative blood loss, blood transfusion, and hospital stay. Instead, BPJ was associated with higher hospital costs. Therefore, the type of digestive tract reconstruction after PD should be selected according to surgical preference.

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Disclosure Statement

The authors declare no conflicts of interest.

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