

# Clinical study on cystogastrostomy and Roux-en-Y-type cystojejunostomy in the treatment of pancreatic pseudocyst

## A single-center experience

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### Abstract

The main purpose is to compare the efficacy of cystogastrostomy (CG) and Roux-en-Y-type cystojejunostomy (RCJ) in the treatment of pancreatic pseudocyst (PPC), and to explore the risk factors of recurrence and complications after internal drainage.

Two hundred eight patients undergoing either CG or RCJ for PPC Between January 1, 2013 and February 1, 2019, at West China Hospital of Sichuan University were retrospectively analyzed. The cure rate, complication rate and related factors were compared between the 2 groups.

Two hundred eight patients with PPC underwent either a CG (n=119) or RCJ (n=89). The median follow-up time was 42.7 months. Between the 2 cohorts, there were no significant differences in cure rate, reoperation rate, and mortality (all  $P > .05$ ). The operative time, estimated intraoperative blood loss, install the number of drainage tubes and total expenses in CG group were lower than those in RCJ group (all  $P < .05$ ). The Logistic regression analysis showed that over twice of pancreatitis' occurrence was independent risk factor for recurrence after internal drainage of PPC (OR 2.760, 95% CI 1.006~7.571,  $P = .049$ ). Short course of pancreatitis (OR 0.922, 95% CI 0.855~0.994,  $P = .035$ ), and RCJ (OR 2.319, 95% CI 1.033~5.204,  $P = .041$ ) were independent risk factors for complications after internal drainage of PPC.

Both CG and RCJ are safe and effective surgical methods for treating PPC. There were no significant differences in cure rate, reoperation rate, and mortality between the 2 groups, while the CG group had a short operation time, less intraoperative bleeding and less cost.

**Abbreviations:** BMI = body mass index, CT = computerized tomography, DP = distal pancreatectomy, PPC = pancreatic pseudocyst, SAP = severe acute pancreatitis.

**Keywords:** complication, internal drainage, pancreatic pseudocyst, recurrence, risk factor

## 1. Introduction

Pancreatic pseudocyst (PPC) is a collection of pancreatic juice surrounded by a fibrous or granulation tissue wall that occurs at least 4 weeks after the onset of symptoms.<sup>[1]</sup> It is often caused by acute

pancreatitis, pancreatic trauma or chronic pancreatitis. PPC is usually sterile, the lesion is called "pancreatic abscess" when infection occurs.<sup>[2]</sup> Pseudocysts may have no obvious symptoms, but it also can be associated with symptoms such as abdominal pain, nausea and vomiting, bloating, upper gastrointestinal bleeding, and abdominal mass. Most pancreatic pseudocysts are expected to self-cure, and about one-third of patients require intervention for complications such as bleeding, compression of organs, and infection.<sup>[3,4]</sup> PPC can be treated with a variety of methods: percutaneous catheter drainage, endoscopic ultrasonography assist, laparoscopic surgery, or open internal drainage. But when and how to choose the best surgical method is still unclear. Open internal drainage surgery is the classic procedure for the treatment of PPC, it is indicated for a significant number of cases.<sup>[4-6]</sup> We reviewed the literatures and found no relevant studies comparing different internal drainage methods. Thus, the purposes of this study were, first, to compare perioperative and long-term outcomes for patients undergoing either cystogastrostomy (CG) or Roux-en-Y-type cystojejunostomy (RCJ) for management of PPC; and second, to analysis the risk factors of recurrence and complications after PPC internal drainage.

## 2. Material and methods

### 2.1. Patient characteristics

We included all patients with acute or chronic PPC who were treated at West China Hospital of Sichuan University between January 1, 2013 and February 1, 2019. Patients' data were retrospectively

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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collected by review of clinical records of the information Center of the West China Hospital. The retrospective study was reviewed by the ethics committee of west China hospital of Sichuan university; review Number [2019 review (1049)].

Inclusion and exclusion criteria of this study are as follows. Inclusion criteria: Patients with PPC, no matter caused by chronic or acute pancreatitis, and CG or RCJ have been performed. Exclusion criteria:

1. Age less than 8 years old.
2. Other pancreas surgeries were performed at the same time.
3. Patients with direct anastomosis of small entero-pseudocyst.
4. Patients lost to follow-up.

Successful operation was defined as the establishment of anastomotic stoma, and the postoperative reexamination of pseudocysts disappeared or decreased significantly. Recurrence is defined as the appearance of a new pseudocyst after the success treatment. Complications refer to 1 or more of the following: recurrence, pancreatitis, infection, intestinal obstruction, effusion, etc. We defined the postoperative fever as a postoperative temperature over 38.0°C. Worsening exocrine insufficiency is defined as the need for oral digestive enzyme-assisted digestion in patients' daily life. Alike, worsening endocrine insufficiency is defined as the need to increase medication to control blood sugar or newly diagnosed diabetes. The diagnosis of sinistral portal hypertension was based on clinical presentation, laboratory tests, and radiological evaluations. The normal liver condition, isolated gastric varices (with/without esophageal varices), and/or splenomegaly is the characteristic of sinistral portal hypertension; patients with AP who had no signs of a liver disease but demonstrated isolated gastric varices (with/without esophageal varices) and/or splenomegaly on the Magnetic Resonance Imaging or computerized tomography (CT) scans were considered to have sinistral portal hypertension.<sup>[7,8]</sup> The size of the pseudocyst is indicated by its maximum diameter.

## 2.2. Data collection

All patients underwent preoperative abdominal enhanced CT or Magnetic Resonance Imaging to assess the location, size, and surrounding anatomy of the PPC. We recorded the following data: demographic information (gender, age, body mass index, etiology of pancreatitis); initial symptoms; initial onset time; imaging performance including the cyst size, location and number; the main symptoms of pancreatic pseudocysts including abdominal pain, compression obstruction, bleeding, infection, and rupture; details of internal drainage surgery; average length of hospital stay and total cost patients; Postoperative complications and long-term prognosis. We have identified the following indicators to assess perioperative related conditions: operation time, estimated blood loss, gastric tube retention time, postoperative fever, length of hospital stay, etc. We determined the following data to evaluate the long-term outcome: cure rate, overall complication, need for reoperation, and survival rate. Additionally, we regard deterioration of glucose and worsening exocrine insufficiency as secondary outcome index. Patients with insufficient follow-up information were excluded from this study.

## 2.3. Data analysis

The data were grouped as categorical and continuous variable based on clinical characteristics. Patients undergoing CG and

RCJ were compared in demographic information, perioperative index, postoperative complications, exocrine enzyme requirements, recurrence of PPC and survival, etc. Parameters that lost more than 10% of the total will be excluded from statistical analysis. To explore the independent risk factors for recurrence of PPC; all indicators with  $P < .1$  in univariate analysis were included in logistic regression scores. Continuous variables were expressed as the mean and standard deviation. Categorical variables were summarized as frequency and percentage rates. The Chi-Squared test was used for two-category variables. T test, Fisher exact test and Mann–Whitney  $U$  test were used to compare outcomes with a  $P$  value of  $< .05$  representing statistical significance. Statistical analysis was performed using Excel 2016 and SPSS 24.0 software.

## 3. Results

### 3.1. Patient demographics and disease characteristics

From January 2013 to February 2019, 208 patients underwent either CG ( $n = 119$ ) or RCJ ( $n = 89$ ) for management of pancreatic pseudocyst. The average follow-up time of patients was 42.7 months. Baseline demographic information and disease characteristics were analyzed and compared as shown in Table 1. There were no significant differences in gender, age, BMI, initial onset time and the etiologies of pancreatitis between the 2 surgical cohorts (all  $P > .05$ ). Additionally, analysis showed that there was no marked difference in the choice of surgical approach for the location and size of the pseudocyst. The above results indicate that the baseline levels of the 2 groups of patients in this study are consistent and have clinical comparable.

### 3.2. Perioperative characteristics

The choice of surgical procedure is determined by the surgeon intraoperatively, and all procedures are performed by a doctor

**Table 1**  
Patient demographics and disease characteristics.

Characteristics	CG (n=119)	RCJ (n=89)	P
Mean age (years)	46.3 ± 12.6	47.8 ± 14.0	.408
Sex (%)			.154
Male	67 (56.3%)	59 (66.3%)	
Female	52 (43.7%)	30 (33.7%)	
BMI (kg/m <sup>2</sup> )	21.6 ± 2.8	22.1 ± 3.1	.208
Smoking (%)	48 (40.3%)	39 (43.8%)	.671
Etiology of pancreatitis (%)			.704
Gallstones	80 (67.2%)	57 (64.0%)	
Traumatic	7 (5.9%)	6 (6.7%)	
Alcohol	5 (4.2%)	3 (3.4%)	
Hyperlipemia	15 (12.5%)	8 (9.0%)	
Chronic pancreatitis	4 (3.4%)	4 (4.5%)	
Iatrogenic	4 (3.4%)	3 (3.4%)	
Idiopathic	4 (3.4%)	8 (9.0%)	
Initial onset time (months)	4 (0.5–120.0)	4 (1–36.0)	0.643
Preoperative puncture drainage (%)	24 (20.2%)	24 (27.0%)	0.318
Cyst location (%)			0.147
pancreatic head and neck	48 (40.3%)	27 (30.3%)	
pancreatic body and tail	71 (59.7%)	62 (69.7%)	
Size of the cyst (cm)	10.7 ± 4.2	10.1 ± 4.2	0.151
Portal hypertension (%)	57 (47.9%)	33 (37.1%)	0.123
SAP times (≥2) (%)	70 (58.8%)	49 (55.1%)	0.671

BMI = Body Mass Index, SAP = severe acute pancreatitis.

**Table 2**  
Perioperative details for patients undergoing CG versus RCJ.

Characteristics	CG (n = 119)	RCJ (n = 89)	P
Operative time (minutes)	107.2 ± 33.5	126.7 ± 36.1	<i>P</i> < .01
Estimated blood loss (ml)	50 (10–700)	60 (15–800)	.011
Gastric tube retention time (d)	5 (1–21)	3 (0–12)	<i>P</i> < .01
Number of plasma tubes	1 (0–3)	1 (0–5)	<i>P</i> < .01
Plasma tube retention time (d)	5 (0–15)	6 (0–13)	.083
Postoperative fever Cases (%)	49 (41.2%)	47 (52.8%)	.122
Length of stay (d)	15.6 ± 9.1	16.2 ± 11.2	.675
Death (%)	0	1 (1.1%)	.428
Total expenses (¥)	41548.3 (20789.5–186619.0)	46353.9 (17404.0–246000.7)	.037

with extensive experience in pancreatic surgery. Comparing the characteristics of CG and RCJ perioperative period, there was no significant statistical difference in the length of hospital stay (15.6 ± 9.1 vs 16.2 ± 11.2, *P* = .675), postoperative fever [49 (41.2%) vs 47 (52.8%), *P* = .122] and death rate [0 vs 1 (1.1%), *P* = .428]. Compared with RCJ, CG resulted in less operative time (107.2 ± 33.5 vs 126.7 ± 36.1, *P* < .01), estimated blood loss [50 (10–700) vs 60 (15–800), *P* = .011] and lower total costs [41548.3 (20789.5–186619.0) vs 46353.9 (17404.0–246000.7) CNY, *P* = .037]. Comparison of perioperative details are shown in Table 2.

### 3.3. Postoperative Complications

Postoperative complications and long-term follow-up indicators are shown in Table 3. No significant differences were noted between patients undergoing either CG or RCJ with regard to recurrence [9 (7.5%) vs 10 (11.2%), *P* = .463], reoperation [8 (6.7%) vs 8 (9.0%), *P* = .604]. However, the overall complication rate in group RCJ was higher than that in group CG [20 (22.5%) vs 13 (10.9%), *P* = .034]. There was no significant difference in the changes of endocrine and exocrine function between the 2

**Table 3**  
Postoperative details and complications.

Characteristics	CG (n = 119)	RCJ (n = 89)	P
Recurrence (%)	9 (7.5%)	10 (11.2%)	.467
Overall complication (%)	13 (10.9%)	20 (22.5%)	.034
Reoperation (%)	8 (6.7%)	8 (9.0%)	.604
Worsening endocrine insufficiency (%)	22 (18.5%)	25 (28.1%)	.131
Worsening exocrine insufficiency (%)	24 (21.2%)	16 (18.0%)	.726

groups. In the RCJ group, 1 patient had a major abdominal hemorrhage after drainage surgery, and an emergency laparotomy was performed 2 days later, eventually the family of the patient request automatic discharge. This case was included in the death group.

### 3.4. Risk factors for recurrence and complications

In this study, there were 19 cases of recurrence. A detailed comparison between the recurrence group and the non-recurrence group is shown in Table 4. We performed a univariate analysis of risk factors for recurrence and complications after internal drainage, including age, BMI, initial onset time, size of the cyst, etc. Details are shown in Table 4 and Table 6. The results showed that the recurrence of pseudocysts was significantly associated with cyst location, size of the cyst, and amount of cyst fluid (all *P* < .05). The results of logistic regression analysis showed that as the size of the cyst increased, the possibility of recurrence decreased after internal drainage of the pancreatic cyst. The recurrent of PPC was higher when the severe acute pancreatitis (SAP) episode times ≥ 2 and the PPC in the head and neck. SAP times ≥ 2 were independent risk factors for recurrence after PPC internal drainage (OR 2.760, 95% CI 1.006~7.571, *P* = .049). As shown in the Table 5.

In this study, a total of 33 patients developed complications. A detailed comparison between the complication group and the

**Table 4**  
Univariate analysis of risk factors for recurrence after internal drainage.

Items	Recurrence (n = 19)	Non-recurrence (n = 189)	Statistic	P
Age (years)	47.9 ± 13.5	46.8 ± 13.2	t = 0.334	.739
BMI (kg/m <sup>2</sup> )	21.4 ± 2.8	21.8 ± 2.9	t = 0.596	.552
Smoking (%)	11 (57.9%)	99 (52.4%)	χ <sup>2</sup> = 0.211	.810
Drinking (%)	8 (42.1%)	64 (33.9%)	χ <sup>2</sup> = 0.518	.461
Initial onset time (m)	3 (1–36)	4 (0.5–120)	U = 1460.00	.177
Multiple cysts (%)	6 (31.6%)	73 (38.6%)	χ <sup>2</sup> = 0.364	.627
Portal hypertension (%)	8 (42.1%)	82 (43.4%)	χ <sup>2</sup> = 0.012	1.000
SAP times (≥ 2) (%)	12 (63.2%)	77 (40.7%)	χ <sup>2</sup> = 3.544	.087
Cyst location (%)			χ <sup>2</sup> = 6.661	.013
pancreatic head and neck	12 (63.2%)	63 (33.3%)		
pancreatic body and tail	7 (36.8%)	126 (66.7%)		
Operation time (minutes)	120 (60~210)	120 (60~180)	U = 1933.50	.550
Estimated blood loss (ml)	50 (15~150)	50 (10~800)	U = 1478.00	.190
Preoperative puncture drainage (%)	2 (10.5%)	46 (24.3%)	χ <sup>2</sup> = 1.855	.255
Anastomotic methods (%)			χ <sup>2</sup> = 0.828	.467
CG	9 (47.4%)	110 (58, 2%)		
RCJ	10 (52.6%)	79 (41.8%)		
Size of the cyst (cm)	8.1 ± 2.9	10.6 ± 4.2	t = 2.507	.013
Amount of cyst fluid (ml)	300 (50~1000)	500 (30~2300)	U = 1121.50	.007
Amount of necrotic tissue (g)	50 (0–300)	60 (0–1000)	U = 1648.50	.555

BMI = Body Mass Index, SAP = severe acute pancreatitis.

**Table 5****Multivariate logistic regression analysis of risk factors associated with risk factors for recurrence after internal drainage.**

Items	Odds ratio	95% CI	P
SAP times ( $\geq 2$ )	2.760	1.006~7.571	.049
PPC of the head and neck	2.488	0.850~7.284	.096
Size of the cyst (cm)	0.933	0.666~1.305	.684
Amount of cyst fluid	0.999	0.995~1.003	.618

PPC = pancreatic pseudocyst, SAP = severe acute pancreatitis.

non-complication group is shown in Table 6. Similarly, indicators with  $P < .1$ , initial onset time, anastomotic methods (converted to "RCJ"), size of the cyst and amount of cyst fluid, were included in logistic regression analysis, as shown in Table 7. The results showed that the shorter the course of pancreatitis, the greater the risk of complications after internal drainage of PPC (OR: 0.922, 95% CI: 0.855–0.994,  $P = .035$ ). RCJ was associated with a higher risk of complications than CG (OR: 2.319, 95% CI: 1.033–5.204,  $P = .041$ ). Short course of pancreatitis and RCJ were independent risk factors for complications after PPC.

#### 4. Discussion

Various reasons can lead to pancreatic duct discontinuity and pancreatic juice's leak into the abdominal cavity, was considered a main pathogenesis of pancreatic pseudocyst currently.<sup>[1–3]</sup> Pancreatic pseudocysts are gradually being recognized, and the number of patients is increasing. Although the clinical manifestations of pancreatic pseudocysts are diverse, the basic principle of treatment is mainly to solve abnormal drainage of pancreatic juice. In more than 2 thirds of patients, pseudocysts spontaneously disappeared, so the first treatment option for this disease is conservative treatment based on observation and follow-up.<sup>[9,10]</sup> In another part of the patient, after long-term conservative treatment, the fistulas fail to close, or even accompanied by

**Table 7****Multivariate logistic regression analysis of risk factors associated with risk factors for postoperative internal drainage.**

Items	Odds ratio	95% CI	P
Initial onset time	0.922	0.855–0.994	.035
RCJ	2.319	1.033–5.204	.041
Size of the cyst	0.815	0.614–1.082	.157
Amount of cyst fluid	1.000	0.996–1.003	.789

bleeding, infection, digestive tract obstruction, pancreatic portal hypertension and other complications, and require endoscopic or surgical treatment. Currently, no international guidelines or consensus treatment method was proposed and it is often difficult and unclear to choose operative technique.<sup>[11]</sup> There is basically no relevant report on the comparison of internal drainage methods until now.

Percutaneous puncture drainage was usually performed under image guidance, ultrasound and CT guidance are most commonly used. Percutaneous drainage has been widely used because of its advantages of simple operation, small trauma and low price.<sup>[10,12–14]</sup> On the other hand, because percutaneous drainage is prone to cause complications such as secondary infection, bleeding, catheter blockage, and pancreatic cutaneous fistula, it should be carefully selected in clinical work.<sup>[14–16]</sup> In this study, a total of 48 patients underwent percutaneous drainage before internal drainage, all treatment failure due to poor drainage. Moreover, percutaneous puncture had no significant effect on PPC recurrence and complications. We consider that the main factor influencing the puncture drainage is the pseudocyst contains unequal amounts of necrotic tissue, which often block the drainage tube and cause drainage failure. In this study, 1 patient who recurrence PPC after RCJ, and underwent percutaneous drainage under ultrasound guidance. After 1 week, the drainage fluid gradually disappeared. Therefore, the pseudocysts that do not contain necrotic tissue,

**Table 6****Univariate analysis of risk factors for postoperative complications of internal drainage.**

Items	Complication group (n=33)	Non-complication group (n=175)		P
Age (years)	50.2 ± 13.1	46.3 ± 13.1	t = -1.551	.122
BMI (kg/m <sup>2</sup> )	21.8 ± 3.1	21.8 ± 2.9	t = 0.074	.127
Smoking (%)	18 (54.5%)	92 (52.6%)	$\chi^2 = 0.043$	.852
Drinking (%)	13 (39.4%)	59 (33.7%)	$\chi^2 = 0.396$	.553
Initial onset time (m) (%)	3 (1–36)	5 (0.5–120)	U = 1947.50	.012
Multiple cysts (%)	15 (45.5%)	64 (36.6%)	$\chi^2 = 0.930$	.336
Portal hypertension (%)	14 (42.4%)	76 (43.4%)	$\chi^2 = 0.011$	1.000
SAP times ( $\geq 2$ ) (%)	18 (54.5%)	71 (40.6%)	$\chi^2 = 2.215$	.179
Cyst location (%)			$\chi^2 = 2.627$	.117
pancreatic head and neck	16 (48.5%)	59 (33.7%)		
pancreatic body and tail	17 (51.5%)	116 (66.3%)		
Operation time (minutes)	120 (60~210)	120 (60~180)	U = 3325.00	.629
Estimated blood loss (ml)	60 (15~200)	50 (10~800)	U = 3036.00	.135
Preoperative puncture drainage (%)	5 (15.2%)	43 (24.6%)	$\chi^2 = 1.388$	.270
Anastomotic methods (%)			2 = 5.087	.034
CG	13 (39.4%)	106 (60.6%)		
RCJ	20 (60.6%)	69 (39.4%)		
Size of the cyst (cm)	8 ± 2.4	10.9 ± 4.3	t = 3.698	<.01
Amount of cyst fluid (ml)	350 (50~1000)	500 (30~2300)	U = 1768.50	<.01
Amount of necrotic tissue (g)	50 (0–300)	60 (0–1000)	U = 2820.50	.832

BMI = Body Mass Index, SAP = severe acute pancreatitis.

such as traumatic or iatrogenic pseudocysts, or patients who cannot undergo surgery, percutaneous drainage can be considered.

Nowadays, endoscopic treatment of PPC is the most heated topic of discussion.<sup>[17–19]</sup> Patients with main pancreatic duct lesions can be treated with implantation pancreatic duct stents via endoscopic to treat PPC, but the target population is limited. At the same time, endoscopic treatment of PPC has the disadvantages of high requirements for cyst location and high long-term recurrence rate. Studies have shown that endoscopic internal drainage must meet the distance between the cyst and the intestinal wall or stomach wall is less than 1 cm.<sup>[20]</sup> Felix et al<sup>[11]</sup> retrospectively analyze 51 patients who underwent endoscopic drainage for PPC, long-term follow-up showed a quarter of the patients developed recurrent PPC. In general, endoscopically assisted PPC has an obvious advantage and has been regarded as the first choice for the treatment of PPC. However, before the selection, the optimal treatment plan should be customized according to the specific condition of the patient.

In 1937, some scholars first proposed the fistulojejunostomy procedure for treat PPC. Including a tract formed by fibrous tissue around the drainage tube and the small intestine.<sup>[21]</sup> Pancreaticojejunostomy and pancreaticogastric anastomosis are also described. Murage et al<sup>[22]</sup> evaluating 76 patients who underwent either distal pancreatectomy (DP) or internal drainage procedures including RCJ. Although the short-term cure rate of DP surgery is relatively high, compared with RCJ, its operation time increased by an average of 1 hour, intraoperative estimated bleeding was about 3 times than RCJ, and postoperative blood glucose levels deteriorated severely. Therefore, DP is often regarded as a treatment option after failure of internal drainage. In our study, a total of 6 recurrence patients underwent DP due to recurrence of pseudocyst with pancreatic portal hypertension. In the long-term efficacy of treatment of PPC, especially for the protection of pancreatic endocrine function, internal drainage appears to be more meaningful. Vikrom et al<sup>[23]</sup> had reached a similar conclusion. Pearson et al<sup>[6]</sup> reported a series of 7 patients undergoing RCJ with no evidence of recurrent pancreatitis or exocrine insufficiency, though half the cohort required antidiabetic medications for endocrine insufficiency. It may be mainly because SAP causes necrosis of pancreatic tissue, which in turn leads to impaired pancreatic endocrine and exocrine function. About 20% of patients in this study have the situation above, which is much lower than the distal pancreatectomy.<sup>[23]</sup> Moreover, our research shows that there is no difference in the effects of the 2 internal drainage methods on pancreatic endocrine and exocrine function.

This study showed that there were no significant differences in recurrence rates, reoperation rates. And the cure rate of the 2 groups was as following: for CG 92.5% and for RCJ 87.6%. It is basically consistent with past literature reports.<sup>[22]</sup> But on the contrary, the overall complication rate of RCJ was higher than CG group. Regression analysis showed that the incidence of complications was negatively correlated with the length of disease and the size of the cyst. Our experience suggests that drainage of pancreatic pseudocysts within a short period of time may result in recurrence or complications, due to immature pancreatic necrosis, pancreatic fistula, and instability of the cystic wall. Comparing with RCJ, CG has a larger gastric drainage opening, which can remove necrotic tissue better and place the gastric tube in the cyst to achieve a better drainage. Moreover, gastric acid action on the capsule wall is beneficial to hemostasis and inhibition of pancreatic secretion; CG can also be placed in the cyst cavity through a gastric tube for adequate drainage. On the

other hand, RCJ has 2 anastomoses, and the risk of related complications is also increased. Of course, there are many other factors that may influence the results, such as the etiology of PPC. PPC caused by chronic pancreatitis is easy to relapse, It may be associated with chronic fibrosis of the main or branch pancreatic duct and continuous abnormal drainage of pancreatic fluid.<sup>[24]</sup> The PPC caused by pancreatic surgery was relatively clear and contained little necrotic tissue. The severity of pancreatitis may also affect the prognosis of PPC, but we didn't compare this in our study. Similarly, different types of PPC may also affect the treatment mode and efficacy of PPC. Gang Pan et al<sup>[3]</sup> developed a new classification system for pancreatic pseudocysts based on the anatomical location and clinical manifestations of the pseudocyst as well as the relationship between the pseudocyst and the pancreatic duct. This classification system can guide the selection of optimal treatment for a pancreatic pseudocyst.

The other shortcoming of this study is there is no clear standard in the choice of patient's surgical approach, which is determined by the surgeon. Moreover, it is a single-center study, and there may be selection bias in patient inclusion. The surgeon's experience plays a large role in the choice of surgical approach. This study is a retrospective study, some factors may be subjective. Further research is needed to determine whether additional clinical or imaging predictive features can be used to identify subsets of patients, who may benefit from 1 procedure over the other. And explore the best time for surgical intervention in PPC.

## 5. Conclusions

We retrospectively analyzed data on internal drainage in a single center PPC patient, the results showed that both CG and RCJ are safe and effective in the treatment of PPC. There was no significant difference in cure rate, reoperation rate, and mortality between CG and RCJ. The operative time, estimated intraoperative blood loss, install the number of drainage tubes and total expenses in CG group was lower than that in RCJ group. Number of episodes of SAP ( $\geq 2$ ) is an independent risk factor for the recurrence of PPC. Short course of pancreatitis and RCJ were independent risk factors for complications after PPC. Therefore, we recommend that when treat PPC clinically, try to treat it conservatively for a longer period of time. When surgical intervention is needed, CG is the first choice.

## Author contributions

**Data curation:** Jun Ye, Shan Lu, Dujiang Yang.

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