**Name of Journal:** *World Journal of Gastrointestinal Surgery*

**Manuscript NO:** 65067

**Manuscript Type:** ORIGINAL ARTICLE

***Retrospective Study***

**Choice of operative method for pancreaticojejunostomy and a multivariable study of pancreatic leakage in pancreaticoduodenectomy**

Liang H *et al*. Operative method for pancreaticojejunostomy

Hui Liang, Jian-Guo Wu, Fei Wang, Bo-Xuan Chen, Shi-Tian Zou, Cong Wang, Shuai-Wu Luo

**Hui Liang, Fei Wang, Bo-Xuan Chen, Shi-Tian Zou, Cong Wang, Shuai-Wu Luo,** Department of Hepatobiliary and Pancreas, The Second Affiliated Hospital of Nanchang University, Nanchang 330006, Jiangxi Province, China

**Jian-Guo Wu,** Department of Nuclear Medicine, The Second Affiliated Hospital of Nanchang University, Nanchang 330006, Jiangxi Province, China

**Author contributions:** Liang H and Wu JG design the experiment; Wang F drafted the work; Chen BX and Zou ST collected the data; Wang C analyzed and interpreted data, Liang H and Luo SW wrote the article.

**Supported by** Scientific Research Programme for Health Commission of Jiangxi Province, No. 20204269.

**Corresponding author: Jian-Guo Wu, PhD, Chief Doctor,** Department of Nuclear Medicine, The Second Affiliated Hospital of Nanchang University, No. 1 Minde Road, Donghu District, Nanchang 330006, Jiangxi Province, China. grantwu2021@163.com

**Received:** April 6, 2021

**Revised:** July 3, 2021

**Accepted:** July 21, 2021

**Published online:**

**Abstract**

BACKGROUND

As one of the major abdominal operations, pancreaticoduodenectomy (PD) involves many organs. Its operation is complex, and the scope of operation is large, which can cause great trauma in patients. The operation has a high rate of complications. Pancreatic leakage is the main complication after PD. When pancreatic leakage occurs after PD, it can often lead to abdominal bleeding and infection, threatening the lives of patients. One study found that pancreatic leakage was affected by many factors; among which, the choice of pancreaticojejunostomy method was the one that could be well controlled.

AIM

To investigate the choice of operative methods for pancreaticojejunostomy and to conduct a multivariate study of pancreatic leakage in PD.

METHODS

A total of 420 patients undergoing PD in our hospital from January 2014 to March 2019 were enrolled and divided into group A (*n* = 198) and group B (*n* = 222) according to the pancreatointestinal anastomosis method adopted during the operation. Duct-to-mucosa pancreatojejunostomy was performed in group A and bundled pancreaticojejunostomy was performed in group B. The operation time, intraoperative blood loss, and pancreatic leakage of the two groups were assessed. The occurrence of pancreatic leakage after the operation in different patients was analyzed.

RESULTS

The differences in operative time and intraoperative bleeding between groups A and B were not significant (*P* > 0.05). In group A, the time of pancreatojejunostomy was 26.03 ± 4.40 min and pancreatic duct diameter was 3.90 ± 1.10 mm. These measurements were significantly higher than those in group B (*P* < 0.05). The differences in the occurrence rates of pancreatic leakage, abdominal infection, abdominal hemorrhage and gastric retention between group A and group B were not significant (*P* > 0.05). The occurrence rates of pancreatic leakage in patients with preoperative albumin < 30 g/L, preoperative jaundice time ≥ 8 wk, and pancreatic duct diameter < 3 mm, were 23.33%, 33.96%, and 19.01%, respectively. These were significantly higher than those in patients with preoperative albumin ≥ 30 g/L, preoperative jaundice time < 8 wk, and pancreatic duct diameter ≥ 3 cm (*P* < 0.05). Logistic regression analysis showed that preoperative albumin < 30 g/L, preoperative jaundice time ≥ 8 wk, and pancreatic duct diameter < 3 mm were risk factors for pancreatic leakage after PD operation (Odds ratio = 2.038, 2.416 and 2.670, *P* < 0.05).

CONCLUSION

The pancreatointestinal anastomosis method during the PD operation has no significant effect on the occurrence of pancreatic leakage: the main risk factors include preoperative albumin, preoperative jaundice time, and pancreatic duct diameter.

**Key Words:** Pancreatoduodenectomy; Pancreatojejunostomy; Choice of operative methods; Pancreatic leakage; Multivariate analysis

Liang H, Wu JG, Wang F, Chen BX, Zou ST, Wang C, Luo SW. Choice of operative method for pancreaticojejunostomy and a multivariable study of pancreatic leakage in pancreaticoduodenectomy. *World J Gastrointest Surg* 2021; In press

**Core Tip:** Through retrospective studies, it was confirmed that the type of pancreaticojejunostomy during pancreaticoduodenectomy operation had no significant effect on the occurrence of postoperative pancreatic leakage. The main risk factors for its occurrence include preoperative albumin, preoperative jaundice time and pancreatic duct diameter.

**INTRODUCTION**

As one of the major abdominal operations, pancreaticoduodenectomy (PD) involves many organs. Its operation is complex, and the scope of operation is large, which can cause great trauma in patients. The operation has a high rate of complications. Pancreatic leakage is the main complication after PD[1-5]. When pancreatic leakage occurs after PD, it can often lead to abdominal bleeding and infection, threatening the lives of patients. One study found that pancreatic leakage was affected by many factors; among which, the choice of pancreaticojejunostomy method was the one that could be well controlled. Due to the differences in the specific operation mechanism of the two commonly used anastomosis methods after PD, duct-to-mucosa pancreatojejunostomy and bundled pancreaticojejunostomy, and the individual differences among patients, not all patients can adopt pancreaticojejunostomy. However, each method has advantages and disadvantages. There are still some differences regarding the type of pancreaticojejunostomy that is more favorable to patients[6]. Therefore, in this study, the curative effect of duct-to-mucosa pancreaticojejunostomy and binding pancreaticojejunostomy in PD was reviewed. Multiple factors of postoperative pancreatic leakage were analyzed.

**MATERIALS AND METHODS**

***Patients***

A total of 420 patients undergoing PD in our hospital between January 2014 and March 2019 were selected. The inclusion criteria were as follows: (1) American Association of Anesthesiologists classification I–II; (2) age > 18 years; and (3) complete preservation of clinical variables. The exclusion criteria were abnormal coagulation function, blood system diseases, immune system diseases, and other basic diseases. These patients were divided into group A (*n* = 198) and group B (*n* = 222) according to the pancreatointestinal anastomosis method adopted during the operation. There was no significant difference in the general material between groups A and B (*P* > 0.05, Table 1).

***Operation method***

In PD, the reconstruction of the digestive tract was in the order of pancreaticojejunostomy, choledochojejunostomy, and gastrojejunostomy to conduct Roux-Y anastomosis. Duct-to-mucosa pancreatojejunostomy was performed in group A. First, we sewed up the jejunal seromuscular layer intermittently with the pancreatic tissue at the posterior edge of the pancreatic section. We cut a small hole in the jejunal wall corresponding to the pancreatic duct, then the posterior wall of the jejunum was sutured intermittently with the entire jejunum with three needles, and a silicone tube was inserted into the jejunum and beyond the bilioenterostomy. Next, the anterior wall of the pancreatic duct and the whole jejunum were sewn up intermittently using three needles so that the pancreatic duct was put into the jejunal mucosa as far as possible. We then sutured the anterior tissue of the pancreatic section and the jejunal seromuscular layer intermittently. If necessary, the jejunal seromuscular layer and pancreatic capsule were intermittently embedded and sutured.

Bundled pancreaticojejunostomy was performed in group B. A multifunctional surgical dissector was used to cut the pancreas at the neck of the pancreas, and scrape suction was used to break the pancreas. The jejunum was cut off near the terminal jejunal artery. The jejunum was turned over to 3 o’clock, so that the mucosal surface of the jejunum was outward. After that, we closed the pancreas and intestinal stump and sutured the two sides with silk thread as a single layer. The posterior lip was sutured first, and then the anterior lip was sutured. The two loose temporary ligation knots were cut off and the mucosal surface was destroyed. The jejunum was returned to its original position. A number 0 absorbable suture was passed through the mesenteric puncture hole between the two groups of blood vessels near the broken end of the jejunum to ligate around the jejunum so that the jejunum and pancreas were closely attached. The tightness of ligation was such that the ligation coil could just extend into the small vascular clamp end.

***Data collection***

The operative time, anastomotic time, intraoperative bleeding loss, and pancreatic duct diameter were compared between the two groups. The occurrence rates of pancreatic leakage, abdominal infection, abdominal hemorrhage, and gastric retention were recorded. The preoperative albumin, preoperative jaundice time, pancreatic duct diameter, and other important clinical variables were analyzed and compared.

***Statistical analysis***

SPSS 22.0 software was used for material statistics. The measurement data are expressed as mean ± SD. The differences between these two groups were compared by independent sample *t*-tests. Categorical variables are expressed as frequency or percentage, and the comparison between the two groups was performed using the χ2test. Multivariate analysis adopted the logistic regression analysis, where a = 0.05 was the test level.

**RESULTS**

***Comparison of operation time and anastomosis time between group A and group B***

The differences in operative time and intraoperative bleeding between groups A and B were not significant (*P* > 0.05). The time of pancreatojejunostomy and pancreatic duct diameter in group A were significantly higher than those in group B (*P* < 0.05, Table 2 and Figure 1).

***Comparison of pancreatic leakage and other complications between group A and group B***

The differences in the occurrence rates of pancreatic leakage, abdominal infection, abdominal hemorrhage, and gastric retention between groups A and B were not significant (*P* > 0.05, Table 3).

***Relationship between postoperative pancreatic leakage and clinical indicators***

The occurrence rates of pancreatic leakage in patients with preoperative albumin < 30 g/L, preoperative jaundice time ≥ 8 wk, and pancreatic duct diameter < 3 mm were significantly higher than those in patients with preoperative albumin ≥ 30 g/L, preoperative jaundice time < 8 wk, and pancreatic duct diameter ≥ 3 cm (*P* < 0.05, Table 4).

***Multivariate analysis***

Logistic regression analysis showed that preoperative albumin < 30 g/L, preoperative jaundice time ≥ 8 wk, and pancreatic duct diameter < 3 mm were risk factors for pancreatic leakage after PD operation (Odds ratio = 2.038, 2.416, and 2.670, P < 0.05, Table 5).

**DISCUSSION**

The anatomical structures adjacent to the pancreas are relatively important; therefore, PD is a highly complex operation that involves many organs. The procedure can cause great damage to the body, and the morbidity and mortality associated with postoperative complications are high[7]. Pancreatic leakage is the most dangerous complication of PD[8]. Preventing pancreatic leakage is key to the success of the operation, specifically with regard to the selection of the procedure to use for pancreaticojejunal anastomosis[9]. Previous study[10] found that different anastomosis methods have differences in their effects on different patients. Therefore, clinical recommendations should be made according to the patient's condition, the surgical characteristics, and the selection of the appropriate pancreaticointestinal anastomosis method to improve the surgical effect.

Duct-to-mucosa pancreaticojejunostomy and bundled pancreaticojejunostomy are the most common procedures performed in PD. The results showed that there was no significant difference in operation time and intraoperative blood loss between groups A and B, but the pancreaticojejunostomy duration and pancreatic duct diameter in group A were significantly larger than those in group B. These results indicate that pancreaticojejunal mucosal anastomosis is slow and is mostly used for patients with larger pancreatic duct diameters. Pancreaticojejunostomy can ensure the continuity and patency of the jejunal mucosa and pancreatic duct, thus better maintaining the exocrine function of the pancreas and the patency of the anastomosis. Burying the pancreatic stump under the jejunal serosa can effectively protect the anastomosis and reduce bleeding caused by pancreatic juice eroding the pancreatic stump. However, the operation is relatively difficult, the technical requirements of the anastomosis are high, and they are mostly suitable for patients with large-diameter pancreatic ducts[11,12]. Bundled pancreaticojejunostomy can be used to avoid pinhole indwelling by ensuring the sealing of anastomosis *via* binding instead of sewing, thus reducing the incidence of pancreatic leakage. However, previous studies[13,14] have indicated that this method is not suitable for patients in whom the pancreatic stump is too thick, which must be addressed with certain surgical requirements.

Through further study, no significant difference in the occurrence rate of pancreatic leakage, abdominal infection, intraperitoneal hemorrhage, and gastric retention between groups A and B was found. These results indicate that the rates of pancreatic leakage and other complications after duct-to-mucosa pancreaticojejunostomy and bundled pancreaticojejunostomy were similar. At present, there is no consensus on which specific operation is best for digestive tract reconstruction in PD. Therefore, surgeons need to understand the specific indications for different anastomosis methods. With the development of clinical technology, more ideal pancreatic stump management methods are expected to be explored through large sample and prospective studies to reduce the rate of postoperative pancreatic leakage and improve the safety of the operation.

Analysis of the relationship between postoperative pancreatic leakage and clinical indicators showed that the rate of postoperative pancreatic leakage in patients with preoperative albumin < 30 g/L, preoperative jaundice duration ≥ 8 wk, and pancreatic duct diameter < 3 cm were significantly higher than those before the operation. Logistic regression showed that preoperative albumin < 30 g/L, preoperative jaundice duration ≥ 8 wk, and pancreatic duct diameter < 3 cm were risk factors for pancreatic leakage in patients with PD. These results indicate that preoperative albumin level, preoperative jaundice duration, and pancreatic duct diameter are the main risk factors for pancreatic leakage after PD. Therefore, patients with abnormal preoperative bilirubin and albumin levels and a long duration of jaundice need to be given special attention before the operation and should receive good perioperative support treatment to reduce the rate of postoperative pancreatic leakage. Pancreatic leakage is not only related to surgical and pancreatic factors but is also closely related to the basic state of the patient during the perioperative period. As the duration of jaundice increases, the decreased liver function of patients is gradually aggravated. Related studies[15-17] indicated that vitamin K1 could be used to improve coagulation function and jaundice symptoms, but the absorption of toxins in the body could lead to damage to multiple organs and the liver, inducing pancreatic leakage. Perioperative hypoproteinemia is another main cause of abdominal infection, wound infection, and pancreatic leakage. Patients with relatively poor nutritional status require timely supplementation with albumin and nutrients. A good visual field and pancreatic duct exposure are important factors for ensuring a successful pancreaticoenteric anastomosis; therefore, a large diameter is needed to suture the pancreaticoenteric anastomosis, which should then be left in place. The pinhole is an important cause of pancreatic leakage and requires special attention[18-20].

**CONCLUSION**

In summary, intraoperative pancreaticojejunostomy in PD had no significant effect on postoperative pancreatic leakage. The main risk factors for pancreatic leakage included preoperative albumin, preoperative jaundice time and pancreatic duct diameter.

**ARTICLE HIGHLIGHTS**

***Research background***

The pancreaticoduodenectomy (PD) involves many organs, and its operation is complex and the scope of operation is large. The operation can cause great trauma in patients and has a high rate of complications. Pancreatic leakage is the main complication after PD.

***Research motivation***

This study discussed the selection of surgical methods for pancreaticojejunostomy and pancreatic leakage during PD.

***Research objectives***

This study aimed to investigate the choice of operative methods for pancreaticojejunostomy and multivariate study of pancreatic leakage in PD.

***Research methods***

A total of 420 patients undergoing PD operation were selected and divided into group A and group B according to the pancreatointestinal anastomosis method adopted during the operation. Duct-to-mucosa pancreatojejunostomy was performed in group A and bundled pancreaticojejunostomy was performed in group B. The operation time, intraoperative blood loss, and pancreatic leakage of the two groups were observed, and the occurrence of pancreatic leakage after the operation in different patients was analyzed.

***Research results***

The differences in operative time and intraoperative bleeding between groups A and B were not significant. In group A, the time of pancreatojejunostomy was 26.03 ± 4.40 min and the pancreatic duct diameter was 3.90 ± 1.10 mm. These measurements were significantly higher than those in group B. The differences in the occurrence rates of pancreatic leakage, abdominal infection, abdominal hemorrhage, and gastric retention between group A and group B were not significant. The occurrence rates of pancreatic leakage in patients with preoperative albumin < 30 g/L, preoperative jaundice time ≥ 8 wk, and pancreatic duct diameters < 3 mm were 23.33%, 33.96%, and 19.01%, respectively.

***Research conclusions***

The pancreatointestinal anastomosis method during the PD operation has no significant effect on the occurrence of pancreatic leakage. The main risk factors include preoperative albumin, preoperative jaundice time, and pancreatic duct diameter.

***Research perspectives***

Choose a more advantageous surgical method for pancreaticojejunostomy.

**REFERENCES**

1 **de Medeiros FS**, Junior ESDM, França RL, Neto HCM, Santos JM, Júnior EAA, Júnior SODS, Tavares MHSMP, de Moura EGH. Preemptive endoluminal vacuum therapy after pancreaticoduodenectomy: A case report. *World J Gastrointest Endosc* 2020; **12**: 493-499 [PMID: 33269058 DOI: 10.4253/wjge.v12.i11.493]

2 **Qureshi S**, Ghazanfar S, Quraishy MS, Rana R. Stented Pancreatico-duodenectomy: Does it lead to decreased pancreatic fistula rates? A prospective randomized study. *J Pak Med Assoc* 2018; **68**: 348-352 [PMID: 29540866]

3 **La Greca G**, Primo S, Sofia M, Lombardo R, Puleo S, Russello D, Di Cataldo A. Combination of fibrin glue protection with microsurgical technique for duct-to-mucosa pancreatico-jejunostomy reduces the incidence of leakages after pancreaticoduodenectomy. *Ann Ital Chir* 2014; **85**: 490-494 [PMID: 25402971]

4 **Cirocchi R**, Partelli S, Castellani E, Renzi C, Parisi A, Noya G, Falconi M. Right hemicolectomy plus pancreaticoduodenectomy *vs* partial duodenectomy in treatment of locally advanced right colon cancer invading pancreas and/or only duodenum. *Surg Oncol* 2014; **23**: 92-98 [PMID: 24726745 DOI: 10.1016/j.suronc.2014.03.003]

5 **Choe YM**, Lee KY, Oh CA, Lee JB, Choi SK, Hur YS, Kim SJ, Cho YU, Ahn SI, Hong KC, Shin SH, Kim KR. Risk factors affecting pancreatic fistulas after pancreaticoduodenectomy. *World J Gastroenterol* 2008; **14**: 6970-6974 [PMID: 19058333 DOI: 10.3748/wjg.14.6970]

6 **Song Y**, Tieniber AD, Vollmer CM, Lee MK, Roses RE, Fraker DL, Kelz RR, Karakousis GC. Predictors and outcomes of jejunostomy tube placement at the time of pancreatoduodenectomy. *Surgery* 2019; **165**: 1136-1143 [PMID: 31076092 DOI: 10.1016/j.surg.2019.03.007]

7 **Zhang W**, Huang Z, Zhang J, Che X. Safety and effectiveness of open pancreaticoduodenectomy in adults aged 70 or older: A meta-analysis. *J Geriatr Oncol* 2021 [PMID: 33610506 DOI: 10.1016/j.jgo.2021.02.004]

8 **Tuech JJ**, Pessaux P, Duplessis R, Villapadierna F, Ronceray J, Arnaud JP. [Pancreatojejunal or pancreatogastric anastomosis after cephalic duodenopancreatectomy. A comparative retrospective study]. *Chirurgie* 1998; **123**: 450-455 [PMID: 9882913 DOI: 10.1016/s0001-4001(99)80071-3]

9 **Zhang W**, Huang Z, Zhang J, Che X. Safety and efficacy of robot-assisted versus open pancreaticoduodenectomy: a meta-analysis of multiple worldwide centers. *Updates Surg* 2021; **73**: 893-907 [PMID: 33159662 DOI: 10.1007/s13304-020-00912-5]

10 **Smits FJ**, van Santvoort HC, Besselink MG, Boerma D, Busch OR, van Dam RM, van Eijck CH, Festen S, van der Harst E, de Hingh IH, de Jong KP, Borel Rinkes IH, Molenaar IQ; Dutch Pancreatic Cancer Group. Predicting Successful Catheter Drainage in Patients With Pancreatic Fistula After Pancreatoduodenectomy. *Pancreas* 2019; **48**: 811-816 [PMID: 31210662 DOI: 10.1097/MPA.0000000000001334]

11 **Yang H**, Ren Y, Yu Z, Zhou H, Zhang S, Luo C, Jiao Z. Pancreatic fistula after pancreatoduodenectomy due to compression of the superior mesenteric vessels: a case report. *BMC Surg* 2020; **20**: 170 [PMID: 32723381 DOI: 10.1186/s12893-020-00828-2]

12 **Jester AL**, Chung CW, Becerra DC, Molly Kilbane E, House MG, Zyromski NJ, Max Schmidt C, Nakeeb A, Ceppa EP. The Impact of Hepaticojejunostomy Leaks After Pancreatoduodenectomy: a Devastating Source of Morbidity and Mortality. *J Gastrointest Surg* 2017; **21**: 1017-1024 [PMID: 28342120 DOI: 10.1007/s11605-017-3406-1]

13 **Ishiwatari H**, Sato J, Kaneko J. Hepaticojejunostomy for the right hepatic bile duct using a forward-viewing echoendoscope in a patient after pancreatoduodenectomy. *Dig Endosc* 2019; **31**: e82-e83 [PMID: 30972863 DOI: 10.1111/den.13390]

14 **Khan AS**, Williams G, Woolsey C, Liu J, Fields RC, Doyle MMB, Hawkins WG, Strasberg SM. Flange Gastroenterostomy Results in Reduction in Delayed Gastric Emptying after Standard Pancreaticoduodenectomy: A Prospective Cohort Study. *J Am Coll Surg* 2017; **225**: 498-507 [PMID: 28687510 DOI: 10.1016/j.jamcollsurg.2017.06.006]

15 **Yang JR**, Xiao R, Zhou J, Wang L, Wang JX, Zhang Q, Niu JX, Wang ZF, Yang RF, Ren JJ. Establishment of a Canine Training Model for Digestive Tract Reconstruction after Pancreaticoduodenectomy. *J Invest Surg* 2019: 1-8 [PMID: 31588822 DOI: 10.1080/08941939.2019.1663376]

16 **Kang JS**, Han Y, Kim H, Kwon W, Kim SW, Jang JY. Prevention of pancreatic fistula using polyethylene glycolic acid mesh reinforcement around pancreatojejunostomy: the propensity score-matched analysis. *J Hepatobiliary Pancreat Sci* 2017; **24**: 169-175 [PMID: 28054751 DOI: 10.1002/jhbp.428]

17 **Li Y**, Liu XM, Zhang HK, Zhang XF, Tang B, Ma F, Lv Y. Magnetic Compression Anastomosis in Laparoscopic Pancreatoduodenectomy: A Preliminary Study. *J Surg Res* 2021; **258**: 162-169 [PMID: 33011447 DOI: 10.1016/j.jss.2020.08.044]

18 **Morelli L**, Di Franco G, Guadagni S, Palmeri M, Furbetta N, Gianardi D, Del Chiaro M, Di Candio G, Mosca F. Technical Details and Results of a Modified End-to-Side Technique of Pancreatojejunostomy: a Personal Series of 100 Patients. *J Gastrointest Surg* 2017; **21**: 2090-2099 [PMID: 28936588 DOI: 10.1007/s11605-017-3587-7]

19 **Hayama S**, Senmaru N, Hirano S. Delayed gastric emptying after pancreatoduodenectomy: comparison between invaginated pancreatogastrostomy and pancreatojejunostomy. *BMC Surg* 2020; **20**: 60 [PMID: 32245470 DOI: 10.1186/s12893-020-00707-w]

20 **Pedrazzoli S**. Pancreatoduodenectomy (PD) and postoperative pancreatic fistula (POPF): A systematic review and analysis of the POPF-related mortality rate in 60,739 patients retrieved from the English literature published between 1990 and 2015. *Medicine (Baltimore)* 2017; **96**: e6858 [PMID: 28489778 DOI: 10.1097/MD.0000000000006858]

**Footnotes**

**Institutional review board statement:** Approved by the Second Affiliated Hospital of Nanchang University Ethics Committee.

**Informed consent statement:** All study participants, or their legal guardian, provided informed written consent prior to study enrollment.

**Conflict-of-interest statement:** No conflict of interest.

**Data sharing statement:** No additional data are available.

**Open-Access:** This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: http://creativecommons.org/Licenses/by-nc/4.0/

**Manuscript source:** Unsolicited manuscript

**Peer-review started:** April 6, 2021

**First decision:** May 13, 2021

**Article in press:**

**Specialty type:** Gastroenterology and hepatology

**Country/Territory of origin:** China

**Peer-review report’s scientific quality classification**

Grade A (Excellent): 0

Grade B (Very good): B

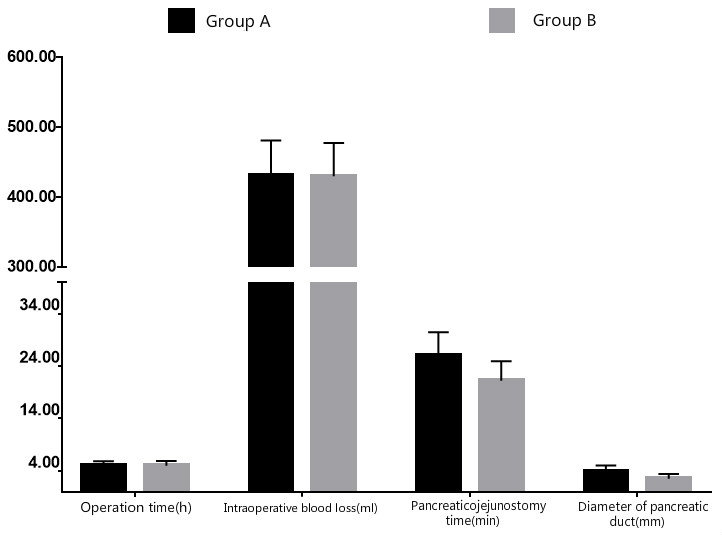
Grade C (Good): C

Grade D (Fair): 0

Grade E (Poor): 0

**P-Reviewer:** Fukuta M, Honda M **S-Editor:** Wang JL **L-Editor: P-Editor:**

**Figure Legends**



**Figure 1 Comparison of operation time and anastomosis time between group A and group B.**

**Table 1 Comparison of general material between group A and group B**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Group** | **Cases** | **Male/female** | **Age (yr)** | **Albumin(g/L)** | **Hemoglobin (g/L)** | **Disease types** | | | |
| **Carcinoma of head of pancreas** | **Carcinoma of ampulla** | **Carcinoma of lower common bile duct** | **Duodenal carcinoma** |
| A group | 198 | 110/88 | 60.33 ± 9.82 | 36.70 ± 4.40 | 110.02 ± 10.43 | 93 (46.97) | 52 (26.26) | 31 (15.66) | 22 (11.11) |
| B group | 222 | 132/90 | 59.81 ± 10.11 | 36.12 ± 5.53 | 109.82 ± 12.21 | 108 (48.65) | 72 (32.43) | 29 (13.06) | 13 (5.86) |
| *t*/*χ*2 |  | 0.653 | 0.533 | 1.180 | 0.179 | 5.372 | | | |
| *P* value |  | 0.419 | 0.594 | 0.239 | 0.858 | 0.146 | | | |

**Table 2 Comparison of operation time and anastomosis time between group A and group B**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **cases** | **Operation time (h)** | **Intraoperative blood loss (mL)** | **Pancreaticojejunostomy time (min)** | **Diameter of pancreatic duct (mm)** |
| A group | 198 | 5.02 ± 0.82 | 430.40 ± 50.03 | 26.03 ± 4.40 | 3.90 ± 1.10 |
| B group | 222 | 4.97 ± 0.90 | 429.28 ± 47.74 | 21.19 ± 3.77 | 2.50 ± 0.88 |
| *t* |  | 0.593 | 0.235 | 12.139 | 14.470 |
| *P* value |  | 0.554 | 0.815 | 0.000 | 0.000 |

**Table 3 Comparison of pancreatic leakage and other complications between group A and group B, *n* (%)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Cases** | **Pancreatic leakage** | **Abdominal infection** | **Abdominal hemorrhage** | **Gastric retention** |
| A group | 198 | 14 (7.07) | 8 (4.04) | 7 (3.54) | 7 (3.54) |
| B group | 222 | 21 (9.46) | 10 (4.50) | 9 (4.05) | 8 (3.60) |
| *χ*2 |  | 0.782 | 0.055 | 0.077 | 0.001 |
| *P* value |  | 0.377 | 0.815 | 0.782 | 0.970 |

**Table 4 Relationship between postoperative pancreatic leakage and clinical indicators, *n* (%)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Index** | **Cases** | **Postoperative pancreatic leakage** | ***χ*2** | ***P* value** |
| Age (yr) |  |  | 0.072 | 0.789 |
| ≤ 60 | 243 | 21 (8.64) |  |  |
| > 60 | 177 | 14 (7.91) |  |  |
| Sex |  |  | 0.004 | 0.953 |
| Male | 242 | 20 (8.26) |  |  |
| Female | 178 | 15 (8.43) |  |  |
| Diabetes |  |  | 0.153 | 0.696 |
| Yes | 120 | 11 (9.17) |  |  |
| No | 300 | 24 (8.00) |  |  |
| Hypertension |  |  | 0.089 | 0.766 |
| Yes | 178 | 14 (7.87) |  |  |
| No | 242 | 21 (8.68) |  |  |
| Preoperative albumin |  |  | 33.739 | 0.000 |
| < 30 g/L | 90 | 21 (23.33) |  |  |
| ≥ 30 g/L | 330 | 14 (4.24) |  |  |
| Preoperative jaundice time |  |  | 52.154 | 0.000 |
| < 8 wk | 367 | 17 (4.63) |  |  |
| ≥ 8 wk | 53 | 18 (33.96) |  |  |
| Operation time |  |  | 0.022 | 0.883 |
| < 4 h | 209 | 17 (8.13) |  |  |
| ≥ 4 h | 211 | 18 (8.53) |  |  |
| Intraoperative blood loss |  |  | 0.087 | 0.768 |
| < 430 mL | 230 | 20 (8.70) |  |  |
| ≥ 430 mL | 190 | 15 (7.89) |  |  |
| Vascular resection and reconstruction |  |  | 0.000 | 1.000 |
| Yes | 60 | 5 (8.33) |  |  |
| No | 360 | 30 (8.33) |  |  |
| Pancreatic texture |  |  | 0.022 | 0.883 |
| Soft | 221 | 18 (8.14) |  |  |
| Hard | 199 | 17 (8.54) |  |  |
| Diameter of pancreatic duct |  |  | 25.355 | 0.000 |
| < 3 mm | 121 | 23 (19.01) |  |  |
| ≥ 3 mm | 299 | 12 (4.01) |  |  |
| Pancreaticojejunostomy time |  |  | 0.305 | 0.580 |
| < 30 min | 320 | 28 (8.75) |  |  |
| ≥ 30 min | 100 | 7 (7.00) |  |  |
| Pancreatic duct indwelling support tube |  |  | 0.162 | 0.687 |
| Yes | 335 | 27 (8.06) |  |  |
| No | 85 | 8 (9.41) |  |  |
| Disease types |  |  | 0.018 | 0.999 |
| Carcinoma of head of pancreas | 201 | 17 (8.46) |  |  |
| Carcinoma of ampulla | 124 | 10 (8.06) |  |  |
| Carcinoma of lower common bile duct | 60 | 5 (8.33) |  |  |
| Duodenal carcinoma | 35 | 3 (8.57) |  |  |

**Table 5 Multivariate analysis**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Factor** | **β** | **SE** | **Walds** | ***P* value** | **Odds ratio (95%CI)** |
| Preoperative albumin < 30 g/L | 0.712 | 0.202 | 12.424 | 0.000 | 2.038 (1.372-3.028) |
| Preoperative jaundice time ≥ 8 wk | 0.882 | 0.329 | 7.187 | 0.000 | 2.416 (1.268-4.604) |
| Diameter of pancreatic duct < 3 mm | 0.982 | 0.311 | 9.970 | 0.000 | 2.670 (1.451-4.911) |