

Featured Article

Effect of preoperative biliary drainage on pancreaticoduodenectomy in patients with low-level malignant obstructive jaundice

Yu Jing, Peng Yong*

Department of Hepatobiliary Surgery, Nanchong Central Hospital, Anzhen Road, Gaoping District, Nanchong 637000, Sichuan Province, China

* Corresponding author: Peng Yong, 1367094653@qq.com

CITATION

Jing Y, Yong P. Effect of preoperative biliary drainage on pancreaticoduodenectomy in patients with low-level malignant obstructive jaundice. *Psycho-Oncologie*. 2025; *Psycho-Oncology Research in China*: 4586.

ARTICLE INFO

Received:

Accepted:

Available online:

COPYRIGHT



Copyright © 2025 by author(s).

Psycho-Oncologie is published by PiscoMed Publishing Pte. Ltd. This work is licensed under the Creative Commons Attribution (CC BY) license.

<https://creativecommons.org/licenses/by/4.0/>

Abstract: Objective: To investigate the effect of preoperative biliary drainage (PBD) on outcomes of pancreaticoduodenectomy (PD) in patients with low-level malignant obstructive jaundice. **Methods:** A retrospective analysis was conducted on patients who underwent PD due to low-level malignant obstructive jaundice at the Affiliated Hospital of North Sichuan Medical College and Nanchong Central Hospital between 1 January 2021, and 30 August 2024. Eligible patients had total serum bilirubin levels $\geq 171 \mu\text{mol/L}$ at the time of admission. Based on whether PBD was performed prior to surgery, patients were categorized into the PBD group and the direct surgery group. In the PBD group, clinical indicators before drainage (at admission) and after drainage (preoperatively) were compared to assess the effectiveness of jaundice reduction. Perioperative outcomes were compared between the two groups. Additionally, Kaplan–Meier survival analysis was used to evaluate the effect of PBD on perioperative outcomes and postoperative survival. **Results:** In the drainage group, significant improvements were observed in total bilirubin, direct bilirubin, alanine aminotransferase (ALT), and aspartate aminotransferase (AST) levels after biliary drainage ($P < 0.05$). There were no significant differences between the two groups in terms of operative time, intraoperative blood loss, postoperative ICU transfer, reoperation rate, length of postoperative hospital stay, incidence of major complications (pancreatic fistula, bile leak, hemorrhage, intra-abdominal infection, delayed gastric emptying), or 30-day mortality (all $P > 0.05$). However, significant differences were found in the total complication rate, preoperative preparation time, and total hospitalization costs (all $P < 0.05$). Postoperative survival did not differ significantly between the two groups ($P > 0.05$). **Conclusion:** Preoperative biliary drainage can effectively improve liver function in patients with low-level malignant obstructive jaundice. It is associated with a reduced overall incidence of postoperative complications following PD. While PBD may have a potential positive impact on postoperative survival, further large-scale studies are warranted to validate these findings.

Keywords: preoperative biliary drainage; obstructive jaundice; pancreaticoduodenectomy; complications

1. Introduction

Pancreaticoduodenectomy (PD) is a well-established surgical procedure primarily used to treat pancreatic head cancer and periampullary carcinoma, which often cause low-level malignant obstructive jaundice. With significant advancements in surgical techniques and perioperative management, the perioperative mortality and complication rates associated with PD have gradually declined. Currently, the perioperative mortality rate is approximately 1–2%, although the overall postoperative complication rate remains high, ranging from 20% to 50%.

Before the mid-1980s, preoperative biliary drainage (PBD) was widely regarded as an effective method to reduce postoperative complications and mortality after PD. However, subsequent studies have raised doubts about the benefits of PBD. Some researchers argue that PBD may actually increase the risk of complications, prolong hospitalization, and increase healthcare costs, thereby challenging its routine use.

To this day, the necessity and efficacy of PBD remain subjects of considerable debate in the academic community. This study retrospectively reviews and analyzes clinical data from patients undergoing PD due to low-level malignant obstructive jaundice at the Affiliated Hospital of North Sichuan Medical College and Nanchong Central Hospital between 1 January 2021, and 30 August 2024, in order to evaluate the pros and cons of PBD.

2. Materials and methods

2.1. General information

Clinical data were collected from patients who underwent pancreaticoduodenectomy (PD) for low-level malignant obstructive jaundice at the Affiliated Hospital of North Sichuan Medical College and Nanchong Central Hospital between 1 January 2021, and 30 August 2024. Eligible patients had total serum bilirubin levels $\geq 171 \mu\text{mol/L}$ at the time of admission. Based on the inclusion and exclusion criteria, a total of 70 patients were enrolled. These patients were divided into two groups based on whether preoperative biliary drainage (PBD) was performed: the PBD group (40 patients) and the direct surgery group (30 patients). This study protocol was approved by the Ethics Committee of Nanchong Central Hospital (Approval No. 2025-002), and all patients provided written informed consent.

2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) Diagnosed with pancreatic head cancer or periampullary carcinoma via imaging studies at admission, confirmed by postoperative pathology; (2) TBIL $\geq 171 \mu\text{mol/L}$ at admission; (3) No distant metastasis on preoperative examination; (4) No contraindications for surgery such as coagulopathy or acute hepatic/renal failure.

Exclusion criteria: (1) Obstructive jaundice not caused by malignancy; (2) Evidence of distant metastasis; (3) Received neoadjuvant chemotherapy or anti-tumor therapy before surgery; (4) Incomplete clinical data.

2.3. Observational indicators

2.3.1. Collected data included

(1) General characteristics: gender, age, comorbidities (diabetes, hypertension, coronary artery disease);

(2) Laboratory indices at admission and before surgery: TBIL, DBIL, AST, ALT, albumin (ALB), international normalized ratio (INR), neutrophil-to-lymphocyte ratio (NLR);

(3) Intraoperative and postoperative indicators: operation time, intraoperative blood loss, complications (pancreatic fistula, bile leak, bleeding, abdominal infection, delayed gastric emptying, SIRS, pneumonia, anastomotic leak, ileus, lymphatic fistula), ICU transfers, reoperations, 30-day mortality, hospital stay, total cost, and follow-up duration and survival status;

(4) Postoperative pathological data: tumor site, size, margin status, and differentiation grade.

2.3.2. Diagnostic criteria for complications

Diagnostic criteria for pancreatic fistula, bile leakage, postoperative hemorrhage, and delayed gastric emptying were based on the recommendations of the International Study Group of Pancreatic Surgery (ISGPS). Other complications were defined according to the 2017 Chinese consensus on the diagnosis and management of common postoperative complications after pancreatic surgery.

(1) Pancreatic fistula: defined as amylase content in abdominal drainage fluid ≥ 3 times the upper normal serum level on or after postoperative day 3, categorized into biochemical leak, grade B, and grade C; (2) Hemorrhage: presence of non-coagulated blood in drainage or gastric decompression fluid, hematemesis, melena, or significant drop in hemoglobin levels; (3) Bile leak: presence of bile-stained drainage fluid for more than 3 days postoperatively with associated symptoms; (4) Delayed gastric emptying: persistent gastric retention >10 days without mechanical obstruction; (5) Intra-abdominal infection: fever, abdominal distension, leukocytosis, hypoproteinemia, and imaging evidence of fluid accumulation or positive culture.

2.4. Treatment methods

PBD included endoscopic biliary stenting, nasobiliary drainage, and percutaneous transhepatic biliary drainage. PD was performed via open or laparoscopic approach depending on patient condition and surgeon expertise.

2.5. Statistical methods

Statistical analysis was performed using SPSS 27.0. For normally distributed data, results were expressed as mean $\pm$ standard deviation (SD) and compared using t-tests. Non-normally distributed data were expressed as median (interquartile range) and compared using the rank-sum test. Ordered categorical variables were analyzed with the rank-sum test; unordered categorical variables were compared using the chi-square test or Fisher's exact test. A P -value < 0.05 was considered statistically significant. Kaplan-Meier method was used for survival analysis between groups.

3. Results

3.1. General clinical characteristics

A total of 70 patients were included in the study, with 30 in the direct surgery group and 40 in the preoperative biliary drainage (PBD) group. There were no statistically significant differences between the two groups in terms of age, sex, comorbidities (hypertension, diabetes, coronary artery disease), preoperative albumin (ALB), international normalized ratio (INR), neutrophil-to-lymphocyte ratio (NLR),

tumor location, tumor differentiation, resection margin status, or tumor size (all $P > 0.05$). However, the PBD group showed significantly lower preoperative levels of total bilirubin (TBIL), direct bilirubin (DBIL), alanine aminotransferase (ALT), and aspartate aminotransferase (AST) compared to the direct surgery group (all $P < 0.05$) (**Table 1**).

Table 1. Baseline characteristics of patients in the direct surgery group and the preoperative biliary drainage group.

Variables	Direct Surgery Group ($n = 30$)	Preoperative Biliary Drainage Group ($n = 40$)	$Z/\chi^2/t$ Value	P Value
Age (years)			$Z = -4.89$	0.625
< 70	24 (80.0%)	30 (75.0%)		
≥ 70	6 (20.0%)	10 (25.0%)		
Sex			$\chi^2 = 0.420$	0.517
Male	18 (60.0%)	27 (67.5%)		
Female	12 (40.0%)	13 (32.5%)		
Hypertension			$\chi^2 = 0.126$	0.723
No	25 (83.3%)	32 (80.0%)		
Yes	5 (16.7%)	8 (20.0%)		
Diabetes mellitus			-	0.511
No	24 (80.0%)	35 (87.5%)		
Yes	6 (20.0%)	5 (12.5%)		
Coronary heart disease			-	1.000
No	28 (93.3%)	38 (95.0%)		
Yes	2 (6.7%)	2 (5.0%)		
TBIL ($\mu\text{mol/L}$)	218.75 (198.53–271.08)	122.40 (92.95–182.18)	$Z = -5.281$	<0.001
DBIL ($\mu\text{mol/L}$)	165.55 (149.38–209.90)	100.00 (76.60–143.53)	$Z = -4.925$	<0.001
AST (U/L)	111.35 (94.48–260.75)	53.50 (39.35–83.50)	$Z = -4.647$	<0.001
ALT (U/L)	173.00 (85.50–345.75)	76.25 (42.98–116.75)	$Z = -3.567$	<0.001
ALB (g/L)	40.05 $\pm$ 4.40	38.16 $\pm$ 3.72	$t = 1.941$	0.056
INR	0.945 (0.89–1.01)	0.950 (0.91–1.02)	$Z = -0.398$	0.691
NLR	3.5313 (3.08–4.89)	3.3782 (2.13–4.73)	$Z = -0.866$	0.386
Tumor location			$\chi^2 = 1.694$	0.638
Pancreas	14 (46.7%)	14 (35.0%)		
Duodenum	3 (10.0%)	8 (20.0%)		
Ampulla	6 (20.0%)	8 (20.0%)		
Common bile duct	7 (23.3%)	10 (25.0%)		
Tumor differentiation			$Z = -0.102$	0.919
Poor	3 (10.0%)	6 (15.0%)		
Moderate	22 (73.3%)	26 (65.0%)		
Well	5 (16.7%)	8 (20.0%)		
Surgical margin			-	0.157
Positive	26 (86.7%)	39 (97.5%)		
Negative	4 (13.3%)	1 (2.5%)		
Tumor size (cm)	2.5 (2.0–3.0)	2.2 (1.5–3.0)	$Z = -1.254$	0.210

Note: All laboratory values including TBIL, DBIL, AST, ALT, ALB, INR, and NLR were collected preoperatively. “-” indicates that specific statistical test values could not be obtained.

3.2. Comparison of biochemical indices before and after PBD

In the PBD group, significant improvements were observed after drainage: TBIL, DBIL, AST, and ALT levels were all significantly reduced ($P < 0.001$ for all). No significant differences were noted in ALB and NLR values before and after drainage ($P > 0.05$) (Table 2).

Table 2. Comparison of biochemical indices before and after biliary drainage in the drainage group.

Variables	At Admission	Pre-operation	Z/t Value	P Value
TBIL (μmol/L)	248.65 (209.65–311.1)	122.4 (92.95–182.18)	$Z = -5.303$	<0.001
DBIL (μmol/L)	183.5 (163.63–231.58)	100 (76.6–143.53)	$Z = -5.061$	<0.001
AST (U/L)	114.5 (79.5–239.25)	53.5 (39.35–83.5)	$Z = -5.156$	<0.001
ALT (U/L)	175.5 (87.8–248.78)	76.25 (42.98–116.75)	$Z = -4.996$	<0.001
ALB (g/L)	38.61 ± 4.41	38.16 ± 3.72	$t = 0.616$	0.541
NLR	4.41 (2.78–5.79)	3.38 (2.13–4.73)	$Z = -1.774$	0.076

3.3. Comparison of relevant indicators between the drainage group and the direct surgery group

3.3.1. Comparison of perioperative indicators

There were no statistically significant differences between the preoperative biliary drainage (PBD) group and the direct surgery group in terms of operative duration, intraoperative blood loss, postoperative hospital stay, 30-day postoperative mortality, or major postoperative complications (including pancreatic fistula, bile leakage, hemorrhage, intra-abdominal infection, and delayed gastric emptying), as well as ICU transfer and reoperation ($P > 0.05$). However, statistically significant differences were observed in preoperative preparation time, overall complication rate, and total hospitalization cost ($P < 0.05$). See Table 3.

Table 3. Perioperative outcomes between the drainage group and the direct surgery group.

Variables	Direct Surgery Group (n = 30)	Drainage Group (n = 40)	Z/χ ² /t Value	P Value
Preoperative preparation time (days)	7.67 ± 3.754	9.75 ± 3.921	$t = -2.24$	0.028
Operation duration (minutes)	402.5 (333.75–495)	360 (330–417.5)	$Z = -1.829$	0.067
Intraoperative blood loss (ml)	200 (100–425)	200 (100–200)	$Z = -1.015$	0.31
Postoperative hospital stay (days)	16 (12.75–20)	16 (14–22)	$Z = -1.352$	0.176
Total hospitalization cost (CNY)	85498.29 (76699.57–93702.11)	95044.27 (79125.67–115670.56)	$Z = -2.231$	0.026
Pancreatic fistula			$Z = -0.63$	0.529
None	16 (53.3%)	24 (60.0%)		
Grade A	12 (40.0%)	13 (32.5%)		
Grade B	1 (3.3%)	3 (7.5%)		
Grade C	1 (3.3%)	0		
Biliary fistula			-	1

Table 3. (Continued).

Variables	Direct Surgery Group (n = 30)	Drainage Group (n = 40)	Z/ χ^2 /t Value	P Value
None	30 (100%)	39 (97.5%)		
Yes	0	1 (2.5%)		
Hemorrhage			-	0.735
None	25 (83.3%)	35 (87.5%)		
Yes	5 (16.7%)	5 (12.5%)		
Intra-abdominal infection			$\chi^2 = 0.365$	0.546
None	25 (83.3%)	31 (77.5%)		
Yes	5 (16.7%)	9 (22.5%)		
Delayed gastric emptying			-	1
None	28 (93.3%)	37 (92.5%)		
Yes	2 (6.7%)	3 (7.5%)		
Total complications			$\chi^2 = 4.342$	0.037
None	9 (30.0%)	22 (55.0%)		
Yes	21 (70.0%)	18 (45.0%)		
Transfer to ICU			$\chi^2 = 0.162$	0.687
No	22 (73.3%)	31 (77.5%)		
Yes	8 (26.7%)	9 (22.5%)		
Reoperation			-	0.383
No	29 (96.7%)	36 (90.0%)		
Yes	1 (3.3%)	4 (10.0%)		
Mortality within 30 days			Z = -2.95	0.768
Survived	28 (93.3%)	38 (95.0%)		
Deceased	2 (6.7%)	2 (5.0%)		

Note: “-” indicates that specific statistical test values could not be obtained.

3.3.2. Postoperative survival analysis

Follow-up was conducted until 15 November 2024. A total of 23 postoperative deaths were recorded. Among them, 8 patients died in the drainage group, with a median survival time of 38 months, while 15 patients died in the direct surgery group, with a median survival time of 31 months. See **Table 4**.

Table 4. Survival outcomes of patients in the drainage and direct surgery groups.

Group	Total Patients	Deaths	Censored	Mean (months)	SEM	Median (M, months)	95% CI
Direct Surgery Group	30	15	15	28.303	3.339	31	21.404–
Drainage Group	40	8	32	32.295	2.893	38	-
Total	70	23	47				

Note: “-” indicates that specific data could not be obtained.

A log-rank test was used to compare the survival curves between the two groups, and the result showed no statistically significant difference ($P = 0.262$),

indicating no significant difference in cumulative survival rates between the groups (see **Figure 1**).

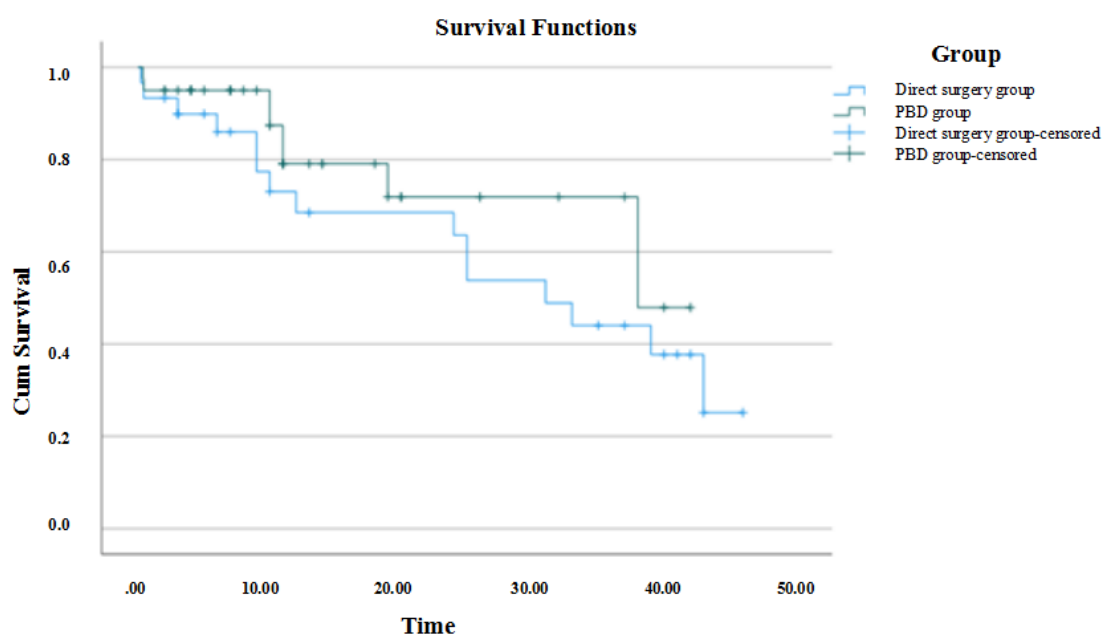


Figure 1. Kaplan-Meier cumulative survival curves comparing the drainage group and the direct surgery group.

4. Discussion

Pancreaticoduodenectomy (PD) is one of the most complex surgical procedures in the field of gastrointestinal surgery due to its extensive resection and reconstruction of multiple digestive tract structures. As a result, it has a relatively high rate of postoperative complications. A transatlantic retrospective study proposed that an “ideal outcome” after PD consists of the absence of six factors: in-hospital mortality, severe complications (Clavien-Dindo grade $\geq$ III), postoperative pancreatic fistula (Grade B/C by the ISGPS), reoperation, prolonged hospital stay (>75 th percentile), and hospital readmission. The study found that postoperative complications were the main obstacle to achieving this ideal outcome [8]. Therefore, reducing the rate of complications after PD remains essential, as the reported incidence ranges from 20% to 50% [1].

The concept of preoperative biliary drainage (PBD) was first introduced by Whipple in 1935 during open PD and consists of two stages: biliary decompression and nutritional support, followed by radical pancreaticoduodenectomy [9]. The main function of PBD is to relieve biliary obstruction via internal or external drainage, thereby reducing serum bilirubin levels and improving the patient’s nutritional status, liver and kidney function, coagulation ability, and immune response. These effects are believed to improve surgical tolerance and reduce postoperative complications [10].

Before the mid-1980s, PBD was widely recognized as a beneficial intervention to reduce PD-related complications and mortality [2]. At China’s first national pancreatic surgery conference in 1985, many experts supported PBD as a method to improve liver function and coagulation, considering its benefits to outweigh the risks [11]. However, with the advancement of clinical studies, some scholars have

questioned the efficacy of PBD. They argue that PBD may not reduce complications or mortality and may even increase the risk of infection and prolong hospitalization, raising treatment costs. Therefore, some researchers do not recommend routine PBD [12–15].

Bile culture studies have shown a higher rate of positive cultures in patients who underwent PBD, which is significantly associated with postoperative complications [16,17]. This finding further suggests that PBD may actually increase postoperative infection risk. Current clinical guidelines recommend PBD for elderly patients, those with poor physical status, prolonged biliary obstruction, liver or renal dysfunction, infectious symptoms (e.g., fever or cholangitis), or those preparing for neoadjuvant therapy. However, whether bilirubin level alone should be used as an indication remains uncertain. Severe jaundice is commonly defined as TBIL $\geq$ 250 μ mol/L (15 mg/dL) [18–20].

Wang et al. proposed a lower TBIL threshold of 171 μ mol/L and found it to be an independent risk factor for Grade B/C pancreatic fistula after PD [21].

Our study showed significant improvement in liver function in the PBD group post-drainage. However, no statistically significant differences were found between the two groups in terms of operative duration, intraoperative blood loss, ICU admission, reoperation rate, postoperative hospital stay, major complications, 30-day mortality, or median survival. The drainage group had a lower total complication rate but required longer preoperative preparation and incurred higher hospitalization costs. These findings are consistent with those reported by Blacker et al. [22].

Although no significant difference was observed in postoperative survival between the two groups, the survival curves showed that the cumulative survival rate was higher in the drainage group at all time points. Additionally, the median survival time was longer in the drainage group (38 months vs. 31 months). Therefore, we believe that PBD may positively impact long-term outcomes in patients undergoing PD.

The lack of statistically significant differences may be due to two main factors: first, some patients were lost to follow-up or had uncertain survival status; second, the sample size in our study was relatively small, limiting statistical power.

5. Conclusion

Our study suggests that PBD offers potential benefits to patients undergoing PD. However, due to the lack of stratification by bilirubin level, limited sample size, and inconsistent follow-up periods, these findings should be interpreted with caution. Further large-scale and stratified studies are necessary to clarify the role of PBD in patients with distal malignant obstructive jaundice undergoing PD.

References

1. Okano K, Suzuki Y. Influence of bile contamination for patients who undergo pancreaticoduodenectomy after biliary drainage. *World Journal of Gastroenterology*. 2019; 25(47): 6847-6856. doi: 10.3748/wjg.v25.i47.6847
2. Cao L, Zhang J. Surgical Approach Selection for Malignant Obstructive Jaundice. *Journal of Practical Clinical Medicine*. 2010; 14(1): 87-88.

3. Bassi C, Marchegiani G, Dervenis C, et al. The 2016 update of the International Study Group (ISGPS) definition and grading of postoperative pancreatic fistula: 11 Years After. *Surgery*. 2017; 161(3): 584-591. doi: 10.1016/j.surg.2016.11.014
4. Wente MN, Bassi C, Dervenis C, et al. Delayed gastric emptying (DGE) after pancreatic surgery: A suggested definition by the International Study Group of Pancreatic Surgery (ISGPS). *Surgery*. 2007; 142(5): 761-768. doi: 10.1016/j.surg.2007.05.005
5. Wente MN, Veit JA, Bassi C, et al. Postpancreatectomy hemorrhage (PPH)—An International Study Group of Pancreatic Surgery (ISGPS) definition. *Surgery*. 2007; 142(1): 20-25. doi: 10.1016/j.surg.2007.02.001
6. Koch M, Garden OJ, Padbury R, et al. Bile leakage after hepatobiliary and pancreatic surgery: A definition and grading of severity by the International Study Group of Liver Surgery. *Surgery*. 2011; 149(5): 680-688. doi: 10.1016/j.surg.2010.12.002
7. Liu W, Liu Y, Liang T, et al. Expert Consensus on Diagnosis, Treatment and Prevention of Common Surgical Complications after Pancreatic Surgery. *Journal of Peking Union Medical College*. 2017; 8(Z1): 139-146.
8. Augustinus S, Mackay TM, Andersson B, et al. Ideal Outcome After Pancreatoduodenectomy. *Annals of Surgery*. 2023; 278(5): 740-747. doi: 10.1097/sla.0000000000006037
9. Whipple AO, Parsons WB, Mullins CR. Treatment of Carcinoma of the Ampulla of Vater. *Annals of Surgery*. 1935; 102(4): 763-779. doi: 10.1097/00000658-193510000-00023
10. Zhang W, Che X. Comparison of effect between nasobiliary drainage and biliary stenting in malignant biliary obstruction: a systematic review and updated meta-analysis. *World Journal of Surgical Oncology*. 2020; 18(1). doi: 10.1186/s12957-020-01848-1
11. Li J. Malignant Obstructive Jaundice and Preoperative Biliary Drainage. *Chinese Journal of Practical Surgery*. 2001; 21(8): 498-502.
12. Dai S, Peng Y, Wang G, et al. Risk factors of delayed gastric emptying in patients after pancreaticoduodenectomy: a comprehensive systematic review and meta-analysis. *International Journal of Surgery*. 2023; Publish Ahead of Print. doi: 10.1097/js9.0000000000000418
13. Ang J, Xiao R, Wang L, et al. Clinical effect of improved cholecystostomy after pancreaticoduodenectomy and the influencing factors of bile leakage. *Chinese Journal of Digestive Surgery*. 2023; 22(5): 642-649.
14. Mentor K, Ratnayake B, Akter N, et al. Meta-Analysis and Meta-Regression of Risk Factors for Surgical Site Infections in Hepatic and Pancreatic Resection. *World Journal of Surgery*. 2020; 44(12): 4221-4230. doi: 10.1007/s00268-020-05741-6
15. Gong L, Huang X, Wang L, et al. The effect of preoperative biliary stents on outcomes after pancreaticoduodenectomy. *Medicine*. 2020; 99(42): e22714. doi: 10.1097/md.00000000000022714
16. Groen JV, Droogh DHM, de Boer MGJ, et al. Clinical implications of bile cultures obtained during pancreaticoduodenectomy: a cohort study and meta-analysis. *HPB*. 2021; 23(7): 1123-1133. doi: 10.1016/j.hpb.2020.10.028
17. Schwarz L, Gillibert A, Rondeaux J, et al. Study protocol of the FRENCH24-ANIS study: postoperative anti-infective strategy following pancreaticoduodenectomy in patients with preoperative biliary stents—an intergroup FRENCH-ACHBT-SFAR prospective randomized controlled trial. *BMC Surgery*. 2024; 24(1). doi: 10.1186/s12893-024-02507-y
18. Xu J. Guidelines for Integrated Diagnosis and Treatment of pancreatic cancer of Chinese Anticancer Association (Simplified version). *Chin Oncology*. 2019; 50(10): 487-496.
19. Yang Y, Tian X. Chinese Guidelines for Diagnosis and Treatment of pancreatic cancer. *Chinese Journal of Practical Surgery*. 2021; 41(07): 725-738.
20. Conroy T, Pfeiffer P, Vilgrain V, et al. Pancreatic cancer: ESMO Clinical Practice Guideline for diagnosis, treatment and follow-up. *Annals of Oncology*. 2023; 34(11): 987-1002. doi: 10.1016/j.annonc.2023.08.009
21. Wang Z, Liu R, Li F, et al. Analysis of related factors of pancreatic leakage after laparoscopic pancreaticoduodenectomy. *Chinese Journal of Minimally Invasive Surgery*. 2019; 19(2): 106-110.
22. Blacker S, Lahiri RP, Phillips M, et al. Which patients benefit from preoperative biliary drainage in resectable pancreatic cancer? *Expert Review of Gastroenterology & Hepatology*. 2021; 15(8): 855-863. doi: 10.1080/17474124.2021.1915127