Antibiotic prophylaxis after 48 hours postoperatively are not associated with decreased surgical site infections and other healthcare associated infections in pancreatic surgery patients: a retrospective cohort study

Xiaoju Ma
Sun Yat-sen University
Qiangsheng He
Sun Yat-sen University
Youpeng Chen
Sun Yat-sen University
Yan Lu
Sun Yat-sen University
Ping Zhu
The First Affiliated Hospital of Nanjing Medical University
Ji Zhang
The First Affiliated Hospital of Nanjing Medical University
Wen-sen Chen
The First Affiliated Hospital of Nanjing Medical University
Yongxiang Zhang
The First Affiliated Hospital of Nanjing Medical University
Wei-hong Zhang
The First Affiliated Hospital of Nanjing Medical University
Chuanlong Zhu
The First Affiliated Hospital of Nanjing Medical University
Qiang Li (liqiang020202@163.com)
The First Affiliated Hospital of Nanjing Medical University
Zhanjie Li
The First Affiliated Hospital of Nanjing Medical University

Research Article

Keywords: antibiotic, antibiotic prophylaxis after 48 hours postoperatively, pancreatic surgery, surgical site infections, healthcare-associated infections

Posted Date: August 11th, 2023

DOI: https://doi.org/10.21203/rs.3.rs-3243909/v1

Additional Declarations: No competing interests reported.

Version of Record: A version of this preprint was published at Antimicrobial Resistance & Infection Control on December 2nd, 2023. See the published version at https://doi.org/10.1186/s13756-023-01348-3.

Abstract

Background

It is controversial whether antibiotic should be used prophylactically 48 hours after pancreatic surgery. Hence, We evaluated the association of antibiotic prophylaxis (AP) after 48 hours postoperatively with the incidence of surgical site infections (SSIs) and other healthcare-associated infections (HAIs) in patients receiving pancreatic surgery.

Methods

A retrospective cohort analysis was performed on 1073 patients who underwent pancreatic surgery. These patients were categorized into non-postoperative AP group (963) and postoperative AP group (110) based on whether or not they obtained AP from 48 hours to 30 days after surgery. Outcomes included SSIs and other HAIs.

Results

The incidence of SSIs was lower in the non-postoperative AP group (98/963, 10.2%) than in the postoperative AP group (22/110, 20.0%) ($P = 0.002$). Other HAIs incidence was not significantly different between the non-postoperative AP group (77/963, 8.0%) and the postoperative AP group (11/110, 10.0%) ($P = 0.468$). Multiple regression analysis demonstrated that postoperative AP was a risk factor for SSIs (OR = 2.14, 95%CI = 1.28–3.59) but not with other HAIs (OR = 1.24, 95%CI = 0.63–2.42) after adjustment for age, gender and diabetes. Subsequent to adjustment for all confounding factors, postoperative AP was not a risk factor for SSIs (OR = 2.42, 95%CI = 0.79–7.37) and other HAIs (OR = 4.10, 95%CI = 0.98–17.22).

Conclusions

Postoperative AP following pancreatic surgery was not associated with the lower morbidity rate of SSIs and other HAIs. Nonetheless, this study may facilitate further development of strategies towards standardization of the duration of AP management of pancreatic surgery.

Introduction

Pancreatic surgery, including pancreaticoduodenectomy and distal pancreatectomy, is a complex and technically demanding treatment for patients with pancreatic diseases. As surgical techniques and postoperative care have evolved, the perioperative mortality rate of patients undergoing pancreatic surgery has dropped to below 5%[1–3]. However, surgical site infections (SSIs) and other healthcare-associated infections (HAIs) still occur at a high rate in patients undergoing pancreatic surgery as pivotal factors of increased hospital readmission and mortality rates[4]. Several studies have demonstrated that the incidence of SSIs following pancreatic surgery was 11.58%-26%[5–8], while that of other HAIs after pancreatectomy was 4.33%-11.0%[9–11]. In addition, SSIs and other HAIs can contribute to more clinical burdens, prolong hospital stays, and elevate costs for patients undergoing pancreatic surgery[5, 12]. Therefore, it is necessary to decrease the morbidity rate of HAIs after pancreatic surgery.

The microbiome of patients is the main contributor to SSIs[13], and post-pancreatic surgery infections frequently include infections with gram-positive, fungal, and drug-resistant organisms[14]. A prior study showed that antibiotic prophylaxis (AP) reduced the incidence of SSIs[15]. In 2015, the *Chinese Guidelines for Clinical Use of Antibiotics*[16] classified that the duration of AP after clean-contaminated surgery and contaminated surgery should not exceed 24 hours and might extend to 48 hours for contaminated surgery when necessary. A recent study elucidated that one preoperative antibiotic dose might be adequate for surgical prophylaxis in patients undergoing pancreatic surgery[17]. However, Fromentin et al.[18] and Hammad et al.[19] reported that extended AP could reduce the incidence of SSI among high-risk patients. Excessive use of antibiotics can lead to the production of drug-resistant bacteria[20], and the microbes that cause SSIs at present have been unveiled to be resistant to antibiotics used for prophylaxis[21, 22]. Therefore, further research is warranted to clarify whether extended AP in patients receiving pancreatic surgery can diminish the incidence of SSIs and other HAIs.

According to this study, we probed the effect of AP after 48 hours to 30 days postoperatively on the incidence of SSIs and other HAIs in patients undergoing pancreatic surgery.

Participants and Methods

Study Design

A retrospective cohort analysis was performed on all patients undergoing pancreatic surgery at the First Affiliated Hospital of Nanjing Medical University, a Grade-A tertiary hospital with 4500 beds.

Cohort Construction

Patients undergoing the first pancreatic surgery between January 2022 and December 2022 were included in our study. The flowchart of this study is displayed in Fig. 1. Fourteen patients were excluded from 1087 patients because they did not actually receive pancreatic surgery in the surgical records. Finally, a total of 1073 patients were included, with 963 patients in the non-postoperative AP group (patients did not receive AP after 48 hours to 30 days postoperatively) and 110 patients in the postoperative AP group (patients received AP at last one dose after 48 hours to 30 days postoperatively).

The Xinglin Real-Time Nosocomial Infection System and iih System were used to collect the demographic data of patients, including population characteristics (age, sex, and diabetes, hospital stays), surgical variables (surgical category, surgical approach, surgical time, emergency, American Society of Anesthesiology (ASA) score (ASA score was divided into two groups according to the principles of surgical risk assessment), National Nosocomial Infections Surveillance (NNIS) score, surgeon, surgery department, and intraoperative blood loss), and Antibiotic (AP, intraoperative redosing, AP within 48 hours postoperatively, AP days).

Outcomes

Outcomes included SSIs within 30 days and other HAIs (postoperative sepsis, postoperative pneumonia, pelvic and abdominal tissue infections, and urinary tract infections, and others) that occurred during the hospital stay after pancreatic surgery. HAIs were diagnosed with the Diagnostic Criteria of Nosocomial Infection (Trial) issued by the Ministry of Health in 2001[23].

Statistical Analysis

Data were summarized as mean ± standard deviation (SD) or frequencies (percentages), as appropriate. The Chi-square or Fisher's exact test and *t*-test or Mann-Whitney U test were utilized for descriptive statistics, as appropriate.

Continuous variables were classified into two categorical variables based on the SSI-risk age (65 years), the mean hospital stays of patients receiving pancreatic surgery (14 days), the 75% time of pancreatic surgery (4.88 hours), and the days of prophylaxis (1 day), respectively. Intraoperative blood loss was categorized into three categorical variables.

Univariate and multivariate logistic regression analyses were utilized to assess associations between postoperative AP and HAIs. The adjusted covariates in model 1 were age (continuous), sex (male or female), and diabetes (yes or no). In model 2, the adjusted covariates were age (continuous), sex (male or female), diabetes (yes or no), hospital stays (continuous), surgical category (pancreaticoduodenectomy, distal pancreatectomy, and others), surgical approach (non-endoscopic surgery and endoscopic surgery), surgical time (continuous), emergency (yes or no), ASA score (0 and 1), NNIS score 1 (0 and 1 point) and 2 (2 and 3 point)), surgery department (pancreatic center and nonpancreatic center), surgeon (Doctor 1, Doctor 2, Doctor 3, Doctor 4, Doctor 5, Doctor 6, and others), intraoperative blood loss (continuous), AP (yes or no), intraoperative redosing (required but no redosing, required and redosing, or not required), AP within 48 hours postoperatively (yes or no), and AP days (continuous).

We conducted a series of analyses to examine whether there was effect modification by age, sex, diabetes, surgical category, ASA score, NNIS score, surgery department, surgical time, intraoperative blood loss, intraoperative redosing, and AP within 48 hours postoperatively. For these analyses, we included an interaction term in the primary model between postoperative AP and these variables.

Analyses were performed with Statistical Product and Service Solutions (SPSS), version 23.0 (IBM Corp. Armonk, NY, USA), R software (version 3.6.0; R Core Team), EmpowerStats (www.empowerstates.com), and Graph Pad Prism 8.0 (San Diego, CA, USA). $P < 0.05$ indicated that a difference was statistically significant.

Results

Patient characteristics, surgical variables, and outcomes

Patient characteristics

The mean (SD) age of patients at the time of hospitalization was 59.58 (13.29) years in the non-postoperative AP group and 62.97 (13.55) years in the postoperative AP group ($P = 0.012$). Other baseline characteristics (sex, diabetes, and hospital stays) were not significantly different between the two groups (Table 1).

Surgical variables

Among the surgical variables, ASA score 1 and NNIS score 1 (0 and 1 point) in the postoperative AP group was higher than that in the non-postoperative AP group ($P = 0.006$). In addition, significant differences were found between the two groups in terms of surgery department and surgeons ($P < 0.001$) (Table 1).

Outcomes

The incidence of SSIs was lower in the non-postoperative AP group (98/963, 10.2%) than in the postoperative AP group (22/110, 20.0%) ($P = 0.002$). There was no significant difference between the incidence of other HAIs in the non-postoperative AP group (8.0%, 77/963) and the postoperative AP group (11/110, 10.0%) ($P = 0.468$) (Table 1).

Analysis of AP

AP was used in 821 (85.3%) patients not undergoing postoperative AP ($P < 0.001$). The proportion of AP within 48 hours postoperatively (83.6% vs. 4.3%) was higher in the postoperative AP group than in the non-postoperative AP group ($P < 0.001$) (Table 1). The type and amount of postoperative AP are depicted in Fig. 2, including third-generation cephalosporins, β-lactamase inhibitor, and other antibiotics (including Carbapenem antibiotic, Latamoxef, Fluoroquinolones, Clindamycin, and Fluconazole).

Table 1
Descriptive data and outcomes of patients categorized by non-postoperative AP and postoperative AP

Characteristic	Non-postoperative AP (n = 963)	Postoperative AP (n = 110)	*P* value
Patient Characteristics			
Age (years)	59.58 ± 13.29	62.97 ± 13.55	0.012
Sex (Male)	535 (55.6)	66 (60.0)	0.374
Diabetes	164 (17.0)	20 (18.2)	0.761
Hospital stays	22.90 ± 14.15	25.60 ± 13.23	0.057
Surgical variables			
Surgical category			0.472
Pancreaticoduodenectomy	481 (49.9)	61 (55.5)	
Distal pancreatectomy	315 (32.7)	30 (27.3)	
Others	167 (17.3)	19 (17.3)	
Surgical approach			0.303
Non-endoscopic surgery	833 (86.5)	99 (90.0)	
Endoscopic surgery	130 (13.5)	11 (10.0)	
Emergency	52 (5.4)	6 (5.5)	0.981
ASA score			0.006
0	766 (79.5)	75 (68.2)	
1	197 (20.5)	35 (31.8)	
NNIS score			0.018
1 (0 and 1 point)	819 (85.0)	84 (76.4)	
2 (2 and 3 points)	144 (15.0)	26 (23.6)	
Surgery department			< 0.001
Nonancreatic center	67 (7.0)	24 (21.8)	
Pancreatic center	896 (93.0)	86 (78.2)	
Surgeon			< 0.001
Doctor 1	65 (6.7)	5 (4.5)	

Characteristic	Non-postoperative AP (n = 963)	Postoperative AP (n = 110)	*P* value
Patient Characteristics			
Doctor 2	156 (16.2)	15 (13.6)	
Doctor 3	411 (42.7)	41 (37.3)	
Doctor 4	73 (7.6)	14 (12.7)	
Doctor 5	47 (4.9)	4 (3.6)	
Doctor 6	140 (14.5)	6 (5.5)	
Others	71 (7.4)	25 (22.7)	
Surgical time (hours)	3.97 ± 1.53	4.18 ± 1.70	0.195
Intraoperative blood loss (mL)	253.24 ± 451.43	329.00 ± 439.76	0.095
Antibiotic			
AP	821 (85.3)	110 (100)	< 0.001
Intraoperative redosing			0.531
Required but no redosing	657 (68.2)	76 (69.1)	
Required and redosing	34 (3.5)	6 (5.5)	
Not required	272 (28.2)	28 (25.5)	
AP within 48 hours postoperatively	41 (4.3)	92 (83.6)	< 0.001
AP days	0.91 ± 0.52	6.95 ± 3.67	< 0.001
Outcomes			
SSIs	98 (10.2)	22 (20.0)	0.002
other HAIs	77 (8.0)	11 (10.0)	0.468

Postoperative AP and SSIs and other HAIs

The results of the univariate logistic regression analyses exhibited that the risk factors of SSIs included female, hospital stays, surgical category (distal pancreatectomy), ASA score, NNIS score, surgical time, intraoperative blood loss, intraoperative redosing and AP within 48 hours postoperatively ($P < 0.05$), whilst the risk factors of other HAIs included female, hospital stays, surgical category (distal pancreatectomy), ASA score, surgical time, intraoperative blood loss, and AP ($P < 0.05$) **(**Table 2**).**

Table 2
Univariate logistic regression for the association of suspected risk factors with SSIs and other HAIs

Exposure	**SSIs**		**other HAIs**	
	OR (95%CI)	***P* value**	**OR (95%CI)**	***P* value**
Patient Characteristics				
Age (years)	1.01 (0.99, 1.02)	0.359	1.01 (0.99, 1.02)	0.448
Sex				
Male	1		1	
Female	0.53 (0.35, 0.80)	0.002	0.60 (0.38, 0.95)	0.031
Diabetes				
No	1		1	
Yes	0.96 (0.58, 1.60)	0.882	1.47 (0.87, 2.49)	0.149
Hospital stays	1.06 (1.05, 1.08)	< 0.001	1.07 (1.06, 1.09)	< 0.001
Surgical Variables				
Surgical category				
Pancreaticoduodenectomy	1		1	
Distal pancreatectomy	0.31 (0.18, 0.52)	< 0.001	0.28 (0.14, 0.54)	< 0.001
Others	0.47 (0.26, 0.83)	0.009	1.03 (0.60, 1.76)	0.928
Surgical approach				
Non-endoscopic surgery	1		1	
Endoscopic surgery	0.57 (0.29, 1.12)	0.102	0.46 (0.20, 1.08)	0.073
Emergency				
No	1		1	
Yes	1.71 (0.84, 3.48)	0.137	1.31 (0.55, 3.15)	0.542
ASA score				
0	1		1	
1	1.73 (1.14, 2.63)	0.010	1.68 (1.04, 2.72)	0.033
NNIS score				
1 (0 and 1 point)	1		1	

Exposure	SSIs		other HAIs	
	OR (95%CI)	*P* value	OR (95%CI)	*P* value
Patient Characteristics				
2 (2 and 3 points)	2.04 (1.31, 3.19)	0.002	1.52 (0.89, 2.60)	0.126
Surgery department				
Nonpancreatic center	1		1	
Pancreatic center	0.61 (0.34, 1.09)	0.097	0.80 (0.39, 1.65)	0.540
Surgeon				
Doctor 1	1		1	
Doctor 2	2.23 (0.82, 6.07)	0.118	3.27 (0.73, 14.69)	0.122
Doctor 3	1.76 (0.68, 4.57)	0.243	2.85 (0.67, 12.14)	0.156
Doctor 4	1.32 (0.41, 4.22)	0.644	4.42 (0.93, 20.86)	0.061
Doctor 5	0.26 (0.03, 2.30)	0.226	3.70 (0.69, 19.87)	0.128
Doctor 6	1.16 (0.39, 3.44)	0.784	3.04 (0.66, 13.99)	0.153
Others	2.41 (0.83, 6.97)	0.105	3.52 (0.74, 16.82)	0.115
Surgical time (hours)	1.40 (1.25, 1.57)	< 0.001	1.28 (1.13, 1.45)	< 0.001
Intraoperative blood loss (mL)	1.00 (1.00, 1.00)	0.029	1.00 (1.00, 1.00)	0.005
Antibiotic				
AP				
No	1		1	
Yes	1.17 (0.65, 2.11)	0.591	0.48 (0.28, 0.82)	0.007
Intraoperative redosing				
Required but no redosing	1		1	
Required and redosing	2.32 (1.10, 4.91)	0.027	0.81 (0.24, 2.68)	0.725
Not required	0.44 (0.26, 0.75)	0.002	0.63 (0.37, 1.09)	0.098
AP within 48 hours postoperatively				
No	1		1	
Yes	1.94 (1.19, 3.16)	0.008	0.90 (0.45, 1.78)	0.759
AP days	1.07 (1.00, 1.15)	0.056	0.92 (0.81, 1.05)	0.236

The univariate logistic regression analysis demonstrated that postoperative AP was a risk factor for SSIs (OR = 2.21, 95%CI = 1.32–3.68, *P* = 0.002) but not a risk factor for other HAIs (OR = 1.28, 95%CI = 0.66–2.49, *P* = 0.469). The multivariate logistic regression analysis demonstrated that subsequent to adjustment for the confounding effect of age, gender and diabetes were associated with SSIs (OR = 2.14, 95%CI = 1.28–3.59, P = 0.004) but not with other HAIs (OR = 1.24, 95%CI = 0.63–2.42, P = 0.532). Furthermore, after adjustment for all confounding factors, postoperative AP was not a risk factor for SSIs (OR = 2.42, 95%CI = 0.79–7.37, *P* = 0.121) and other HAIs (OR = 4.10, 95%CI = 0.98–17.22, *P* = 0.054). The data are detailed in Table 3.

Table 3
Associations of non-postoperative AP and postoperative AP with HAIs in patients undergoing pancreatic surgery

Exposure	**Unadjusted estimate**		**Model 1: adjusted estimate[1]**		**Model 2: adjusted estimate[2]**	
	OR (95%CI)	***P* value**	**OR (95%CI)**	***P* value**	**OR (95%CI)**	***P* value**
SSI						
Postoperative AP						
No	1		1		1	
Yes	2.21 (1.32, 3.68)	0.002	2.14 (1.28, 3.59)	0.004	2.42 (0.79, 7.37)	0.121
Other HAIs						
Postoperative AP						
No	1		1		1	
Yes	1.28 (0.66, 2.49)	0.469	1.24 (0.63, 2.42)	0.532	4.10 (0.98, 17.22)	0.054

1. Model 1 was adjusted for age, sex, and diabetes
2. Model 2 was adjusted for age, sex, diabetes, hospital stays, surgical category, surgical approach, surgical time, emergency, ASA score, NNIS score, surgeon, surgery department, intraoperative blood loss, AP, intraoperative redosing, AP within 48 hours postoperatively, and antibiotic prophylaxis days

Subgroup analysis results

Subgroup analyses showed that the estimated risk of SSIs with postoperative AP did not differ by age, sex, diabetes, surgical category, ASA score, NNIS score, surgery department, surgical time, intraoperative blood loss, intraoperative redosing, and AP within 48 hours postoperatively (Fig. 3). In addition, the estimated risk of other HAIs with postoperative AP did not differ by age, sex, diabetes, surgical category, ASA score, NNIS score, surgery department, surgical time, intraoperative blood loss, and intraoperative redosing, but by AP within 48 hours postoperatively **(**Fig. 4**)**.

Discussion

In this study, postoperative AP with third-generation cephalosporins, β-lactamase inhibitor, or other antibiotics did not statistically and clinically significantly diminish the prevalence of SSIs in patients undergoing pancreatic surgery. In addition, postoperative AP was not associated with the decreased morbidity rate of other HAIs, including postoperative sepsis, postoperative pneumonia, pelvic and abdominal tissue infections, and urinary tract infections.

Postoperative infections can cause antibiotic overuse[24], which calls for the development of a preventive anti-infectious strategy to reduce the postoperative risk of HAIs and to avoid prolonged antibiotic exposure. Current guidelines in China recommend that antibiotic use after clean-contaminated and contaminated surgery should be discontinued within 24 hours after the end of surgery and extended to 48 hours for contaminated hepatopancreatobiliary surgery if necessary[16]. There are inconsistent with the requirements and implementation of AP for pancreatic surgery. Macedo et al[25] reported that 69.47% of 285 hepatopancreatobiliary surgeons extended AP beyond 3 days across the worldwide. In our research, AP was conducted in 10.25% of 1073 patients receiving pancreatic surgery after 48 hours postoperatively, and the duration of postoperative AP was 6.95 ± 3.67 days. The reason for the above situation is that the cognition of the duration of AP in patients receiving pancreatic surgery remains controversial. Recent evidence unraveled that longer (72 h) broad-spectrum antibiotic coverage significantly lowered the incidence of SSIs after pancreaticoduodenectomy (PD) surgery when compared with routine use (24 h) [26]. Similarly, other prior studies elaborated that extended antibiotic use was correlated with the reduced incidence rate of SSIs following PD in high-risk patients[18, 19]. On the contrary, a systematic review illustrated that a single preoperative dose of cefazolin for hepato-biliopancreatic surgery is indicated for AP[17]. In our study, we revealed an insignificant correlation between all types of SSIs and other HAIs with postoperative AP after adjustment for the risk factors of patients, which supports the Chinese guidelines.

The excessive or frequent prescription of antibiotics may not reduce the incidence of postoperative infections at all or may even elevate bacterial resistance to trigger multiple infections oppositely [20], highlighting the importance and necessity of rational duration of perioperative AP. In addition to the duration of AP, the choice of antibiotics is also highly critical for diminishing the rate of postoperative infections. As reported, bacterial colonization in the surgical site is closely associated with the occurrence of SSIs in patients undergoing pancreatic surgery, and it is necessary to conduct targeted AP covering microbes prevalent in post-pancreatic surgery infections[27, 28]. Chinese guidelines recommend the administration of first- and second-generation cephalosporin or ceftriaxone with or without metronidazole, as well as cephalomycin, as perioperative AP in hepatopancreatobiliary surgery[16]. However, it is widely heterogeneous in the selection of antibiotics, such as first-generation cephalosporin/metronidazole, second-generation cephalosporin, ciprofloxacin/metronidazole, ampicillin/sulbactam (Unasyn), ampicillin/gentamicin/metronidazole, extended-spectrum penicillin, and others[25]. The results of the present study revealed an inconsistency in the type and amount of antibiotics used for postoperative AP in pancreatic surgery, including third-generation cephalosporins, β-lactamase inhibitor, and other antibiotics, which also did not meet the guideline. The use of high-level antibiotics, such as third-generation cephalosporins and Carbapenem antibiotic, may due to the expansion of antimicrobial resistance[29, 30]. Importantly, the common drug-resistant bacteria are a cause of SSIs and other HAIs[22, 31]. Accordingly, clinicians should closely monitor patients and select proper antibiotics.

The strengths of our study are clear. First, existing studies mainly focused on specific or selected populations, but this study included the whole population of patients undergoing pancreatic surgery. Although these results were derived from the data of a single center, our sample size was large enough to exceed 1000. There, these findings are applicable to real-world situations. Second, a subgroup analysis was performed and three unadjusted and adjusted models, which were adjusted for confounding factors, were constructed in our study, emphasizing the credibility of our results. Third, in addition to the association between postoperative AP and the incidence of SSIs, the study also highlighted the effect of other HAIs. Nevertheless, there are limitations in the present study. Our data were collected from a single-center study, and more relevant factors can be further analyzed, such as body mass index, preoperative administration time, drain placement, and malnutrition. In addition, our study may involve some subjective factors of surgeons, who overuse AP because of suspecting the patient with greater risk of infection, suspected infection, underestimation of infection[32] or prescribing preventive medications as treatments, which cannot be reflected in the objective factors and cannot be corrected.

Conclusions

This study revealed no statistically significant decrease in the incidence of SSIs and other HAIs in patients receiving postoperative AP. Nonetheless, this study may facilitate further development of strategies towards standardization of the duration of AP management of pancreatic surgery. The findings indicate that in addition to focusing on the duration of postoperative AP, the adaptation of antimicrobial prophylaxis also should be evaluated according to pancreatic surgery performance and local epidemiology to avoid the overuse of antibiotics.

Abbreviations

AP Antibiotic prophylaxis

SSIs Surgical site infections

HAIs Healthcare-associated infections

ASA American Society of Anesthesiology

NNIS National Nosocomial Infections Surveillance

PD Pancreaticoduodenectomy

Declarations

Ethics approval and consent to participate

This study has been approved by the ethical committee of The First Affiliated Hospital of Nanjing Medical University review board.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Competing interests

The authors declare that they have no competing interest.

Funding

This work was supported by the third Outstanding Young and Middle-aged Talents Training Program of Jiangsu Provincial People's Hospital (YNRCQN0314); Young Scholars Fostering Fund of the First Affiliated Hospital of Nanjing Medical University (PY2022017); Jiangsu Province Hospital Management Innovation Research Project (JSYGY-3-2023-559).

Authors' contributions

Conception and design: Xiaoju Ma, Youpeng Chen, Zhanjie Li, and Qiang Li

Provision of study materials or patients: Qiang Li, Yongxiang Zhang, Wei-hong Zhang, and Chuanlong Zhu

Collection and assembly of data: Xiaoju Ma, Zhanjie Li and Ping Zhu

Data analysis and interpretation: Qiangsheng He, Zhanjie Li, Wen-sen Chen, Yan Lu and Ji Zhang

Acknowledgments

The authors thank those who have devoted a lot to this study, including nurses, doctors, statisticians, reviewers, and editors. They were not financially compensated for their contributions.

References

1. Kimura W, Miyata H, Gotoh M, et al. A pancreaticoduodenectomy risk model derived from 8575 cases from a national single-race population (Japanese) using a web-based data entry system: the 30-day and in-hospital mortality rates for pancreaticoduodenectomy[J]. Ann Surg. 2014, 259(4): 773-780.
2. Wang X X, Yan Y K, Dong B L, et al. Pancreatic outflow tract reconstruction after pancreaticoduodenectomy: a meta-analysis of randomized controlled trials[J]. World J Surg Oncol. 2021, 19(1): 203.
3. Tang W, Zhang Y F, Zhao Y F, et al. Comparison of laparoscopic versus open radical antegrade modular pancreatosplenectomy for pancreatic cancer: A systematic review and meta-analysis[J]. Int J Surg. 2022, 103: 106676.
4. Peluso H, Jones W B, Parikh A A, et al. Treatment outcomes, 30-day readmission and healthcare resource utilization after pancreatoduodenectomy for pancreatic malignancies[J]. J Hepatobiliary Pancreat Sci. 2019, 26(5): 187-194.
5. De Pastena M, Paiella S, Fontana M, et al. The clinical and economic impact of surgical site infections after distal pancreatectomy[J]. Surgery. 2022, 171(6): 1652-1657.
6. Nobuhara H, Matsugu Y, Tanaka J, et al. The preventive effects of perioperative oral care on surgical site infections after pancreatic cancer surgery: a retrospective study[J]. Support Care Cancer. 2022, 30(4): 3337-3344.
7. Pollini T, Wong P, Kone L B, et al. Drain Placement After Pancreatic Resection: Friend or Foe For Surgical Site Infections? [J]. J Gastrointest Surg. 2023, 27(4): 724-729.
8. 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[J]. World J Surg. 2020, 44(12): 4221-4230.
9. Lee D U, Hastie D J, Fan G H, et al. Effect of malnutrition on the postoperative outcomes of patients undergoing pancreatectomy for pancreatic cancer: Propensity score-matched analysis of 2011-2017 US hospitals[J]. Nutr Clin Pract. 2022, 37(1): 117-129.
10. Yang P S, Liu C P, Hsu Y C, et al. A Novel Prediction Model for Bloodstream Infections in Hepatobiliary-Pancreatic Surgery Patients[J]. World J Surg. 2019, 43(5): 1294-1302.
11. Okada K, Uemura K, Ohge H, et al. Prognostic impact of postoperative infection in patients with pancreatic cancer: A multicenter cohort study[J]. Surgery. 2022, 172(6): 1768-1775.
12. Fadayomi A B, Kasumova G G, Tabatabaie O, et al. Unique predictors and economic burden of superficial and deep/organ space surgical site infections following pancreatectomy[J]. HPB (Oxford). 2018, 20(7): 658-668.

13. Alverdy J C, Hyman N, Gilbert J. Re-examining causes of surgical site infections following elective surgery in the era of asepsis[J]. Lancet Infect Dis. 2020, 20(3): e38-e43.
14. Behrman S W, Bahr M H, Dickson P V, et al. The microbiology of secondary and postoperative pancreatic infections: implications for antimicrobial management[J]. Arch Surg. 2011, 146(5): 613-619.
15. De Pastena M, Paiella S, Azzini A M, et al. Antibiotic Prophylaxis with Piperacillin-Tazobactam Reduces Post-Operative Infectious Complication after Pancreatic Surgery: An Interventional, Non-Randomized Study[J]. Surg Infect (Larchmt). 2021, 22(5): 536-542.
16. Circular on the issuance of the Guiding principles for the clinical application of antimicrobial drugs (2015 edition) [J]. Bulletin of the National Health and Family Planning Commission of the People's Republic of China. 2015, No.144(07): 29.
17. Steccanella F, Amoretti P, Barbieri M R, et al. Antibiotic Prophylaxis for Hepato-Biliopancreatic Surgery-A Systematic Review[J]. Antibiotics (Basel). 2022, 11(2).
18. Fromentin M, Mullaert J, Gille B, et al. Extended antibiotic prophylaxis after pancreatoduodenectomy reduces postoperative abdominal infection in high-risk patients: Results from a retrospective cohort study[J]. Surgery. 2022, 172(1): 205-211.
19. Hammad A Y, Khachfe H H, Almasri S, et al. Impact of Extended Antibiotic Use After Pancreaticoduodenectomy for Patients with Preoperative Metallic Biliary Stenting Treated with Neoadjuvant Chemotherapy[J]. J Gastrointest Surg. 2023, 27(4): 716-723.
20. Medina E, Pieper D H. Tackling Threats and Future Problems of Multidrug-Resistant Bacteria[J]. Curr Top Microbiol Immunol. 2016, 398: 3-33.
21. Teillant A, Gandra S, Barter D, et al. Potential burden of antibiotic resistance on surgery and cancer chemotherapy antibiotic prophylaxis in the USA: a literature review and modelling study[J]. Lancet Infect Dis. 2015, 15(12): 1429-1437.
22. Stecca T, Nistri C, Pauletti B, et al. Bacteriobilia resistance to antibiotic prophylaxis increases morbidity after pancreaticoduodenectomy: a monocentric retrospective study of 128 patients[J]. Updates Surg. 2020, 72(4): 1073-1080.
23. the Diagnostic Criteria of Nosocomial Infection (Trial) [J]. Zhong Hua Yi Xue Za Zhi. 2001(05): 61-67.
24. Bortolotti P, Delpierre C, Le Guern R, et al. High incidence of postoperative infections after pancreaticoduodenectomy: A need for perioperative anti-infectious strategies[J]. Infect Dis Now. 2021, 51(5): 456-463.
25. Macedo F, Mowzoon M, Parikh J, et al. Disparities in the management and prophylaxis of surgical site infection and pancreatic fistula after pancreatoduodenectomy[J]. J Hepatobiliary Pancreat Sci. 2017, 24(5): 268-280.
26. Fathi A H, Jackson T, Barati M, et al. Extended Perioperative Antibiotic Coverage in Conjunction with Intraoperative Bile Cultures Decreases Infectious Complications after Pancreaticoduodenectomy[J]. HPB Surg. 2016, 2016: 3031749.

27. Pham H, Chen A, Nahm C B, et al. The Role of Targeted Versus Standard Antibiotic Prophylaxis in Pancreatoduodenectomy in Reducing Postoperative Infectious Complications: A Systematic Review and Meta-analysis[J]. Ann Surg. 2022, 275(2): 315-323.
28. Krüger C M, Adam U, Adam T, et al. Bacterobilia in pancreatic surgery-conclusions for perioperative antibiotic prophylaxis[J]. World J Gastroenterol. 2019, 25(41): 6238-6247.
29. Brink A J. Epidemiology of carbapenem-resistant Gram-negative infections globally[J]. Curr Opin Infect Dis. 2019, 32(6): 609-616.
30. Mizrahi A, Delerue T, Morel H, et al. Infections caused by naturally AmpC-producing Enterobacteriaceae: Can we use third-generation cephalosporins? A narrative review[J]. Int J Antimicrob Agents. 2020, 55(2): 105834.
31. Bilgiç Ç, Keske ^, Sobutay E, et al. Surgical site infections after pancreaticoduodenectomy: Preoperative biliary system interventions and antimicrobial prophylaxis[J]. Int J Infect Dis. 2020, 95: 148-152.
32. Khan Z, Ahmed N, Zafar S, et al. Audit of antibiotic prophylaxis and adherence of surgeons to standard guidelines in common abdominal surgical procedures[J]. East Mediterr Health J. 2020, 26(9): 1052-1061.

Figures

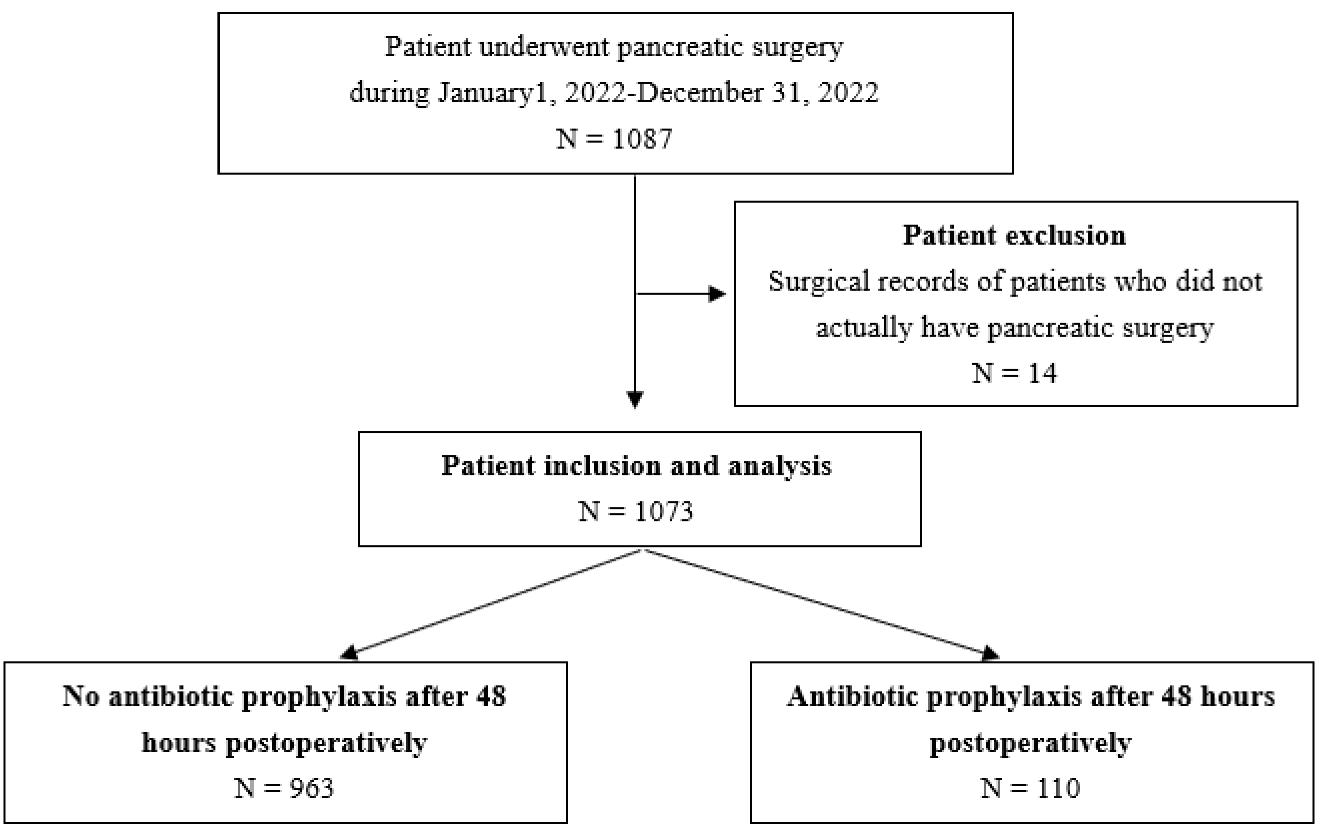

Figure 1

Flowchart of patient exclusion and inclusion

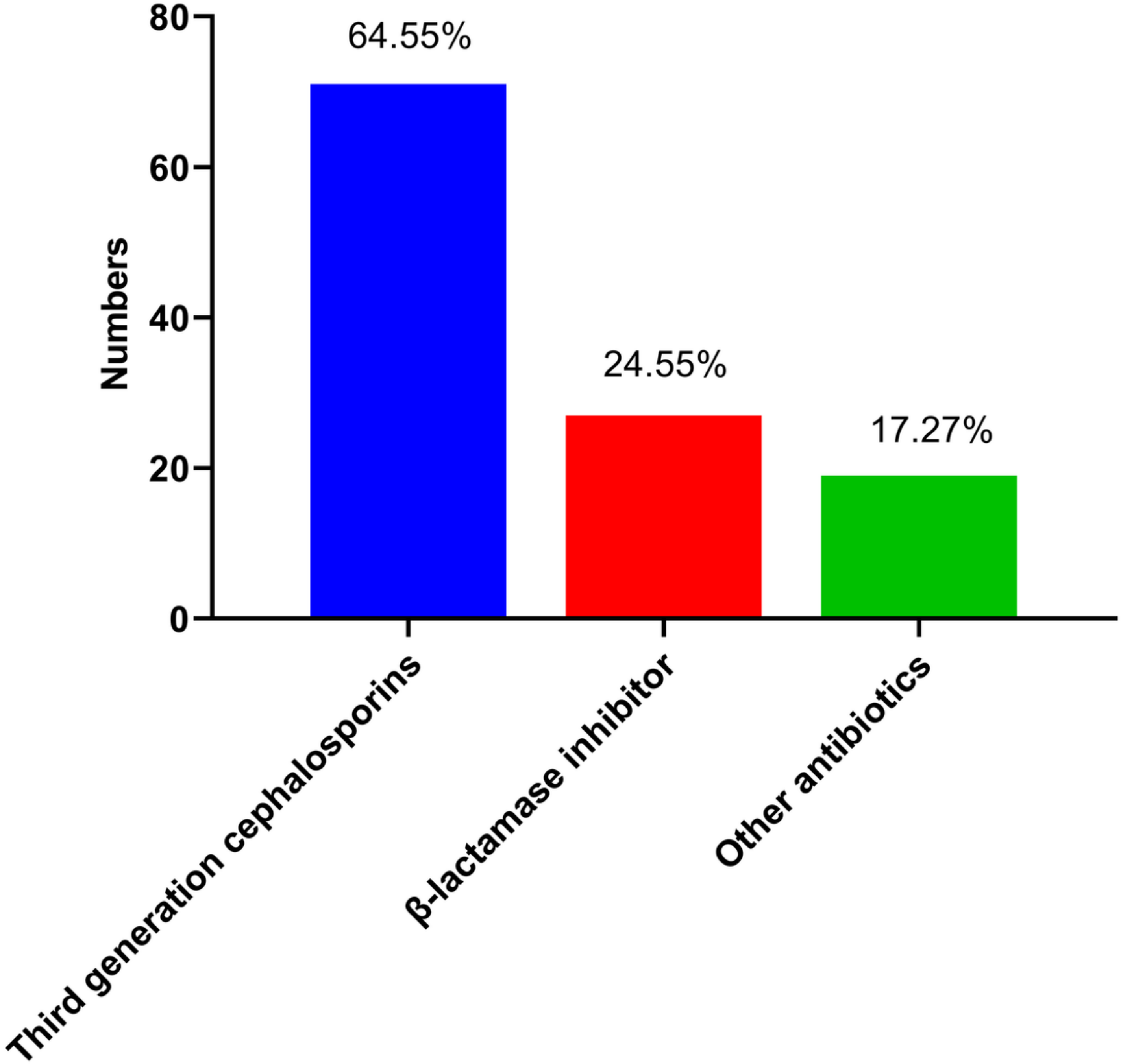

Figure 2

The type and amount of postoperative AP

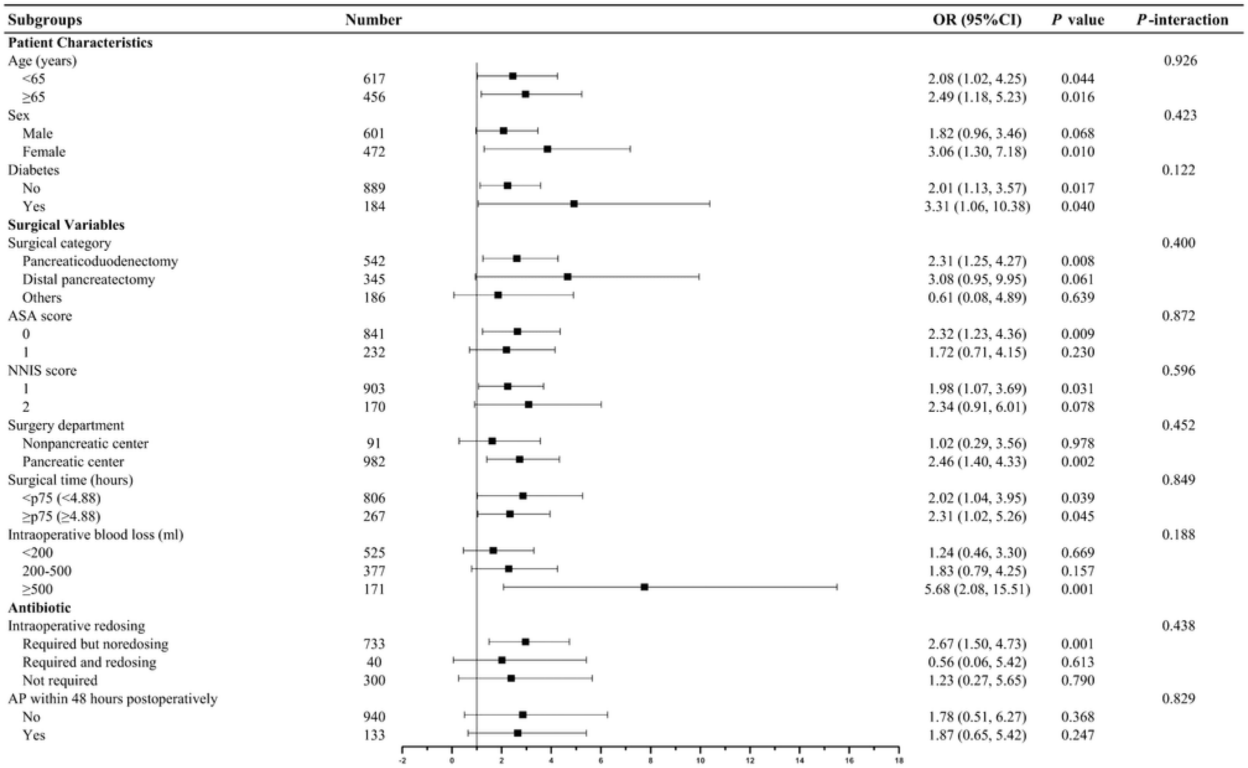

Figure 3

Subgroup analyses of SSIs according to non-postoperative AP and postoperative AP

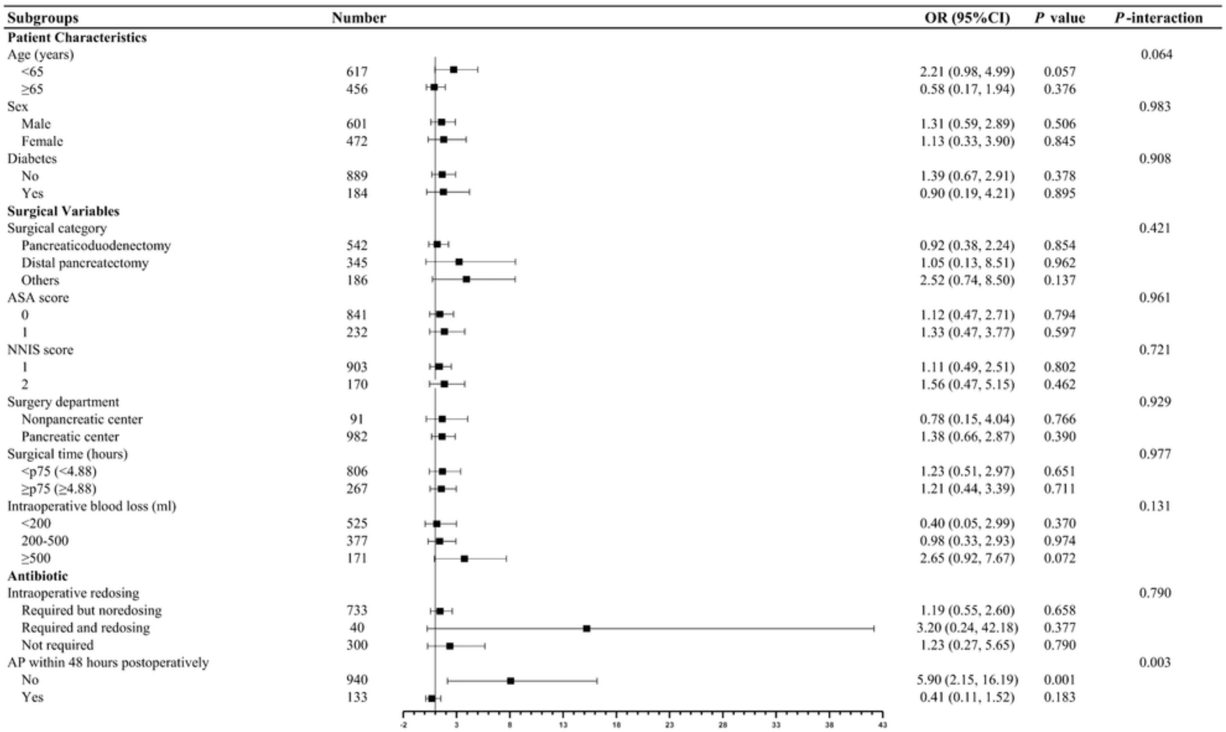

Figure 4

Subgroup analyses of SSIs according to non-postoperative AP and postoperative AP