International Journal of General Medicine

Dovepress
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ORIGINAL RESEARCH

The Duration of Prophylactic Antibiotic Use for Esophageal Cancer Patients with Postoperative Infection and Nutritional Status

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Objective: To verify the hypothesis that "the prophylaxis use time of antibiotics after esophageal cancer (EC) surgery ≤24 hours is associated with a lower postoperative infection rate and improvement of nutritional indicators", a retrospective cohort analysis was conducted to compare the infection incidence and differences in serum nutritional indicators among patients with different medication durations (< 24 hours, 24–48 hours, > 48 hours), and to identify independent risk factors for postoperative infection.

Methods: A retrospective analysis was conducted on the data of 566 patients who underwent EC surgery in Affiliated Hospital of North Sichuan Medical College from January 2020 to October 2022. Patients were divided into three groups based on the duration of postoperative antibiotic prophylaxis: Group A (<24 hours), Group B (24–48 hours), and Group C (>48 hours). The differences in postoperative infection incidence and nutritional indicators [serum albumin (ALB), prealbumin (PA), hemoglobin (Hb) levels] among the three groups of patients were compared. Multivariate logistic regression analysis was performed to analyze the risk factors.

Results: There existed a significant difference in the nutritional indicators among the patients in the three groups after surgery ($P<0.05$). On day 10 after surgery, the ALB, PA, and Hb levels of patients in group A were much higher than those in group B and group C ($P<0.05$). There was no significant difference in the levels of ALB, PA, and Hb between Group B and Group C ($P>0.05$). The infected group had a much higher proportion of patients with age ≥ 65 years, moderate pulmonary ventilation impairment, intraoperative blood loss ≥ 200mL, postoperative respiratory support with a tube, hospitalization days ≥ 25 days, and malnutrition than the uninfected group ($P<0.05$). Age, lung ventilation, hospitalization days, and preoperative malnutrition were all risk factors for postoperative infection in EC patients ($P<0.05$).

Conclusion: This study verified the hypothesis that "antibiotic use time ≤24 hours is associated with a lower infection rate trend and an increase in nutritional indicators", but the causal relationship could not be established due to the retrospective design. Age, pulmonary ventilation function, length of hospital stay, and preoperative malnutrition were independent risk factors for postoperative infection, supporting the clinical formulation of individualized antibiotic regimens based on the association between medication duration and infection/nutrition.

Keywords: esophageal cancer, preventive use of antibiotics, postoperative infection, nutritional status

Introduction

Esophageal cancer (EC) is a common malignant tumor, and the preferred treatment is surgery. However, due to the complex anatomy of the esophagus, EC surgery is difficult, and the incidence of postoperative complications is high. During the surgical process, bacteria in the esophageal cavity may seriously contaminate the surgical field and become important endogenous bacteria for postoperative infections.[1] Postoperative infection not only prolongs the hospital stay of patients and increases medical expenses, but also affects the prognosis of patients.[2] The rational use of antibiotics is the key to preventing infections, according to the *Global Guidelines for the Prevention of Surgical Site Infections*

Received: 22 December 2024
Accepted: 22 July 2025
Published: 5 August 2025

released by the World Health Organization (WHO) and current standard documents guiding the cautious use of antibiotic substances. The long-term prophylactic use of antibiotics after EC surgery is not recommended. Excessive prolongation of medication time does not improve the preventive effect, but may instead increase the chance of drug-resistant bacterial infections.[3,4] However, in clinical practice, the problem of prolonged prophylactic use of antibiotics during the perioperative period still exists, especially in departments with high surgical difficulty and postoperative infection risk. Due to their own diseases and surgical trauma, patients with EC often suffer from malnutrition to varying degrees. Malnutrition can damage the immune system of patients, affect postoperative recovery, and increase the chance of infection.[5] Among them, serum albumin (ALB) is the main protein synthesized by the liver, which can reflect the protein nutritional status of the body and the synthetic function of the liver. Prealbumin (PA) has a short half-life and can sensitively reflect the changes in recent nutritional intake and consumption. Hemoglobin (Hb) is related to the body's oxygen-carrying capacity and anemia status.[6,7] The dynamic changes of these three indicators (ALB, PA, Hb) can directly reflect the recovery process of the postoperative nutritional status of patients and are closely related to the risk of infection and prognosis. Therefore, nutritional support plays a crucial role in the postoperative recovery of EC. Enteral nutrition is a simple, safe, effective, and economical clinical nutritional support method. It not only promotes the recovery of gastrointestinal motility and protects the intestinal mucosal barrier, but also reduces the incidence of intestinal infections, facilitates nutrient absorption, and promotes early recovery of patients. Early postoperative enteral nutrition support can quickly correct patients' immune dysfunction and reduce the incidence of postoperative complications.[8]

Given the high incidence of postoperative infections in EC and the controversy surrounding the timing of antibiotic use, as well as the impact of malnutrition on postoperative recovery, based on the WHO guidelines for the prevention of surgical site infections and the current situation of overly long antibiotic courses in clinical practice, this study set testable goals: ① Compare the differences in the incidence of infection among the three groups of patients with postoperative antibiotic use time < 24 hours, 24–48 hours, and > 48 hours; ② Analyze the correlation between the medication duration and the nutritional indicators 10 days after the operation; ③ Independent risk factors for infection were identified through multivariate Logistic regression. The study adopted a retrospective design to provide relevant evidence for evidence-based drug use.

Materials and Methods

General Materials

A retrospective analysis was conducted on 566 patients who underwent EC surgery at the Affiliated Hospital of North Sichuan Medical College in Shunqing District, Nanchong City, Sichuan Province, from January 2020 to October 2022. The inclusion process was shown in Figure 1. Inclusion criteria: (1) Patients who met the clinical diagnostic criteria for EC[9] and had been pathologically diagnosed as malignant tumors of the esophagus; (2) The patients had indications for radical surgery for EC (patients with clinical stages T1b-N0-M0 to T3-N1-M0, without obvious invasion or surgical contraindications; patients with lesions exceeding 5cm or distant metastasis or lymph node metastasis), and they were all first-time recipients of surgical treatment; (3) The Eastern Cooperative Oncology Group (ECGO) score ranged from 0 to 2 points;[10] (4) The patient's expected survival period was ≥ 6 months; (5) Patients with complete clinical data. Exclusion criteria: (1) Patients with infection at admission; (2) Patients with symptomatic central nervous system metastases; (3) Patients with concomitant thrombotic diseases or those receiving anticoagulant therapy; (4) Patients merged with other types of malignant tumors; (5) Patients with distant metastasis; (6) Patients with combined acute and chronic infections, hematological diseases, and autoimmune diseases.

Surgery Methods

All patients underwent thoracoscopic radical EC. The surgical operations followed the standard surgical procedures, and the specific details of the surgical methods did not affect the analysis of the antibiotic use time in this study.

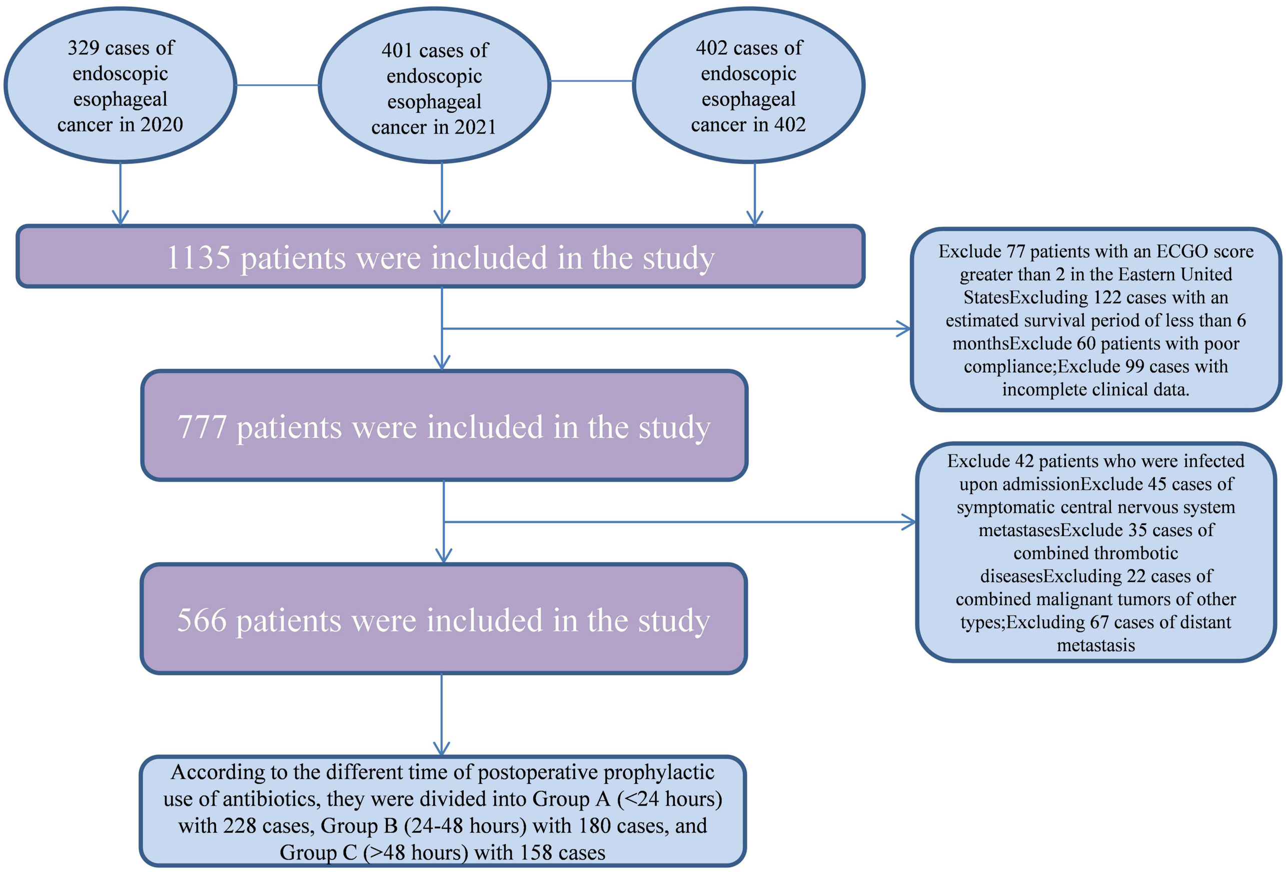

Figure 1 The inclusion process of patients.

Grouping and Treatment Methods

Referring to the WHO guidelines for the prevention of surgical site infections,[3] three time points were set according to the duration of postoperative antibiotic use, among which there were 228 cases in Group A (< 24 hours), 180 cases in Group B (24–48 hours), and 158 cases in group C (>48 hours). Antibiotic treatment plan: Cephalosporins or penicillins were administered intravenously. Cephalosporins: Cefuroxime (Fujian Fukang Pharmaceutical Co., Ltd., approval number: H20063900), 1.5–3g each time, dissolved in 100 mL of 0.9% sodium chloride injection, intravenous drip, once every 12 hours. Penicillins: Ampicillin Sodium and Sulbactam Sodium (Sichuan Pharmaceutical Preparation Co., Ltd., National Medical Products Approval No. H20053497, 0.75g), 1.5g each time, added to 250 mL of 0.9% sodium chloride injection, intravenous drip, every 6 hours.

Use principle: if the patient had no significant infection risk factors (such as old age, weak body, low immune function, diabetes, etc)., the prophylactic use of antibiotics after surgery could be shortened, generally not more than 24 hours. For patients with high infection risk factors, including old age, infirmity, immune dysfunction, diabetes, etc., or with contaminated wounds during surgery, the prophylactic use of antibiotics after surgery is needed more than 48 hours.[11] If the surgery time was long (more than 3 hours), the blood loss was large (more than 300 mL), or there were mild risk factors for infection in the patient, the prophylactic use of antibiotics after surgery might need to be extended to 24–48 hours.[12]

Outcome Measures

(1) The incidence of postoperative infection in groups A, B, and C was recorded with the following criteria:[13] peripheral white blood cell count (WBC)>15×10^9/L, body temperature ≥ 38°C, worsening symptoms such as cough and sputum after surgery, rales in the lungs, and infiltrative lesions on chest X-rays. Infection diagnosis was based on clinical

symptoms and laboratory tests, but bacterial culture and inflammatory marker detection were not routinely carried out. Because this operation was not a necessary step in the decision-making of the antibiotic treatment course after EC, and only a few patients retained relevant records in the retrospective data.

(2) A total of 5mL of elbow venous blood was drawn from the patients in the early morning on 7 days and 10 days after the operation, respectively. Among them, 3mL was injected into an anticoagulant tube containing heparin sodium anticoagulant, and 2mL was injected into a common tube without anticoagulant. The tubes were centrifuged at 3000r/min for 10 minutes to separate the plasma from the anticoagulant tube samples and the serum from the ordinary tube samples. The upper layer of serum was taken for testing. The levels of serum albumin (ALB), prealbumin (PA), and hemoglobin (Hb) were measured using a high-performance liquid-phase electrochemical method (the kits were purchased from Shenzhen Zike Biotechnology Co., Ltd).

(3) A retrospective research method was adopted to collect and analyze the clinical data of patients through the Hospital Infection Prevention and Control Information Platform (HAISS), including demographic characteristics (age and gender, etc)., medical history (smoking history, drinking history, chemotherapy history), preoperative lung ventilation test results, surgical duration, American Society of Anesthesiologists (ASA) score, intraoperative blood loss, length of hospital stay and the duration of postoperative antibiotic prophylaxis, preoperative nutritional status, and other data. Criteria for determining malnutrition: BMI<18.5 kg/m^2; For patients aged ≥ 70 years, a BMI<22 kg/^{2} indicated malnutrition and/or recent involuntary weight loss exceeding 10%, or involuntary weight loss exceeding 5% within 3 months.

Determination of antibiotic treatment course: The time of the first use of antibiotics after the operation is recorded as 0 points. The time of drug withdrawal is based on the end time of the last intravenous infusion, which is independently verified by two attending physicians through the electronic medical order system for confirmation.

Nutritional index detection quality control: ALB and PA were detected using the Beckman Coulter AU5800 fully automatic biochemical analyzer (USA). The intra-batch CV of the kit was less than 5%, and the inter-batch CV was less than 8%. Hb detection was carried out using the Sysmex XN-9000 blood analyzer, and the calibration of the matching calibrators was conducted before the daily startup.

Data collection norms: Data were extracted by three trained researchers through the hospital's electronic medical record system (EMR). A double-person double-entry method was adopted, and logical verification was conducted using Epidata 3.1 software. Inconsistent data were confirmed through the review of the original medical records.

Statistical Analysis

SPSS 22.0 software was used for statistical data analysis in this study. The enumeration data were represented as [cases (%)] and subjected to a χ^2 test. The measurement data were subjected to normality and homogeneity of variance tests. Measurement data that conformed to a normal distribution or approximately followed a normal distribution were presented in the form of (x±s). Analysis of variance was used for inter group comparisons, and the LSD test was used for pairwise comparisons. Univariate and multivariate logistic regression analysis were used to identify risk factors for postoperative infection in patients with EC. In this study, a statistical result of P<0.05 was considered statistically significant.

Results

Comparison of General Information Among the Three Groups

There was no statistically significant difference in age, gender, and ECGO scores among the three groups of patients (P>0.05, Table 1).

Comparison of Postoperative Infection Rates Among the Three Groups

Group A had a lower incidence of postoperative infection than Group B and Group C, and Group B had a lower incidence than Group C. However, there was no statistically significant difference among the three groups (P>0.05, Table 2).

Table 1 Comparison of General Information Among the Three Groups

Groups	Cases	Age (Year)	Gender		ECGO Scoring	
			Male	Female	0-1 Score	2 Scores
Group A	228	56.52±15.13	138(60.53)	90(39.47)	123(53.95)	105(46.05)
Group B	180	57.82±13.42	105(58.33)	75(41.67)	98(54.44)	82(45.56)
Group C	158	55.30±11.77	99(62.66)	59(37.34)	87(55.06)	71(44.94)
F/χ^2			0.660		0.047	
P			0.719		0.977	

Notes: Three time points were set according to the duration of postoperative antibiotic use. Group A (< 24 hours), Group B (24–48 hours), and Group C (>48 hours).

Table 2 Comparison of Postoperative Infection Rates Among the Three Groups

Groups	Cases	Postoperative Infection (Cases, %)
Group A	228	82(35.96)
Group B	180	75(41.67)
Group C	158	72(45.57)
χ^2		3.734
P		0.155

Notes: Three time points were set according to the duration of postoperative antibiotic use. Group A (< 24 hours), Group B (24–48 hours), and Group C (>48 hours).

Comparison of Nutritional Indicators Among the Three Groups

Before surgery, there was no statistically significant difference in the levels of ALB, PA, and Hb among the three groups of patients ($P>0.05$). On day 10 after surgery, the ALB, PA, and Hb levels of patients in group A were much higher than those in group B and group C ($P<0.05$). There was no statistically significant difference in the levels of ALB, PA, and Hb between Group B and Group C ($P>0.05$, Table 3).

Univariate Analysis of Influencing Factors on Postoperative Infection in EC Patients

Univariate analysis exhibited that the infected group had a much higher proportion of patients with age ≥ 65 years, moderate pulmonary ventilation impairment, intraoperative blood loss ≥ 200mL, postoperative respiratory support with a tube, hospitalization days ≥ 25 days, and malnutrition than the uninfected group ($P<0.05$, Table 4).

Table 3 Comparison of Nutritional Indicators Among the Three Groups

Groups	Cases	ALB (g/L)		PA (mg/L)		Hb (g/L)	
		Before Surgery	10 Days After Surgery	Before Surgery	10 Days After Surgery	Before Surgery	10 Days After Surgery
Group A	228	33.42±6.18	44.64±2.54*	187.32±5.47	238.52±2.77*	120.90±2.37	133.67±1.78*
Group B	180	33.65±4.09	38.79±3.77*#	188.25±5.54	195.63±2.60*#	121.25±2.23	126.53±2.04*#
Group C	158	34.55±5.78	39.70±3.15*#	187.66±4.80	195.02±3.85*#	120.88±4.29	126.42±2.35*#
F		2.09	206.14	1.55	1261.99	0.88	850.41
P		0.124	<0.001	0.213	<0.001	0.416	<0.001

Notes: *$P<0.05$ compared to preoperative comparison in the same group, #$P<0.05$ compared to group A. Three time points were set according to the duration of postoperative antibiotic use. Group A (< 24 hours), Group B (24–48 hours), and Group C (>48 hours).

Table 4 Univariate Analysis of Influencing Factors on Postoperative Infection in EC Patients

Factors		Infected Group (n=229)	Uninfected Group (n=337)	χ^2	*P*
Gender	Male	144(62.88)	198(58.75)	0.972	0.324
	Female	85(37.12)	139(41.25)		
Age (year)	<65	125(54.59)	225(66.77)	08.572	0.003
	≥65	104(45.41)	112(33.23)		
Smoking history	Yes	119(51.97)	160(47.48)	1.098	0.295
	No	110(48.03)	177(52.52)		
Drinking history	Yes	93(40.61)	126(37.39)	0.597	0.440
	No	136(59.39)	211(62.61)		
History of chemotherapy	Yes	11(4.80)	8(2.37)	2.481	0.115
	No	218(95.20)	329(97.63)		
Pulmonary ventilation	Normal	122(53.28)	218(64.69)	7.405	0.007
	Moderate impairment	107(46.72)	119(35.31)		
Preoperative blood glucose (mmol/L)	<6.11	161(70.31)	250(74.18)	1.031	0.310
	≥6.11	68(29.69)	87(25.82)		
ASA scoring	GradeI	3(1.31)	7(2.08)	1.970	0.374
	GradeII	178(77.73)	245(72.70)		
	GradeIII	48(20.96)	85(25.22)		
Surgical duration (h)	<4	82(35.81)	106(31.45)	1.165	0.280
	≥4	147(64.19)	231(68.55)		
Intraoperative blood loss (mL)	<200	153(66.81)	264(78.34)	9.339	0.002
	≥200	76(33.19)	73(21.66)		
Postoperative respiratory support with a tube	Yes	79(34.50)	75(22.26)	10.318	0.001
	No	150(65.50)	262(77.74)		
Hospitalization days (d)	<25	99(43.23)	198(58.75)	13.173	<0.001
	≥25	130(56.77)	139(41.25)		
The duration of prophylactic antibiotic use	<24 hours	82(35.81)	146(43.32)	3.734	0.155
	24-48 hours	75(32.75)	105(31.16)		
	>48 hours	72(31.44)	86(25.52)		
Preoperative malnutrition	Yes	28(12.23)	22(6.53)	5.499	0.019
	No	201(87.77)	315(93.47)		

Multivariate Logistic Regression Analysis of Risk Factors for Postoperative Infection in Patients with EC

Using variables with $P<0.05$ in the univariate analysis as independent variables (age: ≥ 65 years=1, <65 years=0; pulmonary ventilation: moderate impairment=1, normal=0; intraoperative blood loss: ≥ 200mL=1, <200mL=0; postoperative respiratory support with tube: yes=1, no=0; length of hospital stay: ≥ 25d=1, <25d=0), and postoperative infection in EC patients as the dependent variable (infection=1, non infection=0), a multivariate logistic regression analysis was performed. The analysis showed that age, lung ventilation, hospitalization days, and preoperative malnutrition were all risk factors for postoperative infection in EC patients ($P<0.05$, Table 5 and Figure 2). By adjusting for confounding variables such as age, pulmonary ventilation, and malnutrition through multivariate Logistic regression (Table 5), the results showed that the duration of antibiotic use was still independently associated with the infection trend (P=0.029).

Discussion

EC is a common malignant tumor of the digestive tract that poses a serious threat to human health. Surgical treatment is one of the important means of comprehensive treatment for EC, but postoperative complications are more common,

Table 5 Multivariate Logistic Regression Analysis of Risk Factors for Postoperative Infection in Patients with EC

Independent Variables	*β*	*S.E.*	*Wald*	*P*	*OR*	95% CI	
						Lower Limit	Upper Limit
Age	0.389	0.312	10.231	<0.001	3.261	2.387	6.575
Lung ventilation	0.526	0.878	7.564	0.003	1.564	1.231	3.242
Intraoperative blood loss	0.338	0.423	2.224	0.423	1.012	0.574	2.231
Postoperative respiratory support with a tube	0.472	0.418	1.784	0.283	0.695	0.352	0.908
Hospitalization days	0.629	0.293	3.332	0.029	1.002	0.912	3.008
Malnutrition	0.743	0.311	5.718	0.017	2.103	1.143	3.867

among which infection is a prominent problem.[14] Postoperative infection can lead to prolonged hospitalization, increased medical expenses, and in severe cases, even endanger the patient's life. Common infection sites include the lungs, incisions, chest cavity, etc. Infection can cause a series of symptoms such as fever, pain, and respiratory dysfunction, which can affect the patient's recovery process.[15] According to research, the incidence of postoperative infection in EC is relatively high. A study[16] showed that among 97 patients undergoing EC surgery, 37 of them developed hospital-acquired infections, with an infection rate of 38.14%. Preventive measures are crucial for postoperative infections, and early prophylactic escalation of antibiotic use is also considered an effective strategy to reduce postoperative lung infections.[17] However, the excessive use of antibiotics may hurt nutritional status, such as causing dysbiosis of the gut microbiota, affecting the absorption and utilization of nutrients, etc.[18] Therefore, reasonable control of antibiotic use time is also one of the important measures to protect the nutritional status of patients.

In surgical procedures, prophylactic use of antibiotics is an effective measure to prevent postoperative infections, increase surgical safety, and improve cure rates. The application of antibiotics can achieve effective bactericidal concentrations in blood and tissue, and maintain them during the risk period of surgical infection, thereby significantly reducing postoperative infections.[19] The duration of postoperative prophylactic use of antibiotics varies depending on the type of surgery and patient condition. However, studies have shown[20] that extending the duration of antibiotic prophylaxis does not further reduce the risk of postoperative infection, but may instead increase the risk of adverse drug reactions and emergency visits. A study by American scholars[21] showed that the benefits of prophylactic use of

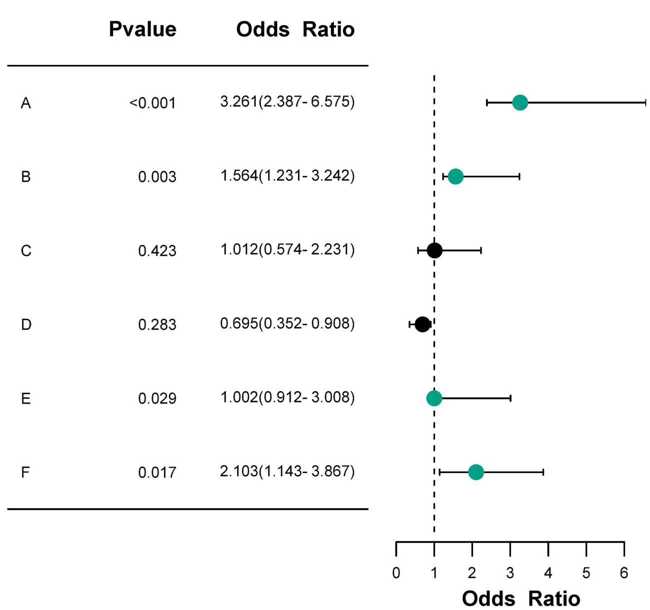

Figure 2 Forest plot analysis of risk factors for postoperative infection in EC patients.
Notes: A: Age; B: Pulmonary ventilation; C: Intraoperative blood loss; D: Postoperative respiratory support with a tube; E: Hospitalization days; F: Malnutrition.

antibiotics after surgery are limited to 24 hours after surgery. For most surgeries, antibiotics should be discontinued within 24 hours after the surgical incision. Bratzler et al[22] found that only 55.7% of the patients received single-dose antibiotic prophylaxis within one hour before the operation. Besides, 92.6% of the patients' medication types were in line with the guideline recommendations. The drug withdrawal rate was only 40.7% within 24 hours after the operation. Hartmann et al[23] found that 877 out of 4304 patients who underwent general surgery and trauma surgery received inappropriate antibiotic prophylaxis. Gorecki et al[24] reported that 71% of patients who underwent elective surgery received unreasonable antibiotic treatment. The main reasons for unreasonable use of antibiotics included prolonged treatment time (61%), followed by inappropriate timing of medication (29%) and improper selection of antibiotic types (28%). At present, relevant guidelines in China mainly refer to foreign data, suggesting that the postoperative antibiotic prophylaxis time should be 24 hours, and it can be extended to 48 hours after surgery for high-risk infected populations. This study showed that the incidence of postoperative infection increased sequentially in Group A, Group B, and Group C, but there was no statistically significant difference among the three groups. The use of antibiotics within 24 hours after surgery might reduce the incidence of postoperative infections. The reason for this might be that the use of antibiotics within 24 hours after surgery could quickly reach effective drug concentrations in the surgical site and blood, thereby inhibiting or killing possible bacteria and reducing the risk of infection. In surgical operations, the prophylactic use of antibiotics is the core measure to prevent postoperative infections. Multiple studies have confirmed that the excessive use of antibiotics after EC surgery is positively correlated with the risk of colonization by drug-resistant bacteria. For example, Suehiro et al[25] found that the use of antibiotics for more than 24 hours during gastric cancer and colorectal surgery did not reduce the infection rate. Instead, it increased the risk of Clostridium difficile infection. Chareancholvanich et al[26] pointed out in the knee replacement study that extending the medication to more than 24 hours increased the prosthesis infection rate from 0.5% to 1.2%. Research by American scholars[27] has shown that the benefits of postoperative antibiotics are limited to within 24 hours, which is consistent with the 24-hour drug withdrawal principle recommended by the international consensus on joint replacement infections.[28] Furthermore, specific studies on EC have shown that the risk of postoperative infection in patients with preoperative malnutrition increases by 2.1 times,[29] which echoes the conclusion in this study that malnutrition is an independent risk factor.

The results of this study showed that on postoperative day 14, the levels of ALB, PA, and Hb in group A were higher than those in group B and group C, suggesting that the use time of antibiotics ≤24 hours may facilitate nutritional recovery by reducing inflammatory consumption. The possible reason for this might be that antibiotics could effectively inhibit the growth of pathogenic bacteria in the surgical site and the whole body, thereby reducing postoperative infections and inflammatory reactions, and ultimately reducing the consumption of nutrients by inflammation in the body. In addition, after infection, the body will produce a series of inflammatory reactions that consume a large amount of nutrients such as protein, vitamins, etc. The application of antibiotics can alleviate inflammatory reactions, thereby reducing the consumption of nutrients and helping to improve the nutritional status of patients.[30] In clinical practice, the specific situation of patients should be comprehensively considered to reasonably control the duration of antibiotic prophylaxis after EC surgery, in order to reduce the risk of postoperative infection, improve the nutritional status of patients, and promote their recovery. The trend change in the incidence of infection in this study might mainly reflect the preventive effect of incision site infection, while the influence of the duration of antibiotic use on complex complications such as anastomotic fistula needs to be further subdivided and studied in combination with surgical techniques.

In this study, we corrected confounding variables such as age, lung ventilation, and malnutrition through multivariate Logistic regression analysis. The results showed that the duration of antibiotic use was still correlated with the infection trend, weakening the influence of selective bias to a certain extent. As age increases, the immune system function of the human body gradually weakens, which reduces the resistance of elderly patients to infections. The wound healing and overall recovery speed of elderly patients after surgery is slow, which increases the risk of infection.[31] In addition, elderly patients may be accompanied by a variety of chronic diseases, such as diabetes, hypertension, etc, which will increase the risk of infection.[32] EC radical surgery often involves incision of the chest cavity and traction of lung tissue, which may lead to inflammation and increased secretion in the lungs. Due to pain, weakness, and other reasons, postoperative patients have limited ability to expel phlegm, and respiratory secretions are prone to accumulate in the lungs. When lung ventilation increases, the airflow velocity accelerates, but secretion discharge may still be obstructed, providing an environment for bacteria to grow and reproduce. Too many or complex types of bacteria in respiratory secretions may further lead to the occurrence of lung infections.[33,34] The extension of hospitalization time means that patients are more exposed to the hospital environment, which is a high-density gathering place for various pathogens. Prolonged hospitalization may also lead to further decline in patients' physical function and sustained weakening of the immune system, thereby increasing the risk of infection.[35] Meanwhile, cross-infection within hospitals is also one of the important reasons for the increased risk of infection in long-term hospitalized patients. To reduce the risk of postoperative infection caused by these risk factors, the following measures can be taken to conduct a comprehensive preoperative evaluation of elderly patients: (1) Develop personalized surgical and postoperative care plans based on the patient's physical condition and chronic disease situation. (2) Strengthen infection control measures within hospitals, such as regular disinfection, strict aseptic procedures, and rational use of antibiotics. (3) For patients who require postoperative respiratory support, the use time and frequency of the tubing should be minimized as much as possible, and the cleaning and disinfection of the tubing should be strengthened. (4) Encourage patients to get out of bed and move around as early as possible to promote physical recovery and improve immune function. (5) Shorten hospitalization time and reduce the exposure time of patients in the hospital, thereby reducing the risk of infection. Preoperative malnutrition can lead to a lack of nutrients such as protein and vitamins in the patient's body, slowing down the healing process of the wound and even potentially causing poor healing. Once the wound does not heal properly, it is susceptible to invasion by external pathogens, thereby increasing the risk of postoperative infection.[36] In addition, malnutrition can weaken the patient's immune system, leading to a decrease in the number and function of immune cells, thereby reducing the patient's resistance to external pathogens.[37] After EC surgery, patients themselves have a lower immune system, and if malnutrition occurs, they are more susceptible to infection by pathogens. The results of this study only reflected the statistical association between the duration of antibiotic use and infection/nutritional indicators, rather than a causal relationship. The use of antibiotics might indirectly affect nutritional consumption by inhibiting bacterial colonization at the surgical site, but this requires verification through prospective studies.

In summary, the prophylactic use of antibiotics for 24 to 48 hours balanced infection prevention and control with nutritional protection. Age ≥65 years old, pulmonary ventilation disorder, hospitalization ≥25 days, and preoperative malnutrition were independent risk factors for postoperative infection. Comprehensive interventions such as preoperative pulmonary function assessment and nutritional support reduced the risk of infection. In the future, we need to expand the sample size and incorporate the research on the deepening mechanism of microbiological detection. This study was a single-center retrospective design. Bacterial culture and detection of inflammatory factors (such as PCT and CRP) before and after antibiotic treatment were not conducted. Therefore, the direct association between the duration of antibiotic use and the clearance efficiency of pathogenic bacteria or the intensity of the inflammatory response could not be clearly defined. Judging infection solely based on clinical symptoms (such as body temperature and white blood cell count) lacks microbiological evidence support, which might lead to false positives or false negatives in the diagnosis of infection. Subsequent studies need to combine etiological detection and dynamic monitoring of inflammatory markers to improve the mechanism analysis. In the future, multicenter prospective cohort studies still need to be carried out to control confounding factors through randomized grouping, to clarify the causal relationship between the duration of antibiotic use and infection.

Conclusion

The prophylactic use of antibiotics after EC surgery was advisable for 24 to 48 hours. This course of treatment reduced the risk of infection and improved nutritional indicators (ALB, PA, Hb). Age, pulmonary ventilation function, length of hospital stay, and preoperative malnutrition were the main risk factors for postoperative infection. In clinical practice, preoperative nutritional assessment, respiratory management, and precise use of antibiotics should be combined to improve the surgical efficacy.

Data Sharing Statement

The figures used to support the findings of this study are included in the article.

Ethical Approval

The Ethics Committee of Affiliated Hospital of North Sichuan Medical College authorized the study (Approval number. 2022ER555-1). Written informed consent was obtained from all individual participants included in the study. Our study complies with the Declaration of Helsinki.

Consent to Participate

The patients participating in the study all agree to publish the research results.

Funding

This study was supported by the grants: The 14th Five-Year Plan project of Nanchong Social Science Federation in 2023 (No. NC23C131).

Disclosure

Dong Ning and Lin Zhou are co-first authors for this study. The authors declare that they have no competing interests in this work.

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