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The Effect of Fiberoptic Bronchoscopy Combined with Alveolar Lavage in the Treatment of Severe Lung Infection After Gastric Cancer Surgery

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Abstract: *Objective:* To explore the effect of fiberoptic bronchoscopy combined with alveolar lavage in the treatment of severe lung infection after gastric cancer surgery. *Methods:* 60 patients with severe lung infection after gastric cancer surgery who were admitted into The First Hospital of Nanping from January 2020 to June 2023 were selected as study subjects. The patients were randomly divided into a control group and an experimental group, with 30 cases in each group. The control group was treated with conventional treatment methods, and the experimental group was treated with fiberoptic bronchoscopy combined with alveolar lavage. The clinical efficacy of the treatment and the blood gas index levels (PaO_2, $PaCO_2$, SpO_2) and serum inflammatory factor levels (CRP, IL-6, IL-8) of the two groups were evaluated. *Results:* The treatment received in the experimental group was more effective than that of the control group ($P < 0.01$). Besides, the PaO_2 and SpO_2 of the patients in the experimental group were higher than those of the control group after treatment; the $PaCO_2$ of the experimental group was lower than that of the control group; and the differences were statistically significant ($P < 0.01$). Both groups showed a significant decrease in CRP, IL-6, and IL-8 levels after the treatment ($P < 0.01$). *Conclusion:* Fiberoptic bronchoscopy combined with alveolar lavage is effective in treating severe lung infection after gastric cancer surgery, so it should be popularized in clinical practice.

Keywords: Gastric cancer; Fiberoptic bronchoscopy; Alveolar lavage; Severe lung infection

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1. Introduction

Gastric cancer is a common malignant tumor of the digestive tract, and it is mainly treated by surgery. However, the surgery may lead to several complications, especially severe lung infection, which brings great pain, treatment difficulty, and economic burden to patients. Lung infection is usually treated with antibiotic therapy and symptomatic treatment, but its effect is less ideal [1]. Fiber bronchoscopy combined with alveolar lavage is a novel minimally invasive procedure that involves removing airway secretions and local necrotic tissues through direct microscopic visualization of the lesion site. It improves the concentration of drugs in the infected site, achieving a better therapeutic effect [2]. In recent years, more and more studies have shown that fiberoptic

bronchoscopy combined with alveolar lavage is effective in treating lung infections, but its application in the treatment of severe lung infection after gastric cancer surgery is limited. Therefore, this study aimed to investigate the therapeutic effect of fiberoptic bronchoscopy combined with alveolar lavage in the treatment of severe lung infection after gastric cancer surgery.

2. General information and methods

2.1. Baseline data of the subjects

60 patients with severe lung infection after gastric cancer surgery who came to our hospital for treatment from January 2020 to June 2023 were selected as the study subjects. Among them, 35 patients were male, with an average age of 56.24 ± 10.2 years old, and 25 patients were female, with an average age of 53.27 ± 9.25 years old. The patients were divided into a control group and an experimental group, with 30 cases in each group. There was no statistically significant difference between the two groups in terms of gender, age, and other general information ($P > 0.05$).

Inclusion criteria: (1) diagnosed with gastric cancer and had undergone gastric cancer surgery, (2) clinically diagnosed with severe lung infection.

Exclusion criteria: (1) history of lung surgery, (2) presence of other serious diseases such as cardiac, hepatic, renal insufficiency, and so on.

2.2. Treatment methods

The control group was treated with conventional treatment methods [3]. The experimental group was treated with fiberoptic bronchoscopy combined with alveolar lavage, which included the following aspects: (1) Preparations were made before the surgery, including necessary laboratory tests and imaging tests, such as blood routine, electrocardiogram, chest X-ray, and computed tomography (CT) scan. The patients' families signed an informed consent form and the patients did preoperative fasting, oral cleaning, etc. (2) During the surgery, the patients were semi-recumbent, using local anesthesia, a fiberoptic bronchoscope was inserted into the airway through the nasal cavity, and the position of the fiberoptic bronchoscope was adjusted according to the site of the lesion to observe the airway. Tracheal or bronchial secretions were extracted and sent for a drug sensitivity test. Thereafter, under direct bronchoscopic visualization, alveolar lavage was performed using saline or drug solutions to remove infected or space-occupying lesions. Subsequently, the fiberoptic bronchoscope was withdrawn, the patients' vital signs and any complications were observed and they were instructed to abstain from food and water for 2 hours and given the necessary medications.

2.3. Detection method

Fasting venous blood of patients 1 day before and 3 days after fiberoptic bronchoscopy combined with alveolar lavage treatment was collected for laboratory testing.

2.4. Observation indicators

Clinical symptoms, CT scans, and blood routine indexes were used to evaluate the clinical efficacy of the treatments (**Table 1**), and the total efficacy = (cured + improved)/100%.

Table 1. Clinical efficacy evaluation indexes

Clinical efficacy indicators	Clinical symptoms	CT scan	Hematologic indicators
Cure	Disappearance of clinical symptoms	Complete lesion absorption	Normal
Improvement	Improvement in clinical symptoms	Partial lesion absorption	Improved
Ineffective	No improvement in clinical symptoms	The lesion was not absorbed	No improvement

The changes in blood gas indexes and serum inflammatory factor levels of patients in the two groups were observed and the evaluation indicators are shown in **Table 2**.

Table 2. Blood gas indicators and serum inflammatory factor level indicators

Indicators	Specific indicators	Acronym
Blood gas indicators	Blood oxygen partial pressure	PaO_2
	Carbon dioxide partial pressure	$PaCO_2$
	Oxygen saturation	SpO_2
Inflammatory factor levels	C-reactive protein	CRP
	Interleukin	IL-6, IL-8

2.5. Statistical analysis

The study data were entered into SPSS 22.0 software for statistical analysis. Measurement information were expressed as mean ± standard deviation and were analyzed using a *t*-test; *Z*-test was used for comparison between groups; $P < 0.05$ indicated a statistically significant difference.

3. Results

3.1. Clinical efficacy

The clinical efficacy of the treatment received in the experimental group (29/96.67%) was significantly higher than that of the control group (22/73.33%), and the difference was statistically significant at $P < 0.05$.

Table 3. Comparison of clinical efficacy levels between the two groups

Group	Ineffective	Improved	Cured	Total efficacy
Control group ($n = 30$)	8	12	10	22 (73.33)
Observation group ($n = 30$)	1	9	20	29 (96.67)
Z		2.923		
P		0.035		

3.2. Blood gas indicators

The PaO_2 of both groups was similar before treatment ($P > 0.05$); after the treatment, the scores of $PaCO_2$ indexes of the two groups were significantly reduced, with the experimental group showing a greater decrease than the control group ($P < 0.01$). The SpO_2 scores of the two groups increased after treatment, with the experimental group showing a greater increase ($P < 0.01$), as shown in **Table 4**.

Table 4. Comparison of blood gas parameters

Blood gas indicators	Time	Control group (n = 30)	Observation group (n = 30)	t	P
PaO_2	Before treatment	47.25 ± 8.21	48.10 ± 10.05	0.359	0.721
	After treatment	59.25 ± 9.15	66.25 ± 10.35	2.775	0.007
t		0.347	6.891	–	–
P		0.000	0.000	–	–
$PaCO_2$	Before treatment	72.12 ± 8.25	71.39 ± 10.14	0.306	0.761
	After treatment	55.58 ± 8.69	36.24 ± 9.21	8.366	0.000
t		7.561	14.051	–	–
P		0.000	0.000	–	–
SpO_2	Before treatment	80.12 ± 10.12	79.99 ± 10.02	0.00	0.960
	After treatment	89.25 ± 9.25	98.57 ± 6.28	4.566	0.000
t		3.648	8.606	–	–
P		0.000	0.000	–	–

3.3. Inflammatory factor levels

After treatment, the experimental group's CRP, IL-6, and IL-8 levels were significantly lower than the control group ($P < 0.01$), as shown in **Table 5**.

Table 5. Comparison of inflammatory factor levels

Inflammatory factor levels	Time	Control group (n = 30)	Observation group (n = 30)	t	P
CRP	Before treatment	122.56 ± 28.35	120.25 ± 27.58	0.320	0.750
	After treatment	25.12 ± 2.25	6.58 ± 2.10	32.994	0.000
t		18.766	22.509	–	–
P		0.000	0.000	–	–
IL-6	Before treatment	90.25 ± 20.15	89.98 ± 20.24	0.052	0.959
	After treatment	12.59 ± 2.17	25.62 ± 2.54	21.363	0.000
t		20.988	17.443	–	–
P		0.000	0.000	–	–
IL-8	Before treatment	310.25 ± 81.26	309.62 ± 82.19	0.030	0.976
	After treatment	45.67 ± 9.68	25.68 ± 10.05	7.847	0.000
t		17.709	18.782	–	–
P		0.000	0.000	–	–

4. Discussion

Gastric cancer is one of the most common malignant tumors worldwide, with an increasing number of cases every year and a high mortality rate. Surgical intervention is still the primary method for treating gastric cancer. However, various complications are prone to occur after gastric cancer surgery, with lung infection being the most common, and patients with severe lung infection are in critical condition [4], requiring timely and effective treatment. Common treatment modalities such as antibiotic therapy, continuous oxygenation, etc. are not effective [5,6]. Thus, along with the development of fiberoptic bronchoscopy technology, the treatment of

fiberoptic bronchoscopy combined with alveolar lavage has been widely used in the treatment of postoperative severe lung infections after gastric cancer surgery. This method is favored for its benefits of minimal trauma and high efficacy [7].

This treatment method is superior in treating lung infections for several reasons. (1) Removal of pathogenic microorganisms and secretions: bronchoscopy allows direct observation of the lesion site of lung infection and the removal of pathogenic microorganisms and excess secretions. This helps to reduce the symptoms of infection and prevent the spread of infection. (2) Improvement of intrapulmonary ventilation and lung function: Through fiberoptic bronchoscopy alveolar lavage, the secretions and obstructions in the airways can be effectively removed, improving intrapulmonary ventilation, and thus restoring the lung function of the patient. As a result, the respiratory condition of the patient will be improved and respiratory difficulties will be alleviated [8,9]. (3) Direct local drug delivery: through fiberoptic bronchoscopy, therapeutic drugs such as antibiotics can be delivered directly to the infected alveolar site, increasing the concentration of the drug in the infected site, improving the penetration and concentration of the drug in the lungs, thus improving the antimicrobial effect [10]. (4) Promotion of lung tissue repair: Alveolar lavage fluid can flush out inflammatory factors and harmful substances, reducing the inflammatory response of the lungs. It can also deliver nutrients and growth factors for lung tissue repair, which can help to repair the damaged tissues in the lungs [11] (5) Precise diagnosis: fiberoptic bronchoscopy allows direct observation of the lesions of lung infection. Besides, samples of lesions can be collected for bacterial culture and drug sensitivity test, which allows precise diagnosis and treatment [12]; (6) Reducing antibiotic resistance: The results of bacterial culture and drug sensitivity test of pathogenic microorganisms obtained by fiberoptic bronchoscopy combined with alveolar lavage can guide doctors in selecting antibiotics to avoid antibiotic abuse and the possibility of drug resistance. (7) Improving the patient's quality of life: Fiberoptic bronchoscopy combined with alveolar lavage can be carried out under local anesthesia, which is less traumatic to the patient. This approach is easy and safe to operate, facilitating a quicker patient recovery. Additionally, it has the potential to shorten hospitalization durations and enhance the overall quality of life for the patient.

In recent years, there have been many studies showing the superiority of this treatment modality [13]. Ye [14] found that this treatment method can downregulate the level of inflammatory factors and improve respiratory function when treating patients with lung infections after lung cancer surgery. Yang et al. [15] found that the treatment method can improve the clinical therapeutic effect of patients and reduce the level of inflammatory factors. These results are consistent with the findings of this paper.

Although this technology is widely used, it is not without limitations. On one hand, it is expensive, which may bring a certain economic burden to patients. On the other hand, it comes with certain risks for the elderly, frail, or patients with other serious diseases. Therefore, there are several things to be noted when implementing this treatment regimen. (1) The indications should be well-defined: This technique is only applicable for treating lung infections after gastric cancer surgery, not to other types of infections or non-infectious diseases. Therefore, it is important to ensure that the patients meet the treatment requirements. (2) Making good preoperative preparations: It is necessary to understand the patient's medical history, signs, laboratory tests, and imaging tests, and evaluate the patient's condition and surgical risks before the operation. Besides, it is necessary to explain to the patient and his family the purpose, procedure, and possible risks of the surgery and make sure that they sign the informed consent. (3) During the surgery, it is crucial to strictly adhere to aseptic operating procedures. Simultaneously, maintaining an open respiratory tract is essential to prevent respiratory distress or asphyxia resulting from the procedure. Furthermore, continuous monitoring of the patient's vital signs is necessary, and any abnormalities should be promptly addressed. (4) Post-operative

nursing precautions: It is necessary to keep the patient's respiratory tract open after the operation to avoid violent coughing and forceful breathing. At the same time, it is necessary to closely observe the changes in the patient's vital signs. Symptoms like fever, chest pain, and dyspnea should be dealt with promptly. In addition, it is also necessary to pay attention to oral hygiene to prevent oral infection. (5) Prevention of complications: Fibrooptic bronchoscopy combined with alveolar lavage may cause some complications, such as hemorrhage, pneumothorax, cardiac arrhythmia, and so on. Therefore, several preventive measures should be taken, such as controlling blood pressure, avoiding violent coughing, and appropriate use of sedatives. (6) Rational use of antibiotics: Fiberoptic bronchoscopy combined with alveolar lavage can guide doctors in choosing suitable antibiotics to avoid antibiotic abuse. Therefore, antibiotics need to be selected according to the results of pathogenic microorganism culture and drug sensitivity tests, and the patients should use them according to the doctor's instructions.

The sample size of this study was small, so it may not fully reflect its the true effectiveness of this treatment in treating severe lung infection after gastric cancer surgery. Therefore, further expansion of the study sample size and long-term, rigorous controlled experiments are needed in the future to verify the reliability of its findings. In addition, this study may have the problem of too short a time frame, which may lead to the inability to adequately assess its long-term effect in the treatment of postoperative combined severe lung infection after gastric cancer.

Disclosure statement

The author declares no conflict of interest.

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