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Study on the Clinical Efficacy of Levofloxacin Combined with Ambroxol in the Treatment of Elderly Patients with Chronic Obstructive Pulmonary Disease and Pulmonary Infection

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Abstract: *Objective:* To investigate the clinical efficacy of levofloxacin combined with ambroxol in the treatment of elderly patients with chronic obstructive pulmonary disease (COPD) and pulmonary infection. *Methods:* A total of 80 elderly COPD patients with pulmonary infection, treated between December 2022 and November 2023, were randomly divided into a control group and an observation group, with 40 cases in each group. The control group was treated with levofloxacin hydrochloride, while the observation group received ambroxol hydrochloride injection in addition to the treatment in the control group. Laboratory indices (white blood cell count, procalcitonin, C-reactive protein, and apolipoprotein E levels), imaging-based pulmonary lesion absorption time, hospital stay, and incidence of adverse reactions were compared between the two groups. *Results:* After treatment, the biochemical indices of the observation group were significantly lower than those of the control group, with highly significant differences ($P < 0.001$). Compared to the control group, the imaging-based pulmonary lesion absorption time and hospital stay of the observation group were significantly shorter ($P < 0.001$). Additionally, the incidence of adverse reactions in the observation group was significantly lower than in the control group ($P < 0.05$). *Conclusion:* Levofloxacin combined with ambroxol demonstrates advantages in improving biochemical indices, shortening imaging-based pulmonary lesion absorption time and hospital stay, and reducing adverse reaction rates in elderly COPD patients with pulmonary infection. It holds significant clinical application value.

Keywords: Levofloxacin; Ambroxol; Elderly chronic obstructive pulmonary disease; Pulmonary infection

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1. Introduction

Chronic obstructive pulmonary disease (COPD), a common chronic respiratory disease, has a high prevalence, and heavy disease burden, and poses a severe threat to the health of the elderly. It is one of the leading causes

of death in older adults [1,2]. The primary characteristics of COPD include chronic respiratory symptoms such as dyspnea, cough, and sputum production, typically presenting as persistent and progressively worsening airflow obstruction. This leads to a gradual decline in respiratory function and significantly affects the patient's quality of life. Clinically, COPD not only has a high incidence but is also frequently accompanied by pulmonary infections, which exacerbate the condition. Pulmonary infections aggravate symptoms like dyspnea, increased cough, and sputum production, severely impairing quality of life, increasing hospitalizations, and raising mortality rates [3].

Timely and effective treatment is critical to improving the prognosis of these patients. Antibiotic therapy is one of the most important measures for controlling pulmonary infections associated with COPD [4]. Levofloxacin hydrochloride, a commonly used quinolone antibiotic, exhibits broad-spectrum antibacterial activity and effectively inhibits the growth and reproduction of various bacteria. It is widely used in treating COPD with pulmonary infections. However, the sole use of antibiotics sometimes fails to meet all treatment needs.

Ambroxol hydrochloride injection, a mucolytic agent, increases the secretion of serous glands in the respiratory tract, reduces mucus gland secretion, decreases sputum viscosity, and promotes sputum clearance. Additionally, ambroxol possesses antioxidant and anti-inflammatory properties, reducing pulmonary inflammation and improving lung function. Therefore, combining ambroxol with levofloxacin may achieve better therapeutic outcomes.

This study aims to explore the clinical efficacy of levofloxacin combined with ambroxol in the treatment of elderly COPD patients with pulmonary infection, providing a more effective clinical treatment plan.

2. Materials and methods

2.1. General information

Eighty elderly patients with COPD complicated by pulmonary infection who were hospitalized in the respiratory department of our hospital from December 2022 to November 2023 were selected as study subjects.

Inclusion criteria: (1) Patients meeting the diagnostic criteria in the "Chinese Expert Consensus on the Diagnosis and Treatment of Acute Exacerbations of Chronic Obstructive Pulmonary Disease (2023 Revision)" [5]; (2) Age ≥ 60 years; (3) Signed informed consent provided by the patients or their families.

Exclusion criteria: (1) Patients with severe cardiovascular or cerebrovascular diseases, or liver and kidney dysfunction; (2) Patients allergic to levofloxacin or ambroxol; (3) Patients who had used other antibiotics or immunomodulators within the past three months; (4) Patients with psychiatric disorders who could not cooperate with treatment.

The patients were randomly divided into a control group and an observation group using a random number table, with 40 cases in each group. The control group included 22 males and 18 females, aged 60–80 years, with a COPD duration of 5–15 years and a pulmonary infection duration of 3–10 days. The observation group included 20 males and 20 females, aged 62–82 years, with a COPD duration of 4–14 years and a pulmonary infection duration of 2–9 days. No statistically significant differences were observed between the two groups in terms of gender, age, COPD duration, or pulmonary infection duration ($P > 0.05$), indicating comparability (see **Table 1**).

Table 1. Comparison of general information between the two groups

Group	*n*	Gender (*n*)		Mean age (mean ± SD, years)	Mean COPD duration (mean ± SD, years)	Mean pulmonary infection duration (mean ± SD, days)
		Male	Female			
Control	40	22	18	68.51 ± 5.37	9.24 ± 3.15	5.67 ± 2.26
Observation	40	20	20	69.17 ± 5.84	8.94 ± 2.92	5.24 ± 2.08
χ^2 / t	-	0.201		0.526	0.442	0.885
P	-	0.654		0.600	0.660	0.379

2.2. Methods

2.2.1. Control group

Patients were treated with levofloxacin sodium chloride injection (manufacturer: Beijing Jiluohua Pharmaceutical Co., Ltd.; specification: 100 mL containing levofloxacin 0.5 g and sodium chloride 0.9 g; approval number: H20020636). The dosage was 0.5 g once daily via intravenous infusion, with a treatment course of 10–14 days. During treatment, routine symptomatic and supportive care, such as oxygen therapy, antitussive therapy, and bronchodilation, was provided based on the patient's condition.

2.2.2. Observation group

On the basis of the control group treatment, patients received ambroxol hydrochloride injection (manufacturer: Shandong Luoxin Pharmaceutical Group Co., Ltd.; specification: 4 mL containing 30 mg; approval number: H20133026). The dosage was 30 mg twice daily via intravenous infusion, with the same treatment course as the control group. Other routine symptomatic and supportive treatments were identical to those in the control group.

2.3. Observation indicators

(1) Laboratory indices: After treatment, venous blood was collected from the patient's inner elbow. A blood routine analyzer was used to measure white blood cell count (WBC), immunostaining to measure procalcitonin (PCT), enzyme-linked immunosorbent assay (ELISA) to measure C-reactive protein (CRP), and immunoturbidimetric assay to measure apolipoprotein E (ApoE).

(2) Imaging-based pulmonary lesion absorption time and hospital stay: Chest X-ray or CT was used to observe changes in pulmonary lesions and the time required for complete absorption of the lesions was recorded. The length of hospital stay was also recorded, from admission to discharge.

(3) Incidence of adverse reactions: Adverse reactions such as nausea, vomiting, diarrhea, and rash were monitored and recorded during treatment, and the incidence rate was calculated.

2.4. Statistical methods

Data analysis was performed using SPSS 27.0 statistical software. Measurement data were expressed as mean ± standard deviation (SD) and analyzed with the *t*-test. Categorical data were expressed as [*n* (%)] and analyzed with the χ^2 test. A P-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of laboratory indices

After treatment, the levels of WBC, PCT, CRP, and ApoE in the observation group were significantly lower than those in the control group, with highly significant differences ($P < 0.001$). See **Table 2**.

Table 2. Comparison of laboratory indices after treatment between the two groups (mean ± SD)

Group	WBC ($\times 10^9$/L)	PCT (ng/mL)	CRP (mg/L)	ApoE (mg/L)
Control ($n = 40$)	10.22 ± 3.10	1.18 ± 0.37	44.31 ± 6.39	61.27 ± 7.45
Observation ($n = 40$)	7.44 ± 3.02	0.61 ± 0.21	25.14 ± 5.63	40.03 ± 6.20
t	4.023	8.474	14.236	13.860
P	< 0.001	< 0.001	< 0.001	< 0.001

3.2. Comparison of imaging-based pulmonary lesion absorption time and hospital stay

The pulmonary lesion absorption time and hospital stay were significantly shorter in the observation group compared to the control group, with highly significant differences ($P < 0.05$). See **Table 3**.

Table 3. Comparison of pulmonary lesion absorption time and hospital stay between the two groups (mean ± SD, days)

Group	*n*	Pulmonary lesion absorption time	Hospital stay
Control ($n = 40$)	40	15.65 ± 2.77	18.04 ± 3.65
Observation ($n = 40$)	40	8.26 ± 2.85	11.26 ± 3.09
t		11.760	8.967
P		< 0.001	< 0.001

3.3. Comparison of adverse reaction incidence

The adverse reaction rate in the observation group was 5.00%, significantly lower than the 22.50% in the control group, with a statistically significant difference ($P = 0.023$). See **Table 4**.

Table 4. Comparison of adverse reaction incidence between the two groups [n (%)]

Group	*n*	Nausea and vomiting	Diarrhea	Rash	Total adverse reaction rate
Control ($n = 40$)	40	3 (7.50%)	3 (7.50%)	3 (7.50%)	9 (22.50%)
Observation ($n = 40$)	40	1 (2.50%)	0 (0.00%)	1 (2.50%)	2 (5.00%)
χ^2	-	-	-	-	5.165
P	-	-	-	-	0.023

4. Discussion

Levofloxacin, a fluoroquinolone antibiotic, exhibits a unique and powerful mechanism of action by inhibiting bacterial DNA gyrase and topoisomerase IV, both of which play critical roles in bacterial DNA replication, transcription, and repair [6]. By suppressing these enzymes, levofloxacin disrupts bacterial reproduction, preventing

normal synthesis of genetic material, accelerating DNA dissolution, and ultimately leading to bacterial death. Additionally, levofloxacin has a broad antibacterial spectrum, showing strong activity against Gram-positive bacteria, Gram-negative bacteria, and atypical pathogens. This broad-spectrum activity makes it effective in treating COPD with pulmonary infections, targeting a wide range of pathogens.

Ambroxol hydrochloride, also known as bromhexine hydrochloride, plays a significant role in regulating respiratory physiological functions. It enhances the production of lysosomes in bronchial wall cells, which contain hydrolases that can break down viscous components in sputum, thereby reducing its viscosity [7]. Furthermore, ambroxol inhibits the formation of fibrin, a key substance contributing to sputum viscosity, aiding in sputum dilution and expulsion. It also modulates mucus secretion from airway glandular cells, making the mucus thinner and easier to expectorate.

In elderly patients with COPD complicated by pulmonary infections, the combined use of levofloxacin and ambroxol exerts synergistic effects. Levofloxacin effectively controls pulmonary infections by inhibiting bacterial growth and reproduction, thereby addressing the root cause of the inflammatory response. Meanwhile, ambroxol improves pulmonary ventilation by promoting sputum clearance and alleviating airway inflammation, creating favorable conditions for levofloxacin to exert its antibacterial effects [8]. This combination not only better controls pulmonary infections but also improves respiratory function to some extent, enhancing the quality of life for patients [9].

This study demonstrates that the combination of levofloxacin and ambroxol excels in improving laboratory indices in elderly COPD patients with pulmonary infections. The combined therapy significantly reduces levels of WBC, PCT, CRP, and ApoE, strongly indicating its effectiveness in suppressing inflammatory responses and positively regulating physiological functions.

Regarding treatment progression, imaging-based pulmonary lesion absorption time and hospital stay are key evaluation metrics. The study data indicate that patients receiving the combined therapy showed significantly faster pulmonary lesion absorption and shorter hospital stays. This not only facilitates quicker recovery, reducing physical and psychological distress but also lowers medical costs and enhances the efficiency of healthcare resource utilization.

The safety profile of the combined therapy is also satisfactory, with a lower incidence of adverse reactions compared to traditional monotherapies. This can be attributed to the synergistic effects of the two drugs. Levofloxacin, with its potent antibacterial activity, precisely inhibits bacterial growth and reproduction, effectively controlling infections at their source. Ambroxol, by promoting sputum clearance, alleviates airway obstruction and exerts anti-inflammatory effects, improving the pulmonary microenvironment. Together, these drugs complement each other, providing better control of pulmonary infections while enhancing respiratory function, leading to smoother breathing and improved quality of life for patients. This offers an efficient and safe therapeutic option for elderly COPD patients with pulmonary infections [10,11].

5. Conclusion

In summary, the combination of levofloxacin and ambroxol for treating elderly COPD patients with pulmonary infections demonstrates excellent clinical efficacy and safety. This regimen improves multiple indices, shortens the disease course, and has a lower incidence of adverse reactions, making it worthy of clinical promotion. However, the study has limitations, including a relatively small sample size, which may not comprehensively represent all patient populations, and a short observation period, which limits the precise evaluation of long-term efficacy and

safety. Further in-depth research is required in the future.

Disclosure statement

The author declares no conflict of interest.

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