

# Clinical Study on Respiratory Medicine Treatment of Chronic Obstructive Pulmonary Disease Combined with Respiratory Failure

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**Abstract:** *Objective:* To explore the respiratory medicine treatment methods for treating chronic obstructive pulmonary disease (COPD) combined with respiratory failure. *Methods:* 70 cases of COPD patients with combined respiratory failure admitted to our hospital from January 2021 to January 2023 were selected as the study subjects, and randomly divided into the control group and the experimental group, each with 35 cases. The control group received only conventional treatment, and the experimental group received non-invasive positive pressure ventilation, and the treatment effects and changes in the levels of IL-18, hs-CRP, and CES2 inflammatory factors were observed and evaluated in the two groups. *Results:* There was no significant difference between the general data of the two groups ( $P > 0.05$ ); after treatment, the total effective rate of clinical efficacy of the observation group (91.43%) was significantly higher than that of the control group (71.43%), and the difference showed a significant correlation ( $P < 0.05$ ); after treatment, the level of inflammatory factor of the observation group was significantly reduced compared with that of the control group, and the difference showed a highly significant correlation ( $P < 0.001$ ). *Conclusion:* The non-invasive positive pressure ventilation treatment program significantly improves the therapeutic effect, effectively controls the level of inflammatory factors, and improves the health status of patients when dealing with patients with chronic obstructive pulmonary disease accompanied by respiratory failure, showing a good clinical application prospect.

**Keywords:** Chronic obstructive pulmonary disease; Respiratory failure; Non-invasive positive pressure ventilation; Therapeutic effect; Inflammatory factor

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## 1. Introduction

Chronic obstructive pulmonary disease (COPD) is a disease commonly found in the middle-aged and elderly population, which has a significant impact on the physical and mental health, quality of life, and life safety of the patients, and respiratory failure, which is serious and then life-threatening, can occur<sup>[1]</sup>. COPD is one of the common chronic respiratory disorders in clinics, which is mainly characterized by persistent ventilatory limitation<sup>[2]</sup>. Respiratory failure is a state in which the lungs are unable to adequately provide oxygen and

expel carbon dioxide, resulting in the body's inability to carry out normal gas exchange. COPD is one of the most common chronic diseases in China, with a high mortality rate and socio-economic burden, and it has become one of the most important causes of death for the residents in China, second only to heart disease, cerebrovascular disease, and acute lung infections<sup>[3]</sup>. However, in recent years, the mortality rate of this disease has risen to third place under the influence of factors such as changes in residents' lifestyles and deterioration of the living environment<sup>[4]</sup>. For patients with COPD combined with respiratory failure, treatment protocols need to be more careful and effective. Clinically, patients are mainly treated with anti-infective drugs, but the clinical symptoms of patients on long-term medication do not improve significantly<sup>[5]</sup>. Non-invasive positive pressure ventilation (NIPPV) is a method of respiratory support that does not require the insertion of an endotracheal tube or other invasive means. It delivers positively pressurized air or oxygen into the patient's airway through a device such as a face mask, nasal mask, or hood to help keep the airway open and promote gas exchange. Currently, NIPPV has become an effective treatment option for COPD combined with respiratory failure. NIPPV delivers positive pressure gas to the patient through a mask or nasopharyngeal access to improve respiratory function, reduce respiratory distress, and relieve respiratory muscle fatigue. Compared with invasive ventilation, NIPPV has fewer complications and is better tolerated in non-special care units. Therefore, NIPPV has been widely used in the clinical treatment of COPD combined with respiratory failure. Based on this, this paper aims to discuss the application of non-invasive positive pressure ventilation in COPD combined with respiratory failure and its efficacy and to provide a reference for clinical treatment.

## **2. Materials and methods**

### **2.1. General information**

Seventy cases of chronic obstructive pulmonary disease patients with combined respiratory failure admitted to our hospital from January 2021 to January 2023 were selected as the study subjects, with 42 males and 28 females, and an average age of 58.15 years. Inclusion criteria: (1) aged between 45 and 75 years old; (2) clear thinking, good mental state, good communication; (3) received pulmonary function tests and diagnosed with COPD with respiratory failure; (4) willing to participate in this study and sign the informed consent; and (5) detailed medical history records and physical examination records. Exclusion criteria: (1) patients with other lung diseases, such as bronchial asthma, tuberculosis, etc.; (2) patients with heart diseases such as congenital heart disease, cardiomyopathy, angina pectoris, arrhythmia, etc.; (3) pregnant and breastfeeding women; (4) patients with other serious internal organ diseases such as liver, kidney, etc.; (5) patients suffering from mental diseases or cognitive disorders; and (6) patients refusing to take part in this study or unable to take responsibility for their behavior.

### **2.2. Methods**

#### **2.2.1. Control group**

The control group received conventional treatment, which included oxygen inhalation, supportive therapy, symptom relief therapy, antibiotic therapy, and nutritional support therapy.

#### **2.2.2. Experimental group**

The experimental group received non-invasive positive-pressure ventilation treatment in addition to the conventional treatment provided to the control group. The procedure was as follows: (1) Set appropriate positive-pressure ventilation pressure and respiratory frequency, and choose suitable masks or nasopharyngeal ventilation tubes to administer the non-invasive positive-pressure ventilation treatment; (2) Adjust the

ventilation pressure and respiratory frequency based on the patient's clinical symptoms to achieve the desired therapeutic effect; (3) Continuously monitor the patient's oxygen saturation, respiratory rate, heart rate, and other indicators, making timely adjustments and interventions as needed; (4) The duration of treatment was determined by the patient's condition and response to treatment, typically lasting between 3 to 7 days; (5) During the treatment period, conventional treatments such as oxygen inhalation, supportive therapy, symptom relief therapy, antibiotic therapy, and nutritional support therapy were also administered.

There are several precautions to take note of: (1) Strictly control the ventilation pressure and respiratory frequency for patients in the experimental group to avoid adverse effects; (2) Monitor patients for possible adverse reactions such as dyspnea or mask discomfort during ventilation treatment, and address these issues promptly; (3) Record and analyze the treatment effects and any adverse reactions in real time to ensure patient safety and treatment efficacy.

## **2.3. Observation indicators**

### **2.3.1. Clinical efficacy**

Clinical studies usually categorize efficacy observation into three situations: apparent effect, effective, and ineffective. The apparent effect is characterized by significant improvement of symptoms, significant increase of lung function indexes, significant reduction of acute exacerbation events, and significant improvement of exercise capacity; effective is characterized by a certain degree of improvement, but not as obvious as that of the apparent effect group; and ineffective means that the therapeutic effect is not good or even may have a negative trend. This index helps to assess the actual effect of the treatment plan, guiding clinical decision-making and optimizing the treatment strategy.

### **2.3.2. Inflammatory factors**

Indicators such as interleukin-18 (IL-18), high-sensitivity C-reactive protein (hs-CRP), and carboxylesterase 2 (CES2) play an important role in clinical research. range of IL-18 level: 5–100 pg/mL; range of hs-CRP: 0–3 mg/L; while the normal range of CES2 needs to be referred to laboratory reports. The trends of these indicators can reflect the effect of treatment and changes in inflammatory status, which can help guide the development of individualized treatment strategies.

## **2.4. Statistical methods**

The study data were processed using SPSS 26.0 statistical software. Continuous variables were expressed as mean  $\pm$  standard deviation (SD) and analyzed using the *t*-test, while categorical variables were expressed as the sample size (*n*) and percentage (%) and compared using the  $\chi^2$  test. A difference of  $P < 0.05$  was used to indicate statistical significance.

## **3. Results**

### **3.1. Comparison of general information of patients in the two groups**

As shown in **Table 1**, there was no statistically significant difference in the comparison of gender and age between the two groups of patients ( $P > 0.05$ ).

**Table 1.** Comparison of general information of patients in two groups

Group	n	Gender (n)		Age (mean ± SD; years)
		Male	Female	
Control group	35	20	15	58.46 ± 4.57
Experimental group	35	18	17	57.83 ± 4.48
$\chi^2 / t$ -value	-	0.230		0.582
P-value	-	0.631		0.562

### 3.2. Comparison of clinical efficacy between the two groups of patients after treatment

As shown in **Table 2**, after treatment, the total effective rate of clinical efficacy of the observation group (32/35, 91.43%) was significantly higher than that of the control group (25/35, 71.43%), and the difference was statistically significant ( $P = 0.031$ ).

**Table 2.** Comparison of clinical efficacy after treatment between the two groups of patients [ $n$  (%)]

Group	n	Apparent effect	Effective	Ineffective	Overall effective rate
Control group	35	15 (42.86%)	10 (28.57%)	10 (28.57%)	25 (71.43%)
Observation group	35	20 (57.14%)	12 (34.29%)	3 (8.57%)	32 (91.43%)
$\chi^2$ -value	-	-	-	-	4.629
P-value	-	-	-	-	0.031

### 3.3. Comparison of inflammatory factor indexes between the two groups of patients after treatment

As shown in **Table 3**, compared with the control group, the indicators of inflammatory factors (IL-18, hs-CRP, CES2) in the observation group were reduced, and the differences showed highly significant correlations ( $P \leq 0.001$ ).

**Table 3.** Comparison of inflammatory factors between the two groups of patients after treatment (mean ± SD)

Group	n	IL-18 (pg/mL)	hs-CRP (mg/L)	CES2 (ng/L)
Control group	35	64.38 ± 4.56	2.34 ± 0.51	12.09 ± 1.63
Observation group	35	55.34 ± 3.87	1.67 ± 0.46	10.75 ± 1.57
t-value	-	8.942	5.771	3.503
P-value	-	< 0.001	< 0.001	0.001

## 4. Discussion

Typical presentations of COPD patients include symptoms such as prolonged cough, dyspnea, and fatigue, which are especially common in the elderly [6]. Chronic cough is caused by airway inflammation and mucus accumulation, whereas dyspnea is due to airway narrowing and reduced lung function. In addition, patients may feel tired or weak due to increased physical exertion caused by lung disease. In addition to these main symptoms, COPD may be accompanied by other manifestations such as coughing up sputum, feeling of chest



tightness, weight loss, and sleep disorders. Some studies have pointed out that COPD is very harmful to the human body, and the incidence of acute respiratory failure increases with the prolongation of the disease [7]. Therefore, timely treatment of the disease is needed. Treatment of COPD includes medication (e.g., inhaled bronchodilators and steroids), oxygen therapy, rehabilitation, nutritional support, and surgical procedures (e.g., lung transplantation or lung decompression surgery). COPD is a chronic progressive airflow-restricted disease, and respiratory failure is one of the common and serious complications of the disease. The treatment of COPD combined with respiratory failure has traditionally relied on oxygen therapy, pharmacotherapy, and invasive mechanical ventilation. However, invasive mechanical ventilation may increase patient suffering and risk of complications due to its high invasiveness.

This study investigates the application of NIPPV in COPD combined with respiratory failure and its efficacy. The results showed that the total effective rate of treatment in the NIPPV group (91.43%) was significantly higher than that in the control group (71.43%), indicating that NIPPV can effectively improve the clinical symptoms and lung function of patients with COPD combined with respiratory failure. Huang *et al.* [8] demonstrated that NIPPV is effective in improving patients' pulmonary ventilation and oxygenation, which helps to reduce the rate of endotracheal intubation, shorten hospitalization time, and improve patient survival. Similarly, it has been shown that NIPPV in patients with COPD combined with respiratory failure significantly improves pulmonary function and hemodynamics and reduces mortality [9]. NIPPV reduces dyspnea and improves the quality of life and prognosis of the patients by providing positive-pressure ventilation support, increasing alveolar ventilation, and decreasing respiratory muscle work, thus reducing dyspnea. In addition, this study also observed the effect of NIPPV on the level of inflammatory factors. The results showed that the levels of IL-18, hs-CRP, and CES2 in the NIPPV group were significantly lower than those in the control group after treatment ( $P < 0.001$ ). These inflammatory factors play an important role in the pathogenesis of COPD, and their elevation is closely related to the severity of the disease and poor prognosis. NIPPV reduces the levels of these inflammatory factors by improving ventilation and reducing lung inflammation. This finding further confirms the anti-inflammatory role of NIPPV in the treatment of COPD combined with respiratory failure.

In summary, NIPPV, as a non-invasive respiratory support modality, has a good application prospect in the treatment of COPD combined with respiratory failure. It can not only enhance the therapeutic effect and improve the quality of life and prognosis of patients, but also reduce the level of inflammatory factors and reduce lung inflammation. Therefore, NIPPV is worth promoting its use in the clinic as one of the important treatments for COPD combined with respiratory failure. Future studies are also necessary to further explore the optimal timing of NIPPV application, parameter settings, and joint application with other therapeutic methods to optimize its therapeutic effect and patient prognosis.

## Disclosure statement

The author declares no conflict of interest.

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