Effect of Humidification Oxygen Therapy with High-Flow Nasal Cannula on Blood Gas Index and Inflammatory Reaction in Patients with Severe Pneumonia Complicated with Respiratory Failure

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Abstract: Objective: To investigate the result of high-flow nasal cannula humidification oxygen therapy (HFNC) on blood gas index and inflammation in patients with severe pneumonia complicated with respiratory failure. Methods: The clinical data of 60 patients with severe pneumonia complicated with respiratory failure in our hospital were selected and divided into experimental group (30 cases) and control group (30 cases) according to different oxygen therapy methods according to different oxygen therapy methods. The heart rate, respiratory rate, pH value, PaCO2, oxygenation index of the two groups before and 24 hours after treatment were compared, as well as the disappearance time of clinical symptoms and treatment efficiency after treatment. Results: Before treatment, there were no significant differences in heart rate, respiratory rate, pH value, PaCO2 and oxygenation index between the experimental group and the control group (all $P > 0.05$). After 24 hours of treatment, heart rate, respiratory rate, pH value, PaCO2 and oxygenation index of the experimental group were improved compared with those before treatment. The total effective rate of experimental group (100.0%) was higher than that of control group (40.0%). The difference was statistically significant ($P < 0.05$). Conclusion: The effect of high-flow nasal cannula humidification oxygen therapy in treating severe pneumonia complicated with respiratory failure is significant, which can effectively relieve the clinical symptoms and achieve good treatment effect.

1. Introduction

Pneumonia is a familiar respiratory disease. Its incidence rate is increasing year by year. Because of its lack of typical clinical symptoms and short onset period, it has a high risk of missed diagnosis and misdiagnosis [1]. Once developed into severe pneumonia, the study found that [2], it is prone to respiratory failure. Severe pneumonia with respiratory failure in clinical has a high mortality. Owing to the progress and optimization of clinical medical diagnosis and treatment technology and non-invasive treatment technology, humidification oxygen therapy with high-flow nasal cannula is

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widely applied in treating respiratory diseases, achieving good clinical results. This study analyzes the result of high-flow nasal cannula humidification oxygen therapy in the treatment of severe pneumonia with respiratory failure, and discusses its therapeutic effect on patients, as reported below.

2. Data and Methods

2.1 General Data

The object of this study were 60 cases of patients with severe pneumonia complicated with respiratory failure who were treated in our hospital from April 2019 to December 2020. The 60 cases were randomly divided into two groups. There were 30 cases in the control group, including 16 males and 14 females (50-75 years old). The average age was (60.22 ± 6.46) years old and the course of disease was 3-9 days, with an average of (4.88 ± 1.18) days. The respiratory rate was 16-29 times / min, with an average of (22.65 ± 3.30) times / min. In the experimental group, there were 30 cases, including 14 males and 16 females (50-75 years old). The average age was (60.60 ± 6.48) years old. The course of disease was 3-9 days, with an average of (4.91 ± 1.19) days. The respiratory rate was 16-29 times / min, with an average of (23.16 ± 3.11) times / min. There was no significant difference in general data between the two groups ($P > 0.05$).

2.2 Inclusion and Exclusion Criteria

In inclusion criteria, firstly, it was in accordance with the diagnostic criteria of the *Guidelines for the Diagnosis and Treatment of Severe Pneumonia*. Secondly, it was accompanied with respiratory failure symptoms. Thirdly, PaO2 at rest was less than 60 mmHg (1 mmHg = 0.133 kPa). Fourthly, the patient signed the consent voluntarily.

In exclusion criteria, firstly, there were moderate severe cardiovascular and cerebrovascular diseases with malignant tumor and stroke. Secondly, there were severe liver and kidney diseases. Thirdly, there were systemic blood and immune system diseases. Fourthly, the patient has a history of mental illness or consciousness disorder. Fifthly, it was approved by the medical ethics committee of our hospital.

2.3 Treatment Method

The control group received continuous positive airway pressure (CPAP) ventilation therapy: use non-invasive ventilator [Shanghai haisheng Medical Technology Co., Ltd., Shanghai Food and Drug Administration Certified, 2015, No. 2540647], adjust the positive end expiratory pressure to 5-8 cmH2O, inhaled oxygen concentration to 30%-40%, and oxygen flow to 5-8L/min. The experimental group received humidification oxygen therapy through nasal high-flow nasal cannula: use medical air oxygen mixer [Guangdong Kanghua Biological Equipment Co., Ltd., Guangdong Food and Drug Administration Certified, 2014, No. 2540793] and supporting breathing pipeline, adjust the oxygen flow rate to 2-9L/min, inhaled oxygen concentration to 30%-40%, use the humidifier for ventilator [Ningbo Xinglin Medical Equipment Co., Ltd, Zhejiang Food and Drug Administration Certified, 2014, No. 2540660] and set temperature at 37 ℃.

2.4 Observation Indexes

The following indexes were observed and compared. Firstly, before and 24 hours after treatment, the changes of heart rate, respiratory rate and vital signs and clinical efficacy of the two groups

were observed. Secondly, the clinical symptoms were observed, including cyanosis, pulmonary rales, shortness of breath, three depressions sign, etc. Thirdly, the clinical efficacy was compared. Markedly effective: after treatment, the clinical symptoms and blood gas indexes of the patients were significantly changed or relieved, and the body basically returned to normal or nearly normal. Effective: after treatment, the patients' clinical symptoms were effectively relieved and the body basically recovered. Invalid: after treatment, the clinical symptoms and signs of the patients had no obvious change, even worse.

2.5 Statistical Methods

This study used SPSS26.0 software for data processing, and used (x ± s) to indicate the measurement data. Non-independent sample t test was used between groups, and paired sample t test was used within groups. The data were significantly different and had statistical significance, which was represented by $P < 0.05$.

3. Results

Before treatment, there were no great differences in heart rate, respiratory rate, pH value, $PaCO_2$ and oxygenation index between experimental group and control group (all $P > 0.05$). After 24 hours of treatment, the heart rate, respiratory rate, pH value, $PaCO_2$ and oxygenation index of the experimental group were better than those before treatment, while the heart rate, respiratory rate and oxygenation index of control group were improved compared with those before treatment (all $P < 0.05$). The heart rate, respiratory rate, pH value and oxygenation index of HFNC treatment group were better than those of control group (all $P < 0.05$), as shown in Table 1. The total effective rate of experimental group was 100.0%, greatly higher than 40.0% of control group ($P < 0.05$). See Table 2.

3.1 There Were Great Differences in Heart Rate, Respiratory Rate, Ph Value, $Paco_2$ and Oxygenation Index between the Two Groups ($P < 0.05$). See Table 1.

Table 1 Contrast of Heart Rate, Respiratory Rate, Ph Value, $Paco_2$ and Oxygenation Index between the Two Groups ($\overline{X} \pm s$)

Index	Before Treatment (Experimental Group)	After Treatment (Experimental Group)	Before Treatment (Control Group)	After Treatment (Control Group)
Heart Rate	120±19	82±8	120±19	120±19
Respiratory Rate	30.8±4.6	24.8±4.6	30.3±4.6	28.8±4.6
pH Value	7.24 ±0.83	7.42 ±0.83	7.25 ±0.83	7.26 ±0.83
$PaCO_2$	50.8±4.6	46.8±4.6	49.8±4.6	48.8±4.6
Oxygenation Index	120.8±4.6	281.8±4.6	122.8±4.6	178.8±4.6
t Value	8.372		3.372	
p Value	<0.001		<0.001	

Note: The $PaCO_2$ p value was 0.043 in experimental group and 0.773 in control group. Paired t test was used before and after treatment within group and group t test was applied between groups after treatment.

3.2 Contrast of Total Effective Rate between Two Groups

The total effective rate of experimental group was significantly higher than that of control group ($P < 0.05$), as shown in Table 2.

Table 2 Comparison of Total Effective Rate between Two Groups [n(%)]

Group	Markedly Effective	Effective	Invalid	Total Effective Rate
Experimental Group(n=30)	20(66.0)	10(33.0)	0(0.00)	30(100.0)
Control Group (n=30)	5(16.0)	7(23.0)	18(60.0)	12(40.0)

Compared with the control group, *P<0.05.

4. Discussion

Severe pneumonia is easy to be misdiagnosed with other respiratory diseases, and its incidence is more acute, easy to cause respiratory failure, so there is a high mortality rate. In addition, the release of a large number of inflammatory factors will continue to aggravate the persistent infection of lung tissue, especially for the middle-aged and elderly people, the risk of severe pneumonia with respiratory failure is higher [4]. At this stage, from the clinical practice, drug support therapy, nasal cannula oxygen inhalation, anti infection and other common treatment methods are used. Oxygen inhalation from nasal cannula is a traditional form of oxygen therapy, which can improve clinical symptoms to a certain extent, but its main problem is that humidification is not enough [5]. The patients with severe pneumonia complicated with respiratory failure are faced with higher treatment risk due to the acute onset, and it is necessary to control the deterioration of symptoms in time.

According to the study, after treatment, the heart rate, respiratory rate, pH value, $PaCO_2$ and oxygenation index of experimental group were greater than those of control group, and the total effective rate of experimental group was higher than that of control group. The treatment effect was significant, further showing that the treatment of severe pneumonia combined with respiratory failure by nasal high-flow humidification oxygen therapy is effective, which can actively shorten the treatment cycle and improve the deterioration of symptoms. Through the experiment and analysis, the nasal high-flow nasal cannula humidification oxygen therapy was mainly to promote the continuous increase of oxygen concentration in the body, so as to achieve the full moist of the respiratory tract mucosa, more effectively protect cilia, make the respiratory tract smooth and orderly. From the clinical application point of view, humidification oxygen therapy with high-flow nasal cannula is a relatively safe non-invasive respiratory support technology, easy to operate. The air oxygen mixer provides a certain oxygen concentration and humidity of high-flow gas. Through nasal oxygen therapy, patients feel better and mainly be satisfied at comfort and effect. The flow rate dependent positive airway pressure during treatment can promote the opening of air bubbles, increase alveolar ventilation and oxygen saturation, thus changing the status of hypoxia and avoiding the risk of obstructive and mixed apnea. Meanwhile, the positive airway pressure can effectively promote the physiological recruitment of the lung, reduce the resistance of the upper airway, avoid the risk of collapse, improve the ventilation frequency, and effectively improve the ventilation function [6].

In conclusion, the result of nasal high-flow humidification oxygen therapy in treating severe pneumonia with respiratory failure is more significant. Compared with traditional oxygen therapy, it has obvious advantages and good tolerance, can effectively alleviate the hypoxia, shorten the treatment cycle, conducive to improving the quality of life and promoting the prognosis.

References

[1] Fu Huiwen, Zhao Zhidong, Guo An, et al. Clinical Observation on the Treatment of Middle-Aged and Elderly Patients with Severe Refractory Pneumonia Complicated with Respiratory Failure by Humidification Oxygen Therapy with High-Flow Nasal Cannula [J]. Journal of Difficult Illness Cases, vol.18, no.2, pp.136-139, 2020.

[2] Cheng Xiaosan, Yu Dinghong. Effect of Humidification Oxygen Therapy with High-Flow Nasal Cannula on Middle-Aged and Elderly Patients with Severe Intractable Pneumonia Complicated with Respiratory Failure [J]. Journal of Practical Clinical Medicine, vol.22, no.1, pp.10-13, 2019.

[3] Matthay MA. Saving Lives with High-Flow Nasal Oxygen. N Engl J Med, vol.37, no.23, pp.2225-2226, 2015.

[4] Liu Shuyan, Wei Lingyu, Chen Weidong, et al. Analysis of the Clinical Effect of High-Flow Nasal Cannula Humidification Oxygen Therapy on Acute Respiratory Failure [J]. New Medicine, vol.50, no.1, pp.28-31, 2019.

[5] Yue Weigang, Zhang Zhigang, Zhang Caiyun, et al. Meta Analysis of the Effect of Nasal High-Flow Oxygen Therapy on Patients with Respiratory Failure [J]. Chinese Critical Care Emergency Medicine, vol.29, no.5, pp.396-402, 2017.

[6] Ba Chunhe, Ping Ping, Zhang Hongxia, et al. Effect of High-Flow Humidification Oxygen Therapy System on the Incidence of Hospital Acquired Pneumonia in Patients with Tracheotomy [J]. Chinese Journal of Clinical Health, vol.20, no.20, pp.54, 2017.