THE CLINICAL VALUE OF NONINVASIVE POSITIVE PRESSURE VENTILATION IN COPD WITH ACUTE RESPIRATORY FAILURE

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ABSTRACT

Objective: *To explore the clinical value of noninvasive positive pressure ventilation in COPD with acute respiratory failure.*

Methods: *The experimental group was treated with conventional therapy plus noninvasive positive pressure ventilation, whereas the control group was treated with conventional therapy combined with oxygen therapy. Before and after treatment, the clinical symptoms, respiratory rate, heart rate, blood gas, BNP, PCT and average length of stay were analysed.*

Results: *After treatment, the respiratory rate, heart rate, PaO_2, $PaCO_2$, SaO_2 and pH of the patients in the experimental group and the control group were all improved, but the improvement range of the experimental group was significantly greater than that of the control group, and the average hospitalization time of the experimental group was significantly shorter than that of the control group ($P<0.05$). Compared with the control group, the BNP and PCT concentration in the experimental group improved significantly after treatment ($P<0.05$). Noninvasive positive pressure ventilation is more effective in the treatment of chronic obstructive pulmonary disease with acute respiratory failure. After treatment, there were significant improvements in patients' monitoring indicators, which can effectively shorten the length of stay, and there were no adverse reactions.*

Conclusion: *This proves that noninvasive positive pressure ventilation has a good clinical application value in the treatment of chronic obstructive pulmonary disease with acute respiratory failure.*

Keywords: *Noninvasive positive pressure ventilation, chronic obstructive pulmonary disease, acute respiratory failure, clinical application value.*

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Introduction

Chronic obstructive pulmonary disease (COPD) is a very common chronic respiratory disease which has emphysema and chronic bronchitis. As the disease develops, it can lead to acute respiratory failure(1). It is the third most lethal disease in the world, and its incidence is increasing year by year in China. The causes of COPD mainly include environmental factors and individual physical factors. The environmental factors mainly include smoke, air pollution, dust, irritant odor, etc., while the individual physical factors mainly include genetic factors, as well as special periods such as pregnancy, infancy, etc(2). Respiratory failure is caused by dysfunction of ventilation function, which leads to hypoxia(3). COPD combined with acute respiratory failure will lead to deterioration of the condition, even death in severe cases. In the past, traditional Chinese and Western medicine were mainly used as clinical treatments, and drug therapy was assisted by simple oxygen therapy.

Clinical evidence shows that simple drug therapy or simple oxygen therapy can lead to a

variety of complications, with general effect[4-5]. Invasive ventilation has played a certain role in rescuing patients with AECOPD, but it has high cost as well as high incidence of complications, and brings great pain to patients, so its clinical application is hindered.

Noninvasive ventilation is the treatment that can increase alveolar airflow and relieve symptoms without using artificial airways. Noninvasive positive pressure ventilation is performed by face mask or nose; it does not need to be performed by endotracheal intubation or tracheotomy[7]. Noninvasive positive pressure ventilation has a good effect in COPD with respiratory failure[8-9].

To explore the clinical application value of noninvasive positive pressure ventilation in the treatment of COPD with acute respiratory failure, we selected COPD patients with acute respiratory failure from January 2015 to December 2018 as the research subjects.

Materials and methods

Research subjects

From January 2015 to December 2018, COPD patients with acute respiratory failure in our hospital were selected as the study subjects.

The inclusion criteria were as follows:

• In line with the criteria of the guidelines for the diagnosis and treatment of chronic obstructive pulmonary disease (2013 Revision)[10];

• The clinical data of the patients were complete;

• The results of arterial blood gas examination showed that the patients were complicated with acute respiratory failure;

• Each patient had dyspnoea, but also had autonomous respiration, and had no expectoration disorder.

Exclusion criteria were the following:

• Patients with congestive heart failure, tuberculosis and other symptoms;

• Patients with nasopharynx deformity or maxillofacial injury;

• Patients with serious heart, liver, kidney, hematopoietic system or nervous system diseases;

• Patients who cannot tolerate noninvasive positive pressure ventilation;

• Pregnant women, lactating women and patients who are allergic to nose (face) mask materials.

Before the study, the consent of the patients and their families was to be obtained and approved by the hospital's medical ethics committee.

Research methods

Both groups were given routine comprehensive treatment, including infection, control of airway spasm, expectoration, nutritional support and so on. On this basis, the experimental group plus noninvasive positive pressure ventilation treatment, before treatment, fully communicate with patients and their families, introduce the advantages and effectiveness of noninvasive positive pressure ventilation compared with other treatment, and agree to accept the treatment. During the treatment, the ventilation mode was s/T, oxygen flow[2-5] l/min, and the respiratory frequency was 10-20/min, subject to the patient's respiratory comfort. Then, according to the situation of the patient, the initial positive inspiratory pressure was set to start from 6cmh2o, and gradually adjusted to 12-20cmH2O, so as to ensure that the patient could tolerate it and the arterial oxygen saturation was more than 90%. The positive end expiratory pressure started from 0 cmH2O and was gradually adjusted to 3-5 cmH2O.

On the day of admission, the patients were given noninvasive positive pressure ventilation treatment, usually 3-4 times a day, 3-6 hours a time, more than 8 hours a day, until the patients' cough and respiratory failure were relieved and the condition was stable. This process usually takes 3-5 days, or even a week. The control group was treated with conventional therapy combined with oxygen therapy, and the oxygen flow rate was generally 2-3l/min. Blood gas analysis, respiratory rate, heart rate, blood oxygen saturation, clinical symptoms, length of stay, BNP concentration in plasma, PCT concentration in serum and other indicators were statistically analysed before and after treatment.

Statistical methods

The measurement data were expressed in $\bar{x}\pm S$. After three days of treatment, the group t-test was used for comparison among groups, and the paired t-test was used for comparison within groups. The count data is expressed as a percentage. Statistical software SPSS17.0 was used to analyse the data; $P<0.05$ was regarded as the difference of statistical significance.

Results

According to the inclusion criteria and exclusion criteria, a total of 200 patients with acute respiratory failure were included in this study. Of these, 108 were male and 92 were female; the average age was

58.9±10.4 years (41-78 years). The patients were divided into an experimental group (102 cases) and a control group (98 cases). There was no significant difference between the experimental group and the control group (P>0.05), as shown in Table 1.

Group	Male	Female	Average age (years)	Average medical history (year)
Test group	56	46	60.3±10.2	19.5±2.4
Control group	54	44	61.7±11.5	18.4±2.9

Table 1: Comparison of general data between the treatment group and the observer ($\bar{x}\pm s$).

Comparison of vital signs and blood gas analysis indexes between the two groups before treatment

There was no significant difference in respiratory rate (RR), heart rate (HR), SaO_2, PaO_2, $PaCO_2$ or pH between the experimental group and the control group (non-parameter test was used for pH and $PaCO_2$ with non-normal distribution), as shown in Table 2 and Table 3.

Group	Number of cases	RR (time/min)	HR (time/min)	SaO_2 (%)
Test group	102	29.59±1.52	110.3±3.61	83.49±1.88
Control group	98	29.28±1.31	110.1±2.59	84.34±1.55
t	/	1.03	0.28	1.78
P	/	0.35	0.83	0.12

Table 2: Comparison of vital signs between the two groups before treatment ($\bar{x}\pm s$).

Group	Number of cases	pH	PaO_2 (mmHg)	$PaCO_2$ (mmHg)
Test group	102	7.31±0.04	54.49±2.52	82.48±8.16
Control group	98	7.33±0.02	54.68±2.01	79.96±4.15
T or Z	/	-1.28	0.35	-0.77
P	/	0.22	0.79	0.46

Table 3: Blood gas analysis and comparison between the two groups before treatment ($\bar{x}\pm s$).

Comparison of vital signs and blood gas analysis indexes between the two groups after three days of treatment

There were significant differences in RR (t=40.42, P<0.05), HR (t=40.29, P<0.05), SaO_2 (t=-27.79, P<0.05), PaO_2 (t=-20.66, P<0.05), $PaCO_2$ (t=23.77, P<0.05) and pH (t=-11.58, P<0.05).

There were also significant differences in RR (t=28.56, P<0.05), HR (t=28.91, P<0.05), SaO_2 (t=-19.48, P<0.05), PaO_2 (t=-17.62, P<0.05), $PaCO_2$ (t=17.16, P<0.05), pH (t=-11.09, P<0.05) between the control group and the control group after three days of treatment. There were statistically significant differences in respiratory rate (RR), heart rate (HR), SaO_2, PaO_2, $PaCO_2$ and pH between the experimental group and the control group after three days of treatment (non-parameter test was used for RR, HR and pH of non-normal distribution), as shown in Table 4 and Table 5.

The above statistical results showed that SaO_2, PaO_2 and pH increased, while RR, HR and $PaCO_2$ decreased in the two groups after three days of treatment, while the improvement of monitoring indicators in the experimental group was significantly higher than that of the control group after three days of treatment.

Group	Number of cases	RR (time/min)	HR (time/min)	SaO_2 (%)
Test group	102	20.08±1.48	82.36±4.63	97.11±1.32
Control group	98	24.65±0.82	98.12±2.51	92.85±1.25
t or Z	/	-5.83	-5.79	12.48
P	/	<0.05	<0.05	<0.05

Table 4: Comparison of vital signs between the two groups after three days of treatment ($\bar{x}\pm s$).

Group	Number of cases	pH	PaO_2 (mmHg)	$PaCO_2$ (mmHg)
Test group	102	7.44±0.04	76.31±4.52	51.66±2.84
Control group	98	7.37±0.02	69.58±2.90	60.63±2.56
t or Z	/	-5.25	5.87	-11.03
P	/	<0.05	<0.05	<0.05

Table 5: Comparison of blood gas analysis between the two groups after three days of treatment ($\bar{x}\pm s$).

Comparison of plasma BNP and serum PCT levels between the two groups after three days of treatment

After three days of treatment, the concentration of BNP and PCT in the experimental group was statistically significant compared with that before treatment (P<0.05). After three days of treatment, the concentration of BNP and PCT in the control group was statistically significant compared with that before treatment (P<0.05). After three days of treatment, the concentration of BNP and PCT in the experimental group was statistically significant compared with that in the control group (P<0.05). See Table 6. The above statistical results show that the BNP and PCT concentrations of the patients in the experimental group and the control group are lower than those of the control group. The BNP and PCT concentrations in the experimental group are significantly higher than those in the control group.

Group	Time	Number of cases	BNP (ng/L)	PCT (μg/L)
Test group	Before treatment	102	456.75±52.54	3.76±1.28
	After treatment		35.15±6.02	0.62±0.12
Control group	Before treatment	98	456.93±52.54	3.62±1.28
	After treatment		81.25±6.48	0.93±0.13

Table 6: The comparison of BNP and PCT concentration between the two groups after three days of treatment ($\bar{x}\pm s$).

Comparison of hospitalization time and improvement of clinical symptoms between the two groups

The average length of stay in the experimental group was 16.3±4.4 days, significantly shorter than the average of 27.5±6.7 days for the control group. The difference between the two groups was statistically significant (t=6.351, P=0.007). After three days of treatment, the patients in the two groups were able to breathe regularly, and their breathing gradually deepened from the superficial. Meanwhile, the symptoms of expectoration, chest distress, shortness of breath and dyspnoea were relieved.

Discussion

In this study, the clinical symptoms, vital signs, blood gas analysis, BNP, PCT and average length of stay were used to evaluate the value of noninvasive positive pressure ventilation in COPD with acute respiratory failure.

Due to the unique advantages of noninvasive positive pressure ventilation, in recent years, in the treatment of chronic obstructive pulmonary disease complicated with acute respiratory failure, this method is often adopted in the early stage. Noninvasive positive pressure ventilation can effectively alleviate hypoxemia, CO_2 retention and respiratory acidosis. It can also reduce respiratory rate, oxygen consumption and $PaCO_2$ level. In this study, SaO_2, PaO_2 and pH in the vital signs and blood gas analysis indexes of the experimental group and the control group were increased. RR, HR and $PaCO_2$ were reduced, while the improvement of the monitoring indexes of the experimental group was significantly higher than that of the control group, which proved the advantages of noninvasive positive pressure ventilation therapy. In addition, lung diseases often have a serious impact on the heart function of patients. BNP is secreted by ventricular cells. Pulmonary diseases can easily cause ventricular overload and increase BNP secretion. PCT is a relatively new indicator of systemic bacterial infection, which has very low levels in the serum of healthy people and is hardly influenced by non-infectious factors. Its sensitivity and specificity are significantly higher than those of traditional inflammatory indicators[11-12], and it will decrease after infection control.

The results showed that the BNP and PCT concentrations in the experimental group and the control group decreased after three days of treatment, though the BNP and PCT concentrations in the experimental group were significantly higher than those in the control group. It is suggested that noninvasive positive pressure ventilation can effectively reduce the preload of the heart, improve cardiac function, relieve the inflammation of the body and effectively control patients' infections.

Conclusion

After three days of treatment, the patients in the two groups were able to breathe regularly, and their breathing gradually deepened from the superficial. Meanwhile, the symptoms of expectoration, chest distress, shortness of breath and dyspnoea were relieved. The average hospitalization time of the experimental group was significantly shorter than that of the control group.

All the above results show that after the treatment of non-invasive positive pressure ventilation, the monitoring indicators of the patients were significantly improved. Its curative effect is better, and it has good clinical application value.

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