Observation on the efficacy of noninvasive ventilator of ICU in the treatment of COPD merged with type II respiratory failure

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ABSTRACT

Objective: To explore the efficacy of noninvasive ventilator of ICU in the treatment of COPD merged with type II respiratory failure. Methods: A total of 70 patients with COPD merged with type II respiratory failure were randomized into the observation group and the control group. The patients in the two groups were given anti-infection, cough relieving, phlegm dispersing, asthma relieving, cardiac function improving, electrolyte disturbance and acid-base balance correcting, and appropriate nursing interventions. The patients in the control group were given low-flow oxygen inhalation, while the patients in the observation group were given additional noninvasive ventilator for mask assisted ventilation through the mouth and nose. The changes of PaO2, PaCO2, SaO2, RR, and HR before treatment, and 3d after treatment were detected. The efficacy was evaluated, and the adverse reactions were observed. Results: After treatment, PaO2 and SaO2 in the two groups were elevated, while PaCO2 was reduced when compared with before treatment, and those in the observation group were significantly superior to those in the control group. After treatment, RR and HR were reduced, and those in the observation group were significantly superior to those in the control group. The total effective rate in the observation group was significantly higher than that in the control group (57.1%). And the comparison of the adverse reactions between the two groups was not statistically significant. Conclusions: ICU noninvasive ventilator in the treatment of COPD merged with type II respiratory failure can effectively improve hypoxia and CO2 retention, and rapidly relieve dyspnea, in combined with appropriate nursing intervention can guarantee the successful treatment.

1. Introduction

Chronic obstructive pulmonary disease (COPD) is characterized by incomplete and reversible airway limitation and progressively reduced pulmonary function, and is a common and frequently-occurring disease of respiratory system, with a progressively developing trend[1]. Due to delayed healing and gradual reduced pulmonary function, a respiratory failure can be accompanied by an acute exacerbation; therefore, timely respiration support treatment is required in order to improve the ventilation function[2,3]. In recent years, the report on ICU related noninvasive ventilator in the treatment of COPD merged with type II respiratory failure is gradually increasing in that noninvasive ventilator can timely correct the respiratory failure and improve the clinical symptoms[4]. The study is aimed to explore the efficacy of noninvasive ventilator of ICU in the treatment of COPD merged with type II respiratory failure.

2. Materials and methods

2.1. General materials

A total of 70 patients with COPD merged with type II respiratory failure who were admitted in our hospital from January, 2015 to January, 2016 were included in the study. The patients were in accordance with the diagnostic criteria of COPD[5]. Those who had weak autonomous respiration, airway obstruction, giant pulmonary bullae, uncontrolled arrhythmia, myocardial ischemia, upper
gastrointestinal hemorrhage, and were contradictory to mechanical ventilation were excluded from the study. The patients were randomized into two groups. In the observation group, there were 35 cases, among which 21 were male, and 14 were female; aged from 58 to 84 years old, with an average age of (68.7±7.4) years old. In the control group, there were 35 cases, among which 20 were male, and 15 were female; aged from 58 to 85 years old, with an average age of (68.8±8.1) years old. The comparison of the general materials between the two groups was not statistically significant (P>0.05).

2.2. Methods

The patients in the two groups were given anti-infection, cough relieving, phlegm dispersing, asthma relieving, cardiac function improving, electrolyte disturbance and acid-base balance correcting, and appropriate nursing interventions. The patients in the control group were given low-flow oxygen inhalation, while the patients in the observation group were given additional noninvasive ventilator (BIPAP) for mask assisted ventilation through the mouth and nose, with ventilation mode of S/T, EPAP of 4-8 cmH2O, RR of 12 times/min, IPAP from 8 cmH2O to gradually increasing to 12-24 cmH2O, regulating oxygen concentration to make SpO2>90%. The above parameters were gradually down regulated after the condition being improved, and the nasal tube oxygen inhalation was adopted until the ventilator was withdrawn.

2.3. Observation indicators

The changes of PaO2, PaCO2, SaO2, RR, and HR before treatment, and 3 d after treatment were detected. The efficacy was evaluated, and the adverse reactions were observed.

2.4. Efficacy estimation

Excellent: hypoxia and dyspnea were relieved, and PaO2, PaCO2, and SaO2 were recovered to normal. Effective: hypoxia and dyspnea from 24 h to 48 h were significantly improved, and PaO2, PaCO2, and SaO2 were improved. Invalid: hypoxia and dyspnea after 48 h were not relieved or further aggravated, PaO2, PaCO2, and SaO2 were not improved.

2.5. Statistical analysis

SPSS 19.0 software was used for the statistical analysis. Chi-square test was used for the enumeration data. The measurement data were expressed as mean ± SD, and t test was used. P<0.05 was regarded as statistically significant.

3. Results

3.1. Comparison of PaO2, PaCO2, and SaO2 before and after treatment between the two groups

The comparison of PaO2 and SaO2 before treatment between the two groups was not statistically significant (P>0.05). After treatment, PaO2 and SaO2 in the two groups were elevated, while PaCO2 was reduced when compared with before treatment, and the improved degrees in the observation group were significantly superior to those in the control group (P<0.05) (Table 1).

3.2. Comparison of RR and HR before and after treatment between the two groups

The comparison of RR and HR before treatment between the two groups was not statistically significant (P>0.05). After treatment, RR and HR were significantly reduced when compared with before treatment (P<0.05), and those in the observation group were significantly lower than those in the control group (P<0.05) (Table 2).

3.3. Efficacy observation

After treatment, in the observation group, 21 (60.0%) were excellent, 10 (28.6%) were effective, 4 (11.4%) were invalid, and the total effective rate was 88.6%; while in the control group, 9 (25.7%) were excellent, 11 (31.4%) were effective, 15 (42.9%) were invalid, and the total effective rate was 57.1%. The total effective rate in the observation group was significantly higher than that in the control group (P<0.05).

3.4. Adverse reactions

In the observation group, 3 cases had pharyngeal discomfort, and 2 cases had suffocation and tension; while in the control group, 4 cases had pharyngeal discomfort, and 2 cases had suffocation and tension. No obvious blood pressure fluctuation, arrhythmia, gastrointestinal reaction, liver and renal function damage, and other adverse reactions were observed.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>PaO2 (mmHg) Before treatment</th>
<th>PaO2 (mmHg) After treatment</th>
<th>PaCO2 (mmHg) Before treatment</th>
<th>PaCO2 (mmHg) After treatment</th>
<th>SaO2 (%) Before treatment</th>
<th>SaO2 (%) After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>35</td>
<td>48.7±1.3</td>
<td>35.8±11.6*#</td>
<td>73.6±12.2</td>
<td>35.8±11.6*#</td>
<td>68.7±2.7</td>
<td>94.5±4.1*#</td>
</tr>
<tr>
<td>Control</td>
<td>35</td>
<td>49.2±1.4</td>
<td>60.4±11.7*</td>
<td>72.8±13.4</td>
<td>59.5±12.5*</td>
<td>69.4±2.6</td>
<td>80.6±4.5*</td>
</tr>
</tbody>
</table>

*P<0.05, when compared with before treatment; #P<0.05, when compared with the control group.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>RR (times/min) Before treatment</th>
<th>RR (times/min) After treatment</th>
<th>HR (times/min) Before treatment</th>
<th>HR (times/min) After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>35</td>
<td>29.3±3.7</td>
<td>18.3±4.5*</td>
<td>117.2±5.7</td>
<td>86.5±8.4*</td>
</tr>
<tr>
<td>Control</td>
<td>35</td>
<td>29.2±4.1</td>
<td>22.5±3.9*</td>
<td>116.5±6.8</td>
<td>97.6±5.8*</td>
</tr>
</tbody>
</table>

*P<0.05, when compared with before treatment; #P<0.05, when compared with the control group.
reactions occurred. The comparison between the two groups was not statistically significant (P>0.05).

4. Discussion

COPD is a kind of disease with high morbidity, disability rate, and fatality rate, with characteristics of incomplete and reversible airway limitation and progressively reduced pulmonary function, is highly occurring in the old people, and is progressively aggravated to induce respiratory failure and other severe complications. Currently, due to lack of effective treatments, COPD is progressively developed into an acute exacerbation, which can severely affect the patients’ living qualities[6]. COPD is mainly derived from hypoxia, CO₂ retention, and respiratory muscle fatigue, with airway limitation as its pathogenesis basis[7]. COPD patients have malnutrition, hypoxemia, hypercapnia, electrolyte disturbance, circulation dysfunction, and other pathological changes, resulting in respiratory muscle fatigue, reduced reaction of respiratory center to hypoxia and hypercapnia, maldistribution of pulmonary blood and gas, and ventilation/blood flow disproportion, which can induce severe hypoxia and CO₂ retention[8]. AECOPD patients have pulmonary hyperinflation, resulting in reduced ventilation volume, mainly due to increased PEEP and respiratory muscle fatigue, and obstructed sputum drainage caused by infection, which can further aggravate respiratory system resistance and inadequate respiratory driving force, finally leading to respiratory failure[9]; meanwhile, hypoxemia and hypercapnia will occur, and heart and brain dysfunctions are earlier especially for those who are sensitive to hypoxia and have much oxygen consumption, which can cause multiple organ failure to result in death[10]; therefore, the main treatment for COPD merged with type II respiratory failure patients is to improve the pulmonary ventilation function, and correct hypoxemia and hypercapnia.

The noninvasive ventilation is an effective method to treat COPD merged with type II respiratory failure in ICU in recent years. Due to the increased clinical experience and continuous improvement of ventilator performance, the noninvasive ventilation has been the first-line treatment for respiratory failure[11]. Adoption of BiPAP to provide pressure can effectively avoid the side effects caused by ventilation, automatically regulate the preset EPAP level, and assist the autonomous respiration. A high IPAP to support ventilation can reduce the breathing work and oxygen consumption, enhance the alveolar PaO₂, and expand the airway, which is of great significance in recovering the respiratory muscle fatigue. A low EPAP, as an exogenous PEEP, can maintain the breathing force, increase the functional residual capacity, prevent lung collapse, reduce endogenous PEEP, regulate the respiratory function, increase the alveolar ventilation, improve the oxygenation function, enhance PaO₂, and reduce PaCO₂[12–14].

On the basis of noninvasive ventilation, appropriate nursing measures should be taken. Close observation on the condition change, effective psychological nursing, prevention of facial pressures sores due to oral-nasal mask ventilation, and timely clearing of oral-nasal secretions to prevent aspiration can enhance the therapeutic effect, and reduce the occurrence of complications[15,16]. The results in the study showed that after treatment, PaO₂ and SaO₂ in the two groups were elevated, while PaCO₂ was reduced when compared with before treatment, and those in the observation group were significantly superior to those in the control group (P<0.05); after treatment, RR and HR were reduced, and those in the observation group were significantly superior to those in the control group (P<0.05); the total effective rate in the observation group (88.6%) was significantly higher than that in the control group (57.1%) (P<0.05); and the comparison of the adverse reactions between the two groups was not statistically significant (P>0.05), suggesting that the efficacy of noninvasive ventilator in the treatment of COPD merged with type II respiratory failure is significant.

In conclusion, ICU noninvasive ventilator in the treatment of COPD merged with type II respiratory failure can effectively improve hypoxia and CO₂ retention, and rapidly relieve dyspnea, in combined with appropriate nursing intervention can guarantee the successful treatment.