Application of non-invasive ventilator in the treatment of acute heart failure merged with respiratory failure in ICU

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Objective: To observe the application effect of non-invasive ventilator in the treatment of acute heart failure merged with respiratory failure in ICU. Methods: A total of 80 patients with acute heart failure merged with respiratory failure who were admitted in ICU from January, 2015 to January, 2016 were included in the study and randomized into the observation group and the control group with 40 cases in each group. The patients in the two groups were given routine treatments after admission. On this basis, the patients in the observation group were given non-invasive ventilator. The patients in the control group were given continuous low flow oxygen inhalation. PaO2, pH, PaCO2, SaO2, and PaO2/FiO2 before and after treatment between the two groups were compared. The serum NT-pro BNP and cTnI levels before treatment, 24 h and 48 h after treatment in the two groups were compared. Results: The comparison of PaO2, pH, PaCO2, SaO2, and PaO2/FiO2 before and after treatment between the two groups was not statistically significant. PaO2, pH, SaO2, and PaO2/FiO2 after treatment in the observation group were significantly higher than those in the control group, while PaCO2 was significantly lower than that in the control group. The comparison of NT-pro BNP and cTnI levels before treatment between the two groups was not statistically significant. NT-pro BNP and cTnI levels 12 h and 24 h after treatment in the two groups were significantly elevated when compared with before treatment. NT-pro BNP and cTnI levels 12 h and 24 h after treatment in the observation group were significantly lower than those in the control group. Conclusions: Non-invasive ventilator in the treatment of acute heart failure merged with respiratory failure can effectively improve the ventilation function, reduce NT-pro BNP and cTnI levels, and is of great significance in enhancing the rescued effect.

1. Introduction

Heart failure is a commonly emergent and serious disease in the clinic, and is mostly caused by cardiac structure abnormality or functional diseases, with main clinical manifestations of ventricular filling and or ejection ability damage, which can threaten the patients’ life in a severe condition[1]. The acute heart failure is mainly caused by the reduced cardiac output and abrupt elevation of pulmonary venous pressure, resulting in hypoxemia in a short time, which can then induce anoxic encephalopathy and multiple organ failure, and increase the risk of death[2-4]. In the attack process of acute heart failure, the cardiac ejection function is reduced, the myocardial contractility is weakened, and the heart can not satisfy the normal circulation and metabolism, resulting in the systemic circulation or pulmonary circulation congestion, which can then induce the respiratory failure[5]; therefore, in the treatment of acute heart failure merged with respiratory, timely correction of hypoxia is of great significance in improving the prognosis. The study is aimed to observe the application effect of non-invasive ventilator in the treatment of acute heart failure merged with respiratory failure in ICU.

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2. Materials and methods

2.1. Clinical materials

A total of 80 patients with acute heart failure merged with respiratory failure who were admitted in ICU from January, 2015 to January, 2016 were included in the study, among which 55 were male, and 25 were female; aged from 45 to 81 years old, with an average age of (52±11) years old; 23 had hypertensive heart disease, 41 had coronary heart disease, and 16 had rheumatic heart disease. Those whose NYHA grading was grade IV, had dyspnea, with a large amount of moist rales and wheezing rales in double lungs, PaCO2>50 mmHg, and PaO2<60 mmHg were included in the study. Those who had respiratory failure caused by other diseases were excluded from the study.

2.2. Methods

The patients were randomized into the observation group and the control group with 40 cases in each group. The patients in the two groups were given routine treatments, including cardiotonics, diuretics, bronchodilators, and symptomatic treatments. On this basis, the patients in the observation group were given S/D 20 type non-invasive ventilator (produced by Wellkang US), ventilation mode: PEEP + PSV, inspiration and expiration of 1:1.5, initial expiration pressure of 2 cmH2O, gradually increasing to 5 cmH2O; initial inspiration pressure of 8 cmH2O, gradually increasing to 15 cmH2O; oxygen concentration from 80% to 35%. The ventilation pressure and time were regulated according to the disease progression, and nasal tube oxygen inhalation was adopted after stability. The patients in the control group were given continuous low flow oxygen inhalation, with oxygen flow rate of 2.5 L/min.

2.3. Observation indicators

PaO2, pH, PaCO2, SaO2, and PaO2/FiO2 before treatment and 48 h after treatment in the two groups were compared. The serum NT-pro BNP and cTnI levels before treatment, 24 h and 48 h after treatment in the two groups were compared.

2.4. Statistical analysis

SPSS 19.0 software was used for the statistical analysis. 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 the blood gas indicators before and after treatment between the two groups

The comparison of PaO2, pH, PaCO2, SaO2, and PaO2/FiO2 before treatment between the two groups was not statistically significant (P>0.05). PaO2, pH, SaO2, and PaO2/FiO2 after treatment in the two groups were significantly elevated, while PaCO2 was significantly reduced when compared with before treatment (P<0.05). PaO2, pH, SaO2, and PaO2/FiO2 after treatment in the observation group were significantly higher than those in the control group (P<0.05), while PaCO2 was significantly lower than that in the control group (P<0.05) (Table 1).

3.2. Comparison of NT-pro BNP and cTnI levels before and after treatment between the two groups

The comparison of NT-pro BNP and cTnI levels before treatment between the two groups was not statistically significant (P>0.05). NT-pro BNP and cTnI levels 12 h and 24 h after treatment in the two groups were significantly elevated when compared with before treatment (P<0.05). NT-pro BNP and cTnI levels after treatment in the observation group were significantly lower than those in the control group (P<0.05) (Table 2).

Table 1.

Comparison of the blood gas indicators before and after treatment between the two groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>PaO2</th>
<th>PaCO2</th>
<th>SaO2</th>
<th>PaO2/FiO2</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>40</td>
<td>Before treatment</td>
<td>7.32±2.11</td>
<td>6.97±1.21</td>
<td>71.51±12.62</td>
<td>144.67±26.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After treatment</td>
<td>7.91±2.67*</td>
<td>6.01±0.77*</td>
<td>94.99±5.71*</td>
<td>257.90±15.92*</td>
</tr>
<tr>
<td>Control</td>
<td>40</td>
<td>Before treatment</td>
<td>7.31±2.16</td>
<td>6.93±1.34</td>
<td>72.44±11.83</td>
<td>142.52±13.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After treatment</td>
<td>7.69±2.13*</td>
<td>6.42±0.89*</td>
<td>85.81±7.32*</td>
<td>237.01±13.08*</td>
</tr>
</tbody>
</table>

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

Table 2.

Comparison of NT-pro BNP and cTnI levels before and after treatment between the two groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>NT-pro BNP (pg/mL)</th>
<th>cTnI (ng/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>40</td>
<td>Before treatment</td>
<td>457.06±77.88</td>
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<tr>
<td></td>
<td></td>
<td>24 h after treatment</td>
<td>644.46±112.79*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48 h after treatment</td>
<td>510.82±105.62*</td>
</tr>
<tr>
<td>Control</td>
<td>40</td>
<td>Before treatment</td>
<td>470.52±105.77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24 h after treatment</td>
<td>684.66±102.20*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48 h after treatment</td>
<td>596.39±112.00*</td>
</tr>
</tbody>
</table>

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

The acute heart failure is a commonly emergent and serious disease in the clinic, whose morbidity is gradually increasing due to the dietary habit and population aging in recent years[6]. Due to the acute onset and rapid condition change, the cardiac output in patients with acute heart failure is sharply reduced, and the pulmonary venous backflow is obstructed, which can induce the pulmonary edema, resulting in alveolar ventilation dysfunction, which can induce severe hypoxemia, and even respiratory failure, and further aggravate the heart failure[7–10]; therefore, in the early treatment, how to effectively alleviate the pulmonary ventilation/gas exchange dysfunction is of great significance in improving the prognosis in patients with acute heart failure.

The traditional low flow continuous oxygen inhalation and drug therapy can improve the acute heart failure merged with respiratory failure to a certain degree, but the effect in correcting the hypoxemia is poor[11]. The non-invasive ventilator in assisting the respiration can overcome the airway resistance, and alleviate the respiratory muscle fatigue; moreover, the positive pressure ventilation can prevent the bronchial collapse, enhance the arterial oxygen saturation, promote the discharge of carbon dioxide, and effectively correct the respiratory failure symptoms[12,13]. In addition, the non-invasive mechanical ventilation can significantly reduce the intrathoracic negative pressure, alleviate the cardiac load, reduce the ventricular return blood flow and myocardial tension, and alleviate the heart failure symptoms to a certain extent[14]. The results in the study showed that PaO₂, pH, SaO₂, and PaCO₂/FiO₂ after treatment in the observation group were significantly higher than those in the control group (P<0.05), while PaCO₂ was significantly lower than that in the control group (P<0.05), indicating that the non-invasive ventilator assisted respiration can significantly improve the blood gas indicators in patients with acute heart failure merged with respiratory failure, with efficacy significantly superior to that by the traditional low flow continuous oxygen inhalation. NT-pro BNP is a natural hormone with bioactivity, is mainly synthetized by the myocardial cells, whose secretion amount is changed with the ventricular filling pressure; therefore, NT-pro BNP is often regarded as the monitoring index in the clinic. cTnI is an important indicator to evaluate the prognosis of acute heart failure, and has an important suggesting significance in the early diagnosis of acute heart failure[15,16]. The results in the study showed that NT-pro BNP and cTnI levels 12 h and 24 h after treatment in the observation group were significantly lower than those in the control group (P<0.05), the non-invasive mechanical ventilation in the early treatment of acute heart failure merged with respiratory failure can effectively reduce NT-pro BNP and cTnI levels in order to alleviate the heart failure symptoms.

In conclusion, non-invasive ventilator in the treatment of acute heart failure merged with respiratory failure can effectively improve the ventilation function, reduce NT-pro BNP and cTnI levels, and is of great significance in enhancing the rescued effect.

References