Clinical Study of High Frequency Oscillatory Ventilation on Neonatal Respiratory Distress Syndrome

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Abstract. To investigate the clinical effect of high frequency oscillatory ventilation (HFOV) in neonatal respiratory distress syndrome (NRDS). Forty-six children with NRDS who were treated in Neonatal Intensive Care Unit (NICU) from January 2015 to December 2016 were selected as study subjects, 34 in study group (HFOV) and 12 in control group (SIMV), both groups were given basic and PS treatment, blood gas analysis and clinical treatment before and after treatment were compared indicators. Compared with SIMV group, HFOV group had faster blood gas analysis and treatment and fewer complications. HFOV and PS combined treatment of neonatal respiratory distress syndrome obvious effect, high safety, worthy of clinical promotion and use.

Introduction

Neonatal respiratory distress syndrome (NRDS) is a common comorbidity of premature infants due to a lack of pulmonary surfactant and lung hypoplasia, as well as a significant impact on survival and quality of life in preterm infants. In particular, the smaller the gestational age, the higher the incidence of NRDS. And the increasing rate has become one of the common causes of death in premature infants and can leave serious lung and nervous system sequelae[1]. NRDS is due to insufficient or excessive alveolar surfactant (PS) synthesis in alveolar type II epithelial cells, abnormal alveolar surface tension, and difficulty in maintaining normal state[2]. Neonatal respiratory distress syndrome PS combined with non-invasive ventilation greatly reduced its mortality, but still some children are critically ill and need mechanical ventilation support. Reasonable choice of mechanical ventilation can effectively improve the survival rate of NRDS. As a form of mechanical ventilation, high-frequency oscillatory ventilation is a method of ventilation with low tidal volume and high frequency. Previously, it was mainly used for the treatment of severe respiratory failure in neonates. Because of its unique ventilation mechanism, in recent years, The trend of increasing use of this study is to evaluate the efficacy and safety of HFOV by analyzing and comparing the effects of synchronized intermittent mandatory ventilation and HFOV treatment on blood gas, PS use, ventilator parameters and clinical outcome, and other aspects of the impact, objective evaluation of the efficacy and safety of HFOV, explore the possibility of clinical further promotion of HFOV ventilation mode of application, in order to benefit more NRDS premature children[3].

Therefore, to improve ventilation and hypoxia is the key to clinical treatment. High frequency oscillatory ventilation method was used in our hospital to obtain better clinical effect and to compare with the curative effect of synchronized intermittent mandatory ventilation (SIMV). Through the clinical application of this new ventilatory mode, it is possible to further investigate the long-term follow-up of lung function and nervous system development in children who have used HFOV during the neonatal period.

Method

Subjects

A total of 46 preterm infants with NRDS undergoing mechanical ventilation from a neonatal
intensive care unit (NICU) at a general hospital from January 2015 to December 2016 were selected as study subjects, including 27 males and 19 females. NRDS diagnostic criteria refer to the 4th edition of Practical Neonatology. Meet the standard: birth gestational age \( \leq 36 \) weeks, day \( \leq 1 \)d, clinical diagnosis of NRDS; the need for mechanical ventilation. Exclusion criteria: severe asphyxia; severe congenital malformations (severe congenital heart disease, diaphragmatic hernia, cleft palate, etc.); HFOV treatment, severe infection; shock; mechanical ventilation less than 24 h or to give up treatment. Forty-six patients were divided into study group (treated with HFOV) and control group (n = 12) according to the consent of their families. The eligible children were randomly divided into HFOV group or SIMV group. Requirements of the two groups of children basic information (number, gender, gestational age) by the general information was no significant difference (\( P > 0.05 \)), comparable. See Table 1.

### Table 1. Comparison of two groups in general.

<table>
<thead>
<tr>
<th>Group</th>
<th>Sex (male/female)</th>
<th>Age (X ± S • d)</th>
<th>Gestational week (X ± S • w)</th>
<th>weight (X ± S • g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFOV group</td>
<td>23/11</td>
<td>2.7±0.8</td>
<td>32.7±2.7</td>
<td>1434±341</td>
</tr>
<tr>
<td>SIMV Group</td>
<td>4/8</td>
<td>2.5±0.9</td>
<td>32.5±3.6</td>
<td>1421±327</td>
</tr>
<tr>
<td>X² / t value</td>
<td>0.16</td>
<td>0.77</td>
<td>1.44</td>
<td>0.58</td>
</tr>
<tr>
<td>P value</td>
<td>0.67</td>
<td>0.44</td>
<td>0.14</td>
<td>0.52</td>
</tr>
</tbody>
</table>

### Methods

The two groups of children were given routine basic treatment, including keeping warm, maintaining stable internal environment, nutritional support, preventing infection and stopping bleeding. Some children used cardiovascular active drugs such as dopamine to ensure stable cardiovascular function. All children as soon as possible to use PS, 100 ~ 200mg / kg, as needed, can be reused. Family members of the control group refused HFOV due to other factors, and the SIMV group was ventilated in SIMV mode using a ventilator. Study group selected ventilator, ventilator parameters properly adjusted to maintain stable condition and target blood gas. Target blood gas levels were SpO2 88%-95% and PaCO2 35-50 mmHg (1 mmHg = 0.133 kPa). Weaning was considered when weaning criteria were met, and when necessary, extubation was followed by nasal continuous positive airway pressure (CPAP) transition.

Monitoring indicators: All children were routinely monitored blood pressure, heart rate, respiration, PaO2, PS use, while recording the PaO2, PaCO2, OI before and after treatment and clinical effects.

Statistical methods: SPSS15.0 software for statistical analysis of data, measurement data as mean ± standard deviation (x ± S), normality test, using t test, count data expressed as a percentage, using \( \chi^2 \) test, \( P < 0.05 \) for the difference was statistically significant.

### Results

Comparison of blood gas analysis results between two groups of children after treatment, PaO2 was significantly increased and PaCO2 and OI were significantly decreased in the study group compared with the control group, the difference was statistically significant (<0.05). See Table 2.

### Table 2. Comparison of blood gas analysis results between two groups of children.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of cases</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>OI (mmHg) Before treatment</th>
<th>OI (mmHg) After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFOV</td>
<td>34</td>
<td>46.38±11.76</td>
<td>70.54±14.89</td>
<td>51.36±8.81</td>
<td>34.57±5.48</td>
<td>12.46±7.31</td>
<td>4.59±2.44</td>
</tr>
<tr>
<td>SIMV</td>
<td>12</td>
<td>48.57±11.18</td>
<td>51.42±13.26</td>
<td>52.12±8.46</td>
<td>40.27±4.19</td>
<td>12.21±7.56</td>
<td>7.69±4.56</td>
</tr>
<tr>
<td>T value</td>
<td></td>
<td>-0.112</td>
<td>3.351</td>
<td>-1.514</td>
<td>4.173</td>
<td>0.066</td>
<td>-5.127</td>
</tr>
<tr>
<td>P value</td>
<td></td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>
Two groups of children with clinical treatment effect comparison study group 28 cases of children, 22 cases were significant, 5 cases were effective, 1 case of ineffective treatment of children was 96.4%; control group of children, 3 cases were significant, 5 cases effective, 4 cases were ineffective, the effective rate of children was 66.7%. The treatment effect of two groups of children was significantly different, the study group was better than the control group, the difference was statistically significant ($\chi^2=5.6287, P=0.025$).

Discussion

With the continuous improvement of medical technology and the clinical application of pulmonary surfactant, the cure rate of neonatal respiratory distress syndrome has been greatly improved. Alveolar surfactant is to improve lung compliance and aerobic conditions and thus reduce the oxygen concentration, with lubrication and anti-atrophy. Clinically, the use of synchronized intermittent mandatory ventilation in the treatment of neonatal respiratory distress syndrome, due to its low oxygen concentration and pressure, the ideal ventilation and oxygenation effect, if the high pressure, high ventilation and high suction oxygen in the case, can easily lead to lung poisoning and lung injury, which in turn lead to pneumothorax, chronic lung disease and other complications of premature children. High-frequency oscillatory ventilation has become a new mode of ventilation, with low tidal volume, high ventilation frequency, low ventilation pressure and a little help to correct carbon dioxide retention and hypoxemia, and further improve the oxygenation and oxygen concentration, thereby reducing the body's high oxygen injury, significantly reduce the inhibition of endogenous alveolar surfactant synthesis.

The results showed that the partial pressure of blood oxygen in the study group was $(70.54 \pm 14.89)$ mmHg, which was significantly higher than that in the control group $(51.42 \pm 13.26)$ mmHg, the difference was statistically significant (<0.05). After treatment, the partial pressure of blood carbon dioxide in the study group was $(34.57 \pm 5.48)$ mmHg. Significantly lower than $(40.27 \pm 4.19)$ mmHg, the difference was statistically significant (<0.05). Clinical efficacy of two groups of children compared with the treatment group before and after treatment more obvious effect.

Summary

In summary, high-frequency oscillatory ventilation combined with PS can improve respiratory function of neonatal respiratory distress syndrome, high safety, clinical effect is significant, worthy of clinical promotion and use.

Acknowledgement

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References


