Effect of lung lavage via fiber bronchoscope combined with non-invasive positive pressure ventilation on the blood gas results and systemic state of patients with COPD complicated by severe pneumonia

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ARTICLE INFO

Article history:
Received 25 Oct 2017
Received in revised form 28 Oct 2017
Accepted 2 Nov 2017
Available online 14 Nov 2017

Keywords:
COPD
Severe pneumonia
Non-invasive positive pressure ventilation
Lung lavage via fiber bronchoscope

ABSTRACT

Objective: To discuss the effect of lung lavage via fiber bronchoscope combined with non-invasive positive pressure ventilation on the blood gas results and systemic state of patients with COPD complicated by severe pneumonia. Methods: A total of 68 patients with COPD complicated by severe pneumonia who were treated in the hospital between November 2015 and April 2017 were collected, retrospectively analyzed and then divided into the group A (n=35) who received noninvasive positive pressure ventilation and the group B (n=33) who received lung lavage via fiber bronchoscope combined with non-invasive positive pressure ventilation. The differences in arterial blood gas and serum index levels were compared between the two groups before and after treatment. Results: Before treatment, there was no statistically significant difference in arterial blood gas index levels as well as serum contents of inflammatory mediators, stress hormones and myocardial enzyme spectrum indexes between the two groups. After treatment, arterial blood gas indexes PH and PaO2 levels of group B were higher than those of group A; serum inflammatory mediators HMGB1, PCT and hs-CRP contents were lower than those of group A; serum stress hormones Cor, Ang I and Ang II contents were lower than those of group A; serum myocardial enzyme spectrum indexes α-HBDH and cTn-I contents were lower than those of group A. Conclusion: Lung lavage via fiber bronchoscope combined with non-invasive positive pressure ventilation can effectively optimize the arterial blood gas levels, reduce systemic inflammatory stress state and protect the myocardial function of patients with COPD complicated by severe pneumonia.

1. Introduction

Chronic obstructive pulmonary disease (COPD) is the most common chronic airway inflammatory disease, it causes irreversible damage to airway function along with the progression and increases the probability of pathogen infection, and therefore, the probability of acute pneumonia is high in COPD patients[1,2]. Severe pneumonia is that acute pneumonia is accompanied by respiratory failure as well as heart, liver, kidney and other system involvement in addition to the symptoms of respiratory system, the illness of COPD combined with severe pneumonia is more serious and complicated, and the choice of early therapy is of great influence for final treatment outcome[3]. On the basis of conventional anti-infection, anti-shock, spasmolysis, reducing phlegm and other basic treatment, non-invasive positive pressure ventilation can effectively increase the patients' effective ventilation, optimize oxygenation and improve the hypoxia state of the body. At present, some studies have shown that the important reason for the poor efficacy of severe pneumonia is that the local ventilation/blood flow ratio is abnormal and the intravenous drugs can't reach the lesion due to the accumulation of secretions in the lungs. Lung lavage via fiber bronchoscope is one way to remove secretions in the lung under direct vision, it was combined with noninvasive positive pressure ventilation and used to treat the patients with COPD complicated by severe pneumonia, and the effects of combination therapy on patient's condition were discussed in the study.

2. Information and methods

2.1 Case information and grouping

A total of 68 patients with COPD complicated by severe pneumonia who were treated in the hospital between November 2015 and April 2017 were enrolled as research subjects, retrospectively analyzed and then divided into the group A (n=35) who received noninvasive positive pressure ventilation and the group B (n=33) who received...
lung lavage via fiber bronchoscope combined with non-invasive positive pressure ventilation. Group A included 20 male cases and 15 female cases that were 51-78 years old; group B included 18 male cases and 15 female cases that were 52-76 years old. There was no statistical difference in baseline data distribution between the two groups. The study design was reasonable and obtained approval from the hospital ethics committee.

2.2 Inclusion and exclusion criteria

Inclusion criteria: (1) in accordance with the diagnostic criteria for COPD and severe pneumonia; (2) without history of pneumonia in 6 months prior to admission; (3) cooperating with and completing the treatment, and no cases dropping out voluntarily or dead in the treatment. Exclusion criteria: (1) combined with asthma, lung cancer and other respiratory diseases; (2) combined with the serious infectious diseases of other tissue viscera; (3) combined with severe heart, liver and kidney insufficiency.

2.3 Therapy

Both groups received conventional anti-infection, phlegm reducing, fluid infusion, spasmylosis, nutrition support and other therapies for patients with COPD complicated by severe pneumonia. Group A received non-invasive positive pressure ventilation on the basis, and the daily ventilation was 12-18 h, inspiratory pressure was 12-20 cmH2O and expiratory pressure was 4-8 cmH2O. Group B received lung lavage via fiber bronchoscope combined with non-invasive positive pressure ventilation on the basis, specifically as follows: nose and throat surface anesthesia by 2% lidocaine, inserting fiber bronchoscope into the trachea via nasal cavity, looking for nose and throat surface anesthesia by 2% lidocaine, inserting fiber bronchoscope into the trachea via nasal cavity, looking for oxide partial pressure (PaO2) levels were measured by the blood gas analyzer.

2.4 Arterial blood gas indexes

The radial artery blood samples were collected from two groups before and after treatment, and the arterial blood gas indexes PH and oxygen partial pressure (PaO2) levels were measured by the blood gas analyzer.

2.5 Serum indexes

The fasting peripheral blood samples were collected from two groups before and after treatment, anti-coagulated and centrifuged to get the upper serum and store it in a cryogenic environment. Enzyme-linked immunosorbent assay was used to detect the serum contents of inflammatory mediators high mobility group box (HMGB1), procalcitonin (PCT) and high-sensitivity C-reactive protein (hs-CRP). RIA method was used to detect serum contents of stress hormones cortisol (Cor), angiotensin I (Ang I ) and angiotensin II (Ang II ). Microplate reader was used to detect serum contents of myocardial enzyme spectrum indexes -hydroxybutyrate dehydrogenase (α-HBDH) and cardiac troponin I (cTn- I ).

2.6 Statistical processing

Data input and calculation were both by software SPSS 25.0, and P<0.05 meant statistical significance in differences in statistic. Arterial blood gas indexes, inflammatory mediators, stress hormones, myocardial enzyme spectrum indexes and other measurement data were in terms of mean ± standard deviation and were compared by t test.

3. Results

3.1 Arterial blood gas indexes

Comparison of radial arterial blood gas indexes pH and PaO2 (mmHg) levels between the two groups was as follows: before treatment, the differences in PH and PaO2 levels were not significant between the two groups (P>0.05). After treatment, pH and PaO2 levels of both groups were higher than those before treatment; pH and PaO2 levels of group B were higher than those of group A, and the differences were significant (P<0.05), shown in Table 1.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>pH Before treatment</th>
<th>After treatment</th>
<th>PaO2 Before treatment</th>
<th>After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>34</td>
<td>7.16±0.15</td>
<td>7.28±0.21</td>
<td>46.28±5.91</td>
<td>71.32±8.67</td>
</tr>
<tr>
<td>Group B</td>
<td>34</td>
<td>7.15±0.17</td>
<td>7.35±0.19</td>
<td>45.79±5.67</td>
<td>82.54±9.08</td>
</tr>
<tr>
<td>t</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: compared with same group before treatment, *P<0.05.

3.2 Comparison of serum inflammatory mediator contents between the two groups before and after treatment.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>HMGB1 Before treatment</th>
<th>After treatment</th>
<th>PCT Before treatment</th>
<th>After treatment</th>
<th>hs-CRP Before treatment</th>
<th>After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>34</td>
<td>19.72±2.65</td>
<td>11.64±1.78</td>
<td>1.69±0.25</td>
<td>0.89±0.09</td>
<td>8.29±0.91</td>
<td>5.17±0.56</td>
</tr>
<tr>
<td>Group B</td>
<td>34</td>
<td>19.68±2.49</td>
<td>7.05±0.86</td>
<td>1.67±0.23</td>
<td>0.47±0.05</td>
<td>8.31±0.89</td>
<td>2.89±0.35</td>
</tr>
<tr>
<td>t</td>
<td>0.163</td>
<td>9.287</td>
<td>0.254</td>
<td>7.281</td>
<td>0.146</td>
<td>10.287</td>
<td></td>
</tr>
<tr>
<td>P</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>
<td></td>
</tr>
</tbody>
</table>

Note: compared with same group before treatment, *P<0.05.
Note: compared with same group before treatment, \( P < 0.05 \).

Table 4.
Comparison of serum myocardial enzyme spectrum index contents between the two groups before and after treatment.

<table>
<thead>
<tr>
<th>Groups</th>
<th>( n )</th>
<th>( \alpha)-HBDH</th>
<th></th>
<th>cTn-I</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before treatment</td>
<td>After treatment</td>
<td>Before treatment</td>
<td>After treatment</td>
<td>Before treatment</td>
</tr>
<tr>
<td>Group A</td>
<td>34</td>
<td>274.91±30.65</td>
<td>224.24±25.61</td>
<td>6.83±0.71</td>
<td>4.19±0.45</td>
</tr>
<tr>
<td>Group B</td>
<td>34</td>
<td>271.85±29.74</td>
<td>143.04±15.72</td>
<td>6.81±0.73</td>
<td>2.54±0.27</td>
</tr>
<tr>
<td>( T )</td>
<td></td>
<td>0.172</td>
<td>14.294</td>
<td>0.254</td>
<td>10.617</td>
</tr>
<tr>
<td>( P )</td>
<td></td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Note: compared with same group before treatment, \( P < 0.05 \).

3.2 Inflammatory mediators

Comparison of serum inflammatory mediators HMGB1 (ng/mL), PCT (μg/L) and hs-CRP (mg/L) contents between the two groups was as follows: before treatment, the differences in serum HMGB1, PCT and hs-CRP contents were not significant between the two groups (\( P > 0.05 \)). After treatment, serum HMGB1, PCT and hs-CRP contents of both groups were lower than those before treatment; serum HMGB1, PCT and hs-CRP contents of group B were lower than those of group A, and the differences were significant (\( P < 0.05 \)), shown in Table 2.

3.3 Stress hormones

Comparison of serum stress hormones Cor, Ang I and Ang II contents between the two groups was as follows: before treatment, the differences in serum Cor, Ang I and Ang II contents were not significant between the two groups (\( P > 0.05 \)). After treatment, serum Cor, Ang I and Ang II contents of both groups were lower than those before treatment; serum Cor, Ang I and Ang II contents of group B were lower than those of group A, and the differences were significant (\( P < 0.05 \)), shown in Table 3.

3.4 Myocardial enzyme spectrum indexes

Comparison of serum myocardial enzyme spectrum indexes \( \alpha\)-HBDH (U/L) and cTn-I (μg/L) between the two groups was as follows: before treatment, differences in serum \( \alpha\)-HBDH and cTn-I contents were not significant between the two groups (\( P > 0.05 \)). After treatment, serum \( \alpha\)-HBDH and cTn-I contents of both groups were lower than those before treatment; serum \( \alpha\)-HBDH and cTn-I contents of group B were lower than those of group A, and the differences were significant (\( P < 0.05 \)), shown in Table 4.

4. Discussion

The treatment of COPD combined with severe pneumonia has always been a clinical difficulty. If active intervention is not taken early, the mortality rate of patients will be higher. Non-invasive positive pressure ventilation is the most importantly applied clinical auxiliary ventilation method. It provides positive pressure support by the ventilator to increase the effective ventilation capacity and improve the body ventilation/gas exchange function. The pulmonary pathogen infection is serious in patients with severe pneumonia, a large number of secretions accumulate and are unable to be discharged independently by patients, local lung collapses, the ventilation/blood flow ratio falls, intravenous drugs cannot reach the site, and this is also the important reason of the uncured chronic pneumonia and severe complications[4-5]. Lung lavage via fiber bronchoscope is the method that uses fiber bronchoscope in the lesions, dilutes and sucks out the partial secretions under direct vision, and it can locally inject high-concentration sensitive antibiotics to exert potent antimicrobial effects[6-7]. In this study, lung lavage via fiber bronchoscope combined with non-invasive positive pressure ventilation was used to treat patients with COPD complicated by severe pneumonia, and the effect of the therapy on the blood gas levels and systemic state of the patients was explored. COPD patients with severe pneumonia have severe pulmonary ventilation and pulmonary gas exchange dysfunction, which can lead to insufficient blood oxygen concentration, abnormal oxygenation and even respiratory failure. Arterial blood gas can reflect the patient's ventilation status in real time, and indirectly indicate the efficacy of clinical treatment[8-10]. It was found in this study that compared with those before treatment, radial arterial blood pH and PaO2 levels of both groups increased after treatment, indicating the effectiveness of the two therapies; further compared with those of group A, radial arterial blood pH and PaO2 levels of group B were higher after treatment, showing that lung lavage via fiber bronchoscope combined with non-invasive positive pressure ventilation can be more effective to optimize the ventilation/gas exchange function in patients with COPD complicated by severe pneumonia, which indicates the excellence of its curative effect.

The primary clinical symptom of severe pneumonia is the systemic inflammation caused by pathogen infection, the pathogen accumulated in local lungs prompts the neutrophils and monocyte/macrophage, stimulates them to secrete a large number of inflammatory mediators, and gradually forms the inflammatory cascade reaction. Both HMGB1 and PCT are advanced inflammatory mediators, which increase to the peak 24 h after onset, exert for a long time, and play the roles such as prompting inflammatory factors, amplifying inflammatory response and causing tissue damage[11-13]. hs-CRP can be released into the blood and detected in early inflammation, which is the most common index for the early diagnosis of infectious disease and disease severity, and has high sensitivity[14-15]. It was found in this study that compared with those before treatment, serum HMGB1, PCT and hs-CR contents of both groups decreased after treatment, indicating that the inflammatory state was controlled after both treatments; further compared with
those of group A, serum HMGB1, PCT and hs-CR contents of group B were lower after treatment, showing that lung lavage via fiber bronchoscope combined with non-invasive positive pressure ventilation can more effectively inhibit the systemic inflammatory response, which is mainly because that the fiber bronchoscope removes the intrapulmonary secretions under direct vision.

Pathogen infection and systemic inflammatory reaction will both cause the body stress, the specific manifestations are vasoconstriction, elevated blood pressure, increased catabolism, etc., serological expression is the increased expression of Cor, Ang I, Ang II and other stress hormones, and their contents can objectively reflect the patient’s stress state and disease severity, and evaluate the clinical effect[16,17]. It was found in the study that compared with those before treatment, serum Cor, Ang I and Ang II contents of both groups decreased after treatment; further compared with those of group A, serum Cor, Ang I and Ang II contents of group B were lower after treatment, showing that adding lung lavage via fiber bronchoscope in the overall treatment can be more effective to reduce the body’s stress response, which is consistent with its role in inhibiting the body’s inflammatory response. After released in the blood, the pathogen and inflammatory mediators go through and damage various important viscera, the heart is the most easily damaged viscera, and combination of cardiac dysfunction is also one of the major causes of death in patients with severe pneumonia[8,19]. Myocardial injury can early release many specific indexes into the blood, which are referred to as the myocardial enzyme spectrum, including α -HBDH and cTnI[1], and their contents increase with the aggravation of myocardial damage[20,21]. It was found in the research that compared with those before treatment, serum α -HBDH and cTnI contents decreased after treatment; further compared with those of group A, serum α -HBDH and cTnI contents of group B were lower after treatment, showing that adding lung lavage via fiber bronchoscope in the overall treatment can be more effective in protecting the patients’ cardiac function and avoid severe complications.

Therefore, on the basis of routine treatment, lung lavage via fiber bronchoscope combined with noninvasive positive pressure ventilation can effectively optimize the lung ventilation/gas exchange function, inhibit the systemic inflammatory stress response and actively protect the cardiac function of patients with COPD complicated by severe pneumonia, it is an effective and feasible therapy, and it is worthy of popularization and application in the treatment of similar patients in the future.

To sum up, lung lavage via fiber bronchoscope combined with noninvasive positive pressure ventilation can effectively optimize the arterial blood gas levels, reduce the systemic inflammatory stress state and also protect the cardiac function in patients with COPD complicated by severe pneumonia.

References


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