Value of arterial blood lactate and early lactate clearance in evaluating the prognosis in patients with COPD merged with respiratory failure

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ABSTRACT

Objective: To explore the value of arterial blood lactate and early lactate clearance in evaluating the prognosis in patients with COPD merged with respiratory failure. Methods: A total of 78 patients with COPD merged with respiratory failure were included in the study. The arterial blood lactate level 1 d before treatment and 6 h after treatment was detected. The early lactate clearance was evaluated. The patients were divided into the severe elevation group, mild elevation group, and normal control group according to the blood lactate level. APACHE II score, 28 d death rate, and other clinical related indicators in the three groups were compared. According to the early lactate clearance, the patients were divided into the high lactate clearance group and low lactate clearance group. The arterial blood lactate level, APACHE II score, death rate, and arterial blood gas indicators in the two groups were compared. The multiple-factor analysis of prognosis was performed. Results: With the increasing of blood lactate concentration before treatment, APACHE II score, mechanical ventilation time, ventilation rate, hospitalization time, and death rate were gradually elevated, and the comparison among the three groups was not statistically significant. When compared with before treatment, the arterial blood lactate level, APACHE II score, and PaCO2 in the high lactate clearance group were significantly reduced, but PaO2 and pH were significantly elevated, while PaO2 in the low lactate clearance group was significantly elevated. The death rate in the high lactate clearance group was significantly lower than that in the low lactate clearance group. The early lactate clearance was a factor in protecting the prognosis in patients with COPD merged with respiratory failure. Conclusions: The arterial blood lactate level and early lactate clearance can affect the prognosis in patients with COPD merged with respiratory failure. Dynamic monitoring of early blood lactate level can better evaluate the disease severity degree and prognosis.

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a chronic respiratory disease characterized by incomplete reversible and progressive airway limitation[1]. With the disease progression, COPD can cause the deterioration of cardiopulmonary function, finally developing into respiratory failure, with a high death rate.

Selection of effective and rapid detection methods and early diagnosis and treatment is crucial for the prognosis in patients with COPD merged with respiratory failure. Blood lactate is a sensitive indicator to reflect the peripheral tissue perfusion and intracellular hypoxia. Some researches demonstrate that[2,3] the early lactate clearance can better effectively evaluate the severity degree and prognosis in patients with critical diseases, which has already been studied in severe infection, infection shock, and burn, but is less studied in COPD merged with respiratory failure. The study is aimed to explore the value of arterial blood lactate and early lactate clearance in evaluating the prognosis in patients with COPD merged with respiratory failure.
2. Materials and methods

2.1. General materials

A total of 78 patients with COPD merged with respiratory failure who were admitted in our hospital from May, 2013 to June, 2016 were included in the study, among which 48 were male, and 30 were female; aged from 58 to 76 years old, with an average age of 61 years old; course from 2 to 14 years, with an average course of 7 years; 22 had type I respiratory failure, and 56 had type II respiratory failure. Inclusion criteria: (1) those who were in accordance with the diagnostic criteria of COPD merged with respiratory failure in the Diagnosis and Treatment Guideline of COPD (2007)[4]; (2) those whose PaO2 was less than 60 mmHg, accompanied by or not accompanied by PaCO2>50 mmHg; (3) those who had signed the informed consents. Exclusion criteria: (1) those who had severe heart, liver, and renal dysfunction; (2) those who were merged with endocrine disease, tuberculosis, tumor, and other primary pulmonary diseases; (3) those who were allergic to related drugs; (4) those who had detachment.

2.2. Methods

The patients in the two groups were given anti-infection, spasmolysis, asthma relieving, phlegm reducing, oxygen therapy, and nutrition support. If necessary, the tracheal intubation was performed to connect with the breathing machine for mechanical ventilation. The temperature, heart rate, respiration, blood pressure and other vital signs were monitored. A volume of 1mL arterial blood 1d before treatment and 6 h after treatment was collected, centrifuged for the serum, and preserved at -80℃ for detection. Abbott i-STAT trace blood gas analyzer and CG4+ testing card were used to detect the blood lactate level, and the dry electrochemical method was adopted. Blood lactate >2.0 mmol/L was regarded as positive, while blood lactate >4.0 mmol/L was regarded severe elevation. According to the blood lactate concentration before treatment, the patients were divided into the severe elevation group, mild elevation group, and normal control group. Early lactate clearance=(blood lactate concentration on admission - blood lactate concentration after admission)/blood lactate concentration on admission 100%. According to the critical value of 10%, the patients were divided into the high lactate clearance group and low lactate clearance group.

2.3. Observation indicators

APACHE II score, mechanical ventilation rate, ventilation time, hospitalization time, and 28 d death rate before treatment in the three groups were compared. The arterial blood lactate level, APACHE II score, arterial blood gas indicators, and 28 d death rate after treatment in the two groups were compared. The multiple-factor analysis for the prognosis was performed.

2.4. Statistical analysis

SPSS 22.0 software was used for the statistical analysis. The measurement data were expressed as mean ± SD. After the homogeneity test of variances for the measurement data among groups, LSD-t test was used. The enumeration data were expressed as percentage (%), and chi-square test was used. Logistic analysis was used for the multiple-factor analysis for the prognosis. P<0.05 was regarded as statistically significant.

3. Results

3.1. Comparison of the clinical materials and death rate among the three groups

With the increasing of blood lactate concentration before treatment, APACHE II score, mechanical ventilation time, ventilation rate, hospitalization time, and death rate were gradually elevated, and the comparison among the three groups was not statistically significant (P<0.05) (Table 1).

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>APACHE II</th>
<th>Mechanical ventilation rate</th>
<th>Mechanical ventilation time</th>
<th>Hospitalization time</th>
<th>Death rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe elevation</td>
<td>19</td>
<td>26.93±4.42</td>
<td>13(68.42)</td>
<td>7.89±3.01</td>
<td>22.58±3.47</td>
<td>10(52.63)</td>
</tr>
<tr>
<td>Mild elevation</td>
<td>42</td>
<td>21.64±4.71</td>
<td>14(33.33)</td>
<td>6.21±1.56</td>
<td>15.69±3.42</td>
<td>12(28.57)</td>
</tr>
<tr>
<td>Normal control</td>
<td>17</td>
<td>16.33±3.11</td>
<td>3(17.65)</td>
<td>2.58±1.65</td>
<td>13.25±2.69</td>
<td>2(11.76)</td>
</tr>
<tr>
<td>χ²</td>
<td>/</td>
<td>46.131</td>
<td>10.784</td>
<td>47.58</td>
<td>46.27</td>
<td>7.241</td>
</tr>
<tr>
<td>P</td>
<td>/</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>
3.2. Comparison of the various indicators and death rate in patients with different lactate clearance after treatment

When compared with before treatment, the arterial blood lactate level, APACHE II score, and PaCO₂ in the high lactate clearance group were significantly reduced, but PaO₂ and pH were significantly elevated (P<0.05), while PaO₂ in the low lactate clearance group was significantly elevated (P<0.05) (Table 2).

3.3. Multiple-factor analysis for the prognosis in patients with COPD merged with respiratory failure

Logistic prognosis multiple-factor analysis showed that the early lactate clearance was a protecting factor, while the mechanical ventilation time and APACHE II are the risk factors to affect the prognosis (P<0.05) (Table 3).

4. Discussion

When the patients have COPD merged with respiratory failure, hypoventilation and carbon dioxide retention are often involved, leading to dyspnea, cyanosis, abnormal consciousness, and peripheral circulatory failure, with an extremely high death rate(6,7). Accurate and effective monitoring for patients with COPD merged with respiratory failure is of great significance in estimating the disease progression, selecting the treatment protocol, and evaluating the prognosis. The blood lactate level is affected by hypoxia, the severity degree of shock, and hypoperfusion degree, and is a sensitive indicator to reflect the early tissue perfusion and oxygen metabolic state. The severe elevation of blood lactate level can cause lactic acidosis(8,9). Due to hypoventilation in patients with COPD merged with respiratory failure, oxygen supply imbalance in different degrees, microcirculation disturbance, and endothelial cell damage can be caused, leading to reduced visceral scavenging activity, and significant elevation of arterial blood lactate levels(10,11). However, the arterial blood lactate can only monitor the balance between oxygen supply and oxygen consumption at a given time, and is unable to predict the disease progression and therapeutic effect. Currently, dynamic monitoring of the blood lactate level is often performed in the clinic in the early stage in order to timely reflect the elimination of arterial blood lactate, and is applied in evaluating the severity degree and prognosis of sepsis, infectious shock, and other critical diseases(12,13). APACHE II is often used in evaluating the severity degree of acute diseases. Some researches demonstrate that APACHE II is preferably correlated with the lactate clearance. The lower the early lactate clearance is, the higher APACHE II score is, usually suggesting the poor prognosis(14,15). The results in the study showed that the higher the blood lactate level before treatment was, the higher APACHE II score, mechanical ventilation time, ventilation rate, hospitalization time, and death rate were, indicating that the initial arterial blood lactate level has a certain effect on the prognosis, but can not effectively distinguish between the mild elevation group and the severe elevation group. The results in the study showed that when compared with before treatment, the arterial blood lactate level, APACHE II score, and PaCO₂ in the high lactate clearance group were significantly reduced, but PaO₂ and pH were significantly elevated (P<0.05), while PaO₂ in the low lactate clearance group was significantly elevated (P<0.05); the death rate in the high lactate clearance group was significantly lower than that in the low lactate clearance group (P<0.05), indicating that the early lactate level can not only preferably reflect the tissue...
perfusion state and therapeutic effect at a specific time, but also can reflect the metabolic regulation ability of liver, kidney, and other organs; therefore, effective measures should be taken during the treatment to reduce the blood lactate level in order to avoid a further progression. Some researches demonstrate that the early lactate clearance can estimate the prognosis for patients after CPR[16]. In the study, the multiple-factor analysis for the prognosis was performed, and the results in the study showed that the early lactate clearance is a protective factor for prognosis, and can be served as an effective indicator for prognosis. The higher the early lactate clearance is, the mild the condition is, and the better the prognosis is.

In conclusion, the arterial blood lactate level and early lactate clearance can affect the prognosis in patients with COPD merged with respiratory failure. Dynamic monitoring of early blood lactate level can better evaluate the disease severity degree and prognosis, and has a certain reference value in enhancing the therapeutic effect and improving the therapeutic scheme.

References


