Correlation of serum CRP and PCT levels with systemic inflammatory response in patients with acute exacerbation of COPD

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ARTICLE INFO

Article history:
Received 7 Jul 2016
Received in revised form 17 Jul 2016
Accepted 12 Jul 2016
Available online 24 Jul 2016

Keywords:
Acute exacerbation of COPD
CRP
PCT
Systemic inflammatory response

ABSTRACT

Objective: To investigate the correlation of serum C-reactive protein (CRP) and procalcitonin (PCT) levels with systemic inflammatory response in patients with acute exacerbation of chronic obstructive pulmonary disease (COPD). Methods: 68 patients with acute exacerbation of COPD treated in our hospital between August 2012 and February 2016 were collected as observation group and 50 normal subjects receiving physical examination in our hospital during the same period were selected as normal control group. Radioimmunoassay was used to determine serum CRP and PCT levels; the observation group was further grouped according to the median of CRP and PCT levels, and serum levels of pro-inflammatory factors, anti-inflammatory factors and stress hormones of high level group and low level group were detected. Results: Serum CRP and PCT levels of observation group were significantly higher than those of normal control group (P<0.05); serum pro-inflammatory factors interleukin-1β (IL-1β), interleukin-6 (IL-6) and interleukin-8 (IL-8) levels of high CRP and PCT level groups within observation group were higher than those of low CRP and PCT level groups (P<0.05), anti-inflammatory factors interleukin-4 (IL-4) and interleukin-13 (IL-13) levels were lower than those of low CRP and PCT groups (P<0.05), and stress hormones angiotensin II (Ang II), aldosterone (ALD) and cortisol (Cor) levels were higher than those of low CRP and PCT level groups (P<0.05). Conclusions: Serum CRP and PCT levels in patients with acute exacerbation of COPD are positively correlated with the inflammatory response extent in the body, and can be used as the auxiliary means for early disease diagnosis, treatment effect evaluation and prognosis judgment.

1. Introduction

Chronic obstructive pulmonary disease (COPD) is the most common clinical respiratory chronic disorder, the respiratory function of patients in stable stage is in a tolerable state, and after acute attack of airway inflammation, a variety of inflammatory cells and inflammatory mediators are massively produced, then further destruct the lung structure, reduce ventilation/gas exchange function and even cause respiratory failure[1,2]. For patients with COPD, the early detecting acute infection and confirming infection extent greatly influence the treatment outcome in patients[3]. C-reactive protein (CRP) and procalcitonin (PCT) are the accepted infection-sensitive indexes, many studies have confirmed that serum CRP and PCT levels increase sharply when COPD patients are complicated with acute infection[4], but there is no clear report about the correlation of CRP and PCT levels with systemic infection extent. In the following study, the correlation of serum CRP and PCT levels with systemic inflammatory response extent in patients with acute exacerbation of COPD was analyzed.

2. Materials and methods

2.1. General information

68 patients with acute exacerbation of COPD treated in our
hospital between August 2012 and February 2016 were collected as observation group and 50 normal subjects receiving physical examination in our hospital during the same period were selected as normal control group. Observation group included 38 male cases and 30 female cases, they were 43–80 years old, the body weight was 55–78 kg and (67.12±9.43) kg in average; control group included 26 male cases and 24 female cases, they were 40–79 years old, the body weight was 52–83 kg and (65.94±8.66) kg in average. The two groups of subjects were not statistically different in gender, age and body weight distribution ($P$>$0.05$).

2.2. Serum CRP and PCT level detection methods

After all the subjects were included, 2 mL of fasting peripheral venous blood was extracted, let stand at room temperature and centrifuged at 4 °C to get supernatant, and RIA kit (purchased from Thermo Fisher Company) instructions were followed to detect the CRP and PCT levels. According to the median of CRP and PCT levels, observation group was further divided into high and low CRP level groups as well as high and low PCT groups.

2.3. Pro-inflammatory factor, anti-inflammatory factor and stress hormone detection methods

2 mL of peripheral venous blood was collected from observation group, the same method was used to obtain serum, ELISA kits (purchased from the Sigma Company) were used to detect the levels of pro-inflammatory factors interleukin-1β (IL-1β), interleukin-6 (IL-6) and interleukin-8 (IL-8) as well as anti-inflammatory factors interleukin-4 (IL-4) and interleukin-13 (IL-13), and RIA method was used to detect serum levels of stress hormones, including angiotensin II (Ang II), aldosterone (ALD) and cortisol (Cor).

2.4. Statistical analysis

SPSS18.0 software was used for statistical processing, measurement data in the study was in terms of mean ± standard deviation ($\bar{x}$±$s$), comparison between two groups was by routine $t$ test and $P$<$0.05$ meant statistical significance in differences.

3. Results

3.1. Serum CRP and PCT levels

Comparison of serum CRP and PCT levels between two groups of subjects is as follows: serum CRP and PCT of observation group were significantly higher than those of normal control group. Differences in serum CRP and PCT levels were statistically significant between observation group and normal control group ($P$<$0.05$), shown in Table 1.

<table>
<thead>
<tr>
<th>Groups</th>
<th>CRP (mg/L)</th>
<th>PCT (ng/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation group</td>
<td>15.29±1.87</td>
<td>4.82±0.59</td>
</tr>
<tr>
<td>Control group</td>
<td>2.73±0.35</td>
<td>0.67±0.08</td>
</tr>
<tr>
<td>$t$</td>
<td>9.283</td>
<td>6.124</td>
</tr>
<tr>
<td>$P$</td>
<td>$&lt;$0.05</td>
<td>$&lt;$0.05</td>
</tr>
</tbody>
</table>

| Table 1 | Comparison of serum CRP and PCT levels ($\bar{x}$±$s$). |

3.2. Correlation between CRP and pro-inflammatory as well as anti-inflammatory factors

Comparison of serum pro-inflammatory factors IL-1β, IL-6 and IL-8 as well as anti-inflammatory factors IL-4 and IL-13 levels between patients with different CRP levels within observation group is as follows: serum pro-inflammatory factors IL-1β, IL-6 and IL-8 levels of high CRP level group were significantly higher than those of low CRP level group while anti-inflammatory factors IL-4 and IL-13 levels were significantly lower than those of low CRP group. Differences in serum pro-inflammatory factors IL-1β, IL-6 and IL-8 as well as anti-inflammatory factors IL-4 and IL-13 levels were statistically significant between high CRP level group and low CRP level group within observation group ($P$<$0.05$), shown in Table 2.

3.3. Correlation between PCT and pro-inflammatory as well as anti-inflammatory factors

Comparison of serum pro-inflammatory factors IL-1β, IL-6 and IL-8 as well as anti-inflammatory factors IL-4 and IL-13 levels between patients with different PCT levels within observation group is as follows: serum pro-inflammatory factors IL-1β, IL-6 and IL-8 levels of high PCT level group were significantly higher than those of low PCT level group while anti-inflammatory factors IL-4 and IL-13 levels were significantly lower than those of low PCT group. Differences in serum pro-inflammatory factors IL-1β, IL-6 and IL-8 as well as anti-inflammatory factors IL-4 and IL-13 levels were statistically significant between high PCT level group and low PCT level group within observation group ($P$<$0.05$), shown in Table 3.

3.4. Correlation between CRP and stress hormones

Comparison of serum stress hormones Ang II, ALD and Cor levels between patients with different CRP levels within observation group is as follows: serum stress hormones Ang II, ALD and Cor levels of high CRP level group were significantly higher than those of low CRP level group. Differences in stress hormones Ang II, ALD and Cor levels were statistically significant between high CRP level group and low CRP level group within observation group ($P$<$0.05$), shown in Table 4.
Table 4
Comparison of stress hormone levels between patients with different CRP (n=34, ±s).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Ang II (pg/mL)</th>
<th>ALD (pg/mL)</th>
<th>Cor (nmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High level group</td>
<td>13.76±1.92</td>
<td>143.57±15.17</td>
<td>118.53±13.62</td>
</tr>
<tr>
<td>Low level group</td>
<td>8.19±0.97</td>
<td>93.72±10.18</td>
<td>76.61±8.59</td>
</tr>
<tr>
<td>t</td>
<td>6.231</td>
<td>8.293</td>
<td>7.495</td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

3.5. Correlation between PCT and stress hormones

Comparison of serum stress hormones Ang II, ALD and Cor levels between patients with different PCT levels within observation group as follows: serum stress hormones Ang II, ALD and Cor levels of high PCT level group were significantly higher than those of low PCT level group. Differences in stress hormones Ang II, ALD and Cor levels were statistically significant between high PCT level group and low PCT level group within observation group (P<0.05), shown in Table 5.

Table 5
Comparison of stress hormone levels between patients with different PCT (n=34, ±s).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Ang II (pg/mL)</th>
<th>ALD (pg/mL)</th>
<th>Cor (nmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High level group</td>
<td>11.35±1.46</td>
<td>127.66±17.94</td>
<td>93.27±10.19</td>
</tr>
<tr>
<td>Low level group</td>
<td>6.28±0.79</td>
<td>91.25±10.59</td>
<td>68.1±7.89</td>
</tr>
<tr>
<td>t</td>
<td>7.942</td>
<td>8.093</td>
<td>7.872</td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

4. Discussion

There is persistent low level of local airway inflammation in patients with stable COPD, but the inflammatory mediator levels in circulating blood mostly remain normal, and after acute pathogen infection, local inflammatory mediators are massively released into the blood stream and trigger systemic inflammatory response[5,6]. CRP and PCT are considered to be directly associated with the onset of acute COPD infection, and many scholars believe that high levels of CRP and PCT can be used as the early warning indicators of acute exacerbation of COPD[7,8]. In the study, serum CRP and PCT levels of patients with acute exacerbation of COPD and normal control group were detected at first, and it was found that compared with normal control group, patients with acute exacerbation of COPD were with higher serum CRP and PCT levels (P<0.05), confirming that there are abnormally high expression of CRP and PCT in the circulating blood of patients with acute exacerbation of COPD, but the inner link between their specific levels and systemic inflammatory response is not clear and remains to be further cleared below.

PCT is a glycoprotein, its content is little in human body under physiological state, and serum PCT levels rise sharply after acute infection in the body[9,10]. CRP is the immune component substance widely existing in the body, and the inflammatory stress response in the body can stimulate the secretion of CRP and has been used to assess the severity of infection. In the study, CRP and PCT levels were referred for the secondary grouping of patients with acute exacerbation of COPD, and the inflammatory mediator and stress hormone levels were compared between patients with different levels to define the correlation of CRP and PCT levels with the severity of infection. Pro-inflammatory factor/anti-inflammatory factor imbalance is the basic mechanism of systemic inflammatory response, IL-1β, IL-6 and IL-8 are the typical pro-inflammatory factors that are produced by macrophages, T cells, B cells and other cells, and can regulate immune response, acute phase reaction and so on, and their expression disorders can directly promote the progression of a variety of diseases[11,12]. IL-4 and IL-13 belong to anti-inflammatory factors, IL-4 is mainly produced by the activated...
Th2 cells, it is reactively released in the acute phase of infection, and in the case of continuous aggravation of infection, it is excessively consumed and then lowly expressed[13,14]. It was found in the study that serum pro-inflammatory factors IL-1β, IL-6 and IL-8 levels of high CRP level group were higher while anti-inflammatory factors IL-4 and IL-13 levels were lower (P<0.05); the change trend of pro-inflammatory factors and anti-inflammatory factors of high PCT group was the same as that of high CRP group. It confirms that CRP and PCT levels in patients with acute exacerbation of COPD are directly correlated with the anti-inflammatory and pro-inflammatory factor levels, and can accurately reflect the disease severity.

In addition to the increased inflammatory mediators, stress hormones also change accordingly when acute inflammation occurs[15,16]. Massively produced inflammatory mediators can stimulate the renin-angiotensin-aldosterone system to secrete Ang II, ALD and Cor, make the body in the continuous decomposition and consumption state, hinder the action of anti-inflammatory drugs and lead to COPD progression[17,18]. In the study, serum stress hormones Ang II, ALD and Cor levels in patients with different CRP and PCT levels were detected, and it was found that compared with low level groups, high CRP level group and high PCT level group were with higher serum Ang II, ALD and Cor levels (P<0.05), confirming that the CRP and PCT levels are positively correlated with stress hormone levels.

To sum up, it is concluded as follows: serum CRP and PCT levels in patients with acute exacerbation of COPD are positively correlated with the inflammatory response extent in the body, and can be used as the auxiliary means for early disease diagnosis, treatment effect evaluation and prognosis judgment.

References