Analysis of inflammation, antioxidant, insulin resistance and bone metabolism in patients with chronic periodontitis

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ABSTRACT

Objective: To investigate the changes and clinical significance of inflammation, antioxidant, insulin resistance and bone metabolism in patients with chronic periodontitis. Methods: 50 patients with chronic periodontitis treated in our hospital from January 2017 to March 2018 were selected as the observation group and 50 cases of periodontal health were selected as control group. The expression levels of related indicators of inflammation [including macrophage migration inhibitory factor (MIF), monocyte chemoattractant protein-1 (MCP-1), granulocyte-macrophage colony-stimulating factor (GM-CSF)], antioxidant [including nitric oxide (NO) and nitric oxide synthase (NOS)], insulin resistance [including adiponectin, leptin (LEP)] and bone metabolism [including visfatin and calcitonin gene-related peptide (CGRP)] in the two groups were observed and compared. Results: Except for the levels of adiponectin [(3.03±0.40) ng/L] and CGRP [(32.40±12.61) μg/L] in the observation group [(5.33±0.63) ng/L and (49.84±13.36) μg/L, respectively] were significantly lower than those in the control group (P<0.05). The levels of MIF [(14.15±4.40) ng/mL], MCP-1 [(0.93±0.13) μg/L], GM-CSF [(1.71±0.51) μg/L], NO [(84.67±26.02) μmol/L], NOS [(49.71±9.52) μmol/L], LEP [(0.88±0.27) μg/L] and visfatin [(80.34±33.57) μg/L] were significantly higher than those in the control group [(11.27±1.95) ng/mL, (0.47±0.11) μg/L and (34.61±14.02) μg/L, respectively]. All above differences were significant (P<0.05). Conclusions: Patients with chronic periodontitis are prone to inflammatory reaction. And the degree of inflammation is deeper. It is easy to stimulate antioxidant effect and resist periodontal infection. It may also aggravate insulin resistance to increase blood sugar or affect bone metabolism and osteoporosis.

1. Introduction

Chronic periodontitis is a common oral disease, a chronic infectious disease mediated by plaque bacteria and its products, characterized by periodontal pocket formation, loss of attachment, and alveolar bone absorption and loosening, which can eventually lead to tooth loss[1-3]. This disease has no obvious symptoms in the early stage, and it is easy to be neglected. When the symptoms are obvious, the condition is already serious and can even lead to tooth loss[4,5]. And studies have shown that chronic periodontitis can affect the development of certain systemic diseases (such as arteriosclerosis, cerebral arterial and coronary artery disease, diabetes, etc.)[6-8]. Therefore, it is necessary to give patients timely treatment. This study aimed to investigate the detection and clinical significance of inflammation, antioxidant, insulin resistance and bone metabolism in patients with chronic periodontitis.
group, including 27 males and 23 females, aged 40-65 years, with a BMI of (21.4±2.3). There were no significant differences in gender, age, and BMI between the two groups. The difference was not statistically significant (P>0.05) and could be compared and analyzed.

Inclusion criteria: (1) meet the diagnostic criteria for patients with chronic periodontitis: plaque and calculus, probing depth (PD) ≥ 5 mm of at least two teeth, clinical attachment loss (CAL) ≥ 4 mm of at least two teeth, image shows alveolar bone resorption; (2) has not used antibiotics, immunomodulatory drugs, non-steroidal anti-inflammatory drugs and glucocorticoids in the past 3 months; (3) without heart, lung, kidney and other important organ diseases, normal liver and kidney function test, there is no relevant infectious disease recently and no history of periodontitis. Exclusion criteria: (1) exclude patients with systemic inflammatory diseases, blood diseases, liver damage, kidney disease or trauma; (2) exclude female patients during pregnancy or lactation; (3) exclude those who have a history of smoking and drinking.

2.2 Methods

Sample collection: routinely take 5 mL of fasting venous blood from two groups of subjects, take the supernatant after centrifugation, and store at -20 °C.

Observed indicators: serum MIF, MCP-1, LEP and Visfatin levels were detected by ELISA; serum GM-CSF, CGRP and APN levels were detected by radioimmunoassay; serum NO and NOS levels were detected by chemical method.

2.3 Statistical methods

The data were analyzed by SPSS 13.0 statistical software. The measurement data were expressed by mean ± standard deviation (x±s). The two groups were compared by independent sample t test. When P<0.05, the difference was considered as statistically significant.

3. Results

3.1 Inflammation-related factors levels of patients in the two groups

Detected these levels of both groups, found that the levels of MIF, MCP-1 and GM-CSF in the observation group were (14.15±4.40) ng/mL, (0.93±0.13) μg/L and (1.71±0.51) μg/L, respectively, which is significantly higher than the control group (11.27±1.95) ng/mL, (0.51±0.07) μg/L and (0.45±0.17) μg/L, the difference was statistically significant (P<0.05), see Table 1.

Table 1

Comparison of inflammation-related factors levels in the two groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>MIF (ng/mL)</th>
<th>MCP-1 (μg/L)</th>
<th>GM-CSF (μg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>50</td>
<td>14.15±4.40</td>
<td>0.93±0.13</td>
<td>1.71±0.51</td>
</tr>
<tr>
<td>Control</td>
<td>50</td>
<td>11.27±1.95</td>
<td>0.51±0.07</td>
<td>0.45±0.17</td>
</tr>
</tbody>
</table>

3.2 Antioxidant-related factors levels between the two groups

After levels in the two groups were tested, data showed that the NO and NOS levels in the observation group were (84.67±26.02) μmol/L and (49.71±9.52) μmol/L, respectively, which were significantly higher than those in the control group (P<0.05), see Table 2.

Table 2

Comparison of antioxidant-related factors levels between the two groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>NO (μmol/L)</th>
<th>NOS (μmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>50</td>
<td>84.67±26.02</td>
<td>49.71±9.52</td>
</tr>
<tr>
<td>Control</td>
<td>50</td>
<td>54.80±9.33</td>
<td>30.29±4.63</td>
</tr>
</tbody>
</table>

3.3 Insulin resistance related factor levels of patients between the two groups

The APN levels in the observation group were (3.03±0.40) ng/L, which was significantly lower than that in the control group (5.33±0.63) ng/L, while the LEP level in the observation group was (0.88±0.27) μg/L, significantly higher than the control group (0.47±0.11) μg/L, the difference was statistically significant (P<0.05), see Table 3.

Table 3

Comparison of insulin resistance related factor levels between the two groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>APN (ng/L)</th>
<th>LEP (μg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>50</td>
<td>3.03±0.40</td>
<td>0.88±0.27</td>
</tr>
<tr>
<td>Control</td>
<td>50</td>
<td>5.33±0.63</td>
<td>0.47±0.11</td>
</tr>
</tbody>
</table>

3.4 Bone metabolism related factors in both groups

After testing the two groups, the level of Visfatin in the observation group was (80.34±33.57) μg/L, which was significantly higher than that in the control group (34.61±14.02) μg/L. The CGRP level of observation group was (32.40±12.61) μg/L, which was significantly lower than that of the control group (49.84±13.36) μg/L. The difference was statistically significant (P<0.05), see Table 4.

Table 4

Comparison of bone metabolism related factors between the two groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Visfatin (μg/L)</th>
<th>CGRP (μg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>50</td>
<td>80.34±33.57</td>
<td>32.40±12.61</td>
</tr>
<tr>
<td>Control</td>
<td>50</td>
<td>34.61±14.02</td>
<td>49.84±13.36</td>
</tr>
</tbody>
</table>

4. Discussion

Chronic periodontitis is a common oral disease, which occurs mostly in adults and is a chronic infectious disease. The basic characteristics of the disease are periodontal pocket formation, loss of attachment, and alveolar bone resorption and loosening[9]. Due to the continuous action of periodontal plaque and its products, the
periodontal tissue is inflammatory, and the scavenging pathogen activity of immune response is reduced, which will cause the periodontal plaque to persist, and the continuous inflammatory reaction will cause the absorption and destruction of the alveolar bone[10,11].

Gingival epithelial cells and immune cells can release a variety of inflammatory factors under the action of periodontal pathogens. Chemokines can promote the accumulation of inflammatory factors to the infected site, amplify the inflammatory effect and increase the degree of tissue damage. And some studies have suggested that a variety of serum inflammatory factors in patients with periodontitis showed an elevated state[9]. MIF is a proinflammatory factor of innate immunity, expressed in various cells such as T lymphocytes, macrophages, epithelial cells, and endothelial cells. It is associated with the occurrence and development of various inflammatory diseases. It will increase when suffer stress, inflammation and infection, and it can also increase the release of interleukin and aggravate periodontal damage[12]. MCP-1 is synthesized when suffer internal and external stimulation and is a risk predictor of various heart diseases such as atherosclerosis and myocarditis[13]. It is considered to be related to the activity of periodontitis[9]. GM-CSF is a polypeptide hormone hematopoietic growth factor, released by damaged endothelial cells, a marker sensitive to inflammatory response, and plays an important role in the body’s immune regulation and response[14]. The results of this study showed that the levels of MIF, MCP-1 and GM-CSF in the observation group were significantly higher than those in the control group ($P<0.05$), suggesting that there is a serious inflammatory reaction in patients with chronic periodontitis.

Chronic periodontitis is an inflammatory reaction caused by accumulation of bacteria or plaque in teeth. How to effectively remove subgingival plaque, calculus and diseased cementum to prevent plaque reattachment is very important for the treatment of chronic periodontitis. NO is an intercellular signaling molecule that plays an important role in the immune system. NOS is present in phagocytic cells and produces and secretes NO, which is toxic to bacteria and intracellular parasites. Both have certain reference value for eliminating periodontal tissue infection[15]. The results of this study showed that the levels of NO and NOS in the observation group were significantly higher than those in the control group ($P<0.05$), suggesting that there was bacterial infection in patients with chronic periodontitis, resulting in increased stress levels of NO and NOS.

A large number of research and epidemiological investigations have found that periodontal infection is closely related to cardiovascular and cerebrovascular diseases[16], and periodontitis is also one of the common complications of diabetes. APN is the only negative regulator of adipokines[17], which increases insulin sensitivity, inhibits obesity, and lowers blood glucose. LEP is an important cytokine in lipid metabolism, which regulates blood glucose and lipid levels and is associated with insulin resistance[18]. The results of this study showed that the APN level in the observation group was significantly lower than that in the control group ($P<0.05$); the LEP level was significantly higher than the control group ($P<0.05$). It suggests that insulin resistance occurs in patients with chronic periodontitis, which greatly increases the incidence of diabetes, and should be monitored during clinical treatment.

As a chronic infectious disease, periodontitis can destroy periodontal tissue by periodontal infection through pathogenic bacteria, and it can also destroy bone tissue due to imbalance of systemic proinflammatory/anti-inflammatory immune regulation[9]. Visfatin plays an important role in the body’s immune regulation system, and is related to cellular metabolic activity, which can affect bone metabolism and is a risk factor for osteoporosis[20]. CGRP is a biologically active polypeptide that is widely distributed in bone tissue and is capable of dilating blood vessels, inducing angiogenesis, and promoting bone metabolism and regeneration[21]. The results of this study showed that the level of Visfatin in the observation group was significantly higher than that in the control group; while the level of CGRP in the observation group was significantly lower than that in the control group. It is suggested that patients with chronic periodontitis have abnormal bone metabolism and may cause osteoporosis.

In summary, patients with chronic periodontitis will aggravate the degree of inflammation after bacterial infection, and have a chance to cause diabetes, affect bone metabolism, and cause osteoporosis. The detection of related indicators has certain guiding significance for the diagnosis and evaluation of the disease.

References

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