A Comparison of Plasma Lipid Levels and Fasting Blood Sugar in Patients with Chronic Periodontitis and in Healthy Individuals

Abstract

Introduction:
Recent studies have reported the connection between increased risk of cardiovascular diseases and diabetes with the presence of chronic periodontitis. The aim of this study was to determine the relationship between chronic periodontitis and triglyceride, high- and low-density lipoprotein (HDL and LDL), and glucose levels.

Materials and methods:
A total of 102 individuals participated in this comparative case-control study and were divided into a test group (51 people with chronic periodontitis with at least two periodontal pockets of >5 mm depth) and a control group (individuals with healthy periodontium or gingivitis). Plasma lipid levels and blood glucose were measured, and the data were statistically analyzed using chi-square and t-tests at p < 0.05 with SPSS version 21.

Results:
A significant increase in serum triglyceride, cholesterol, and glucose (p < 0.0001) was observed in the test group (group I), whereas serum HDL and LDL showed no significant increase in the test group (group I) compared to the control group (group II) (p = 0.244 and p = 0.127, respectively).

Conclusion:
This study suggested a connection between hyperglycemia and hyperlipidemia with chronic periodontitis, however, the etiology could not be precisely determined.

Key words:
- Cardiovascular Diseases
- Hyperlipidemias
- Periodontal Diseases
- Risk Factors.
A comparison of Blood Serum Levels and Fasting Blood Sugar in Patients

Introduction

Chronic periodontitis is the most common form of periodontitis and may be aggravated in the presence of systemic or environmental factors such as diabetes, smoking, and stress, which alter the host’s response to the accumulation of plaque.\(^1\) Chronic periodontitis is an infectious disease and results in chronic inflammation of tooth supportive structures, proceeding attachment and bone loss.

Severe systemic or chronic infections such as periodontitis can cause changes in the plasma density of cytokines and hormones that result in altering lipid metabolism.\(^2\) Periodontal disease transfers bacteria into the bloodstream and initiates a change in blood coagulation and fortitude of endothelial, coronary walls and platelet function, which can ultimately cause coronary alteration and atherosclerosis.\(^3\) An increase in pre-inflammatory cytokines, as a response to infection caused by chronic periodontitis, increases the plasma lipid levels.\(^4\)

Studies have shown that people with chronic periodontitis are more prone to develop cardiovascular diseases. As shown by epidemiologic studies in USA, after regulating the known cardiovascular risk factors, coronary disease risk in men with periodontitis is 50%–70% higher.\(^5\) On the other hand, the relationship between diabetes and periodontal diseases is well known. Several clinical studies have shown that periodontal diseases are more common among the diabetics. Smoking and poor oral health habits are the other risk factors for cardiovascular and periodontitis problems.\(^6\) On the other hand, periodontal problems may play a role in the advancement of diabetes. Because periodontal diseases are infectious and infection causes tissue resistance to insulin and blocks glucose from entering the target cell, treatment of chronic periodontitis can be effective in controlling patient’s blood sugar.\(^10\)\(^-\)\(^12\)

Sandi et al.\(^13\) showed that patients with chronic periodontitis face a considerable rise of LDL cholesterol levels in their blood serum, which is a risk factor for cardiovascular disease. Poplaw ska et al.\(^14\) showed the connection between type II diabetes and periodontitis.

Due to the current life style, increased diabetes and blood lipids in the population and hyperlipidemia are main causes of cardiovascular diseases; therefore, special attention must be paid to periodontal treatments and reduction or elimination of periodontal pocket for cardiovascular or diabetic patients. Thus, the purpose of this study is to compare blood serum levels and fasting blood sugar in the periodontium of patients with.

Materials and Methods

This case-control study was conducted on 102 patients referring to the periodontology department of Rasht dentistry school of GUMS (Guilan University of Medical Sciences). The exclusion criteria were systemic diseases such as heart strokes (MI= Myocardial Infarction), cancer, liver, and kidney problems, cases with hypertension, receiving periodontal treatment in the past 6 months, corticosteroid or anabolic steroid consumption, pregnant or breastfeeding, mental or physical disability, and interfering effects on self-plaque control.

This study was approved by the Ethics Committee of Research Deputy in GUMS. Written informed consent was obtained from all the participants at the beginning of the study. All participants were informed of the voluntary nature of participation and were assured about confidentiality of their personal information.

Patients were divided into two groups of case and control with 51 in each group, and were based on personal and social (age and gender) characteristics. Patients in the case group were having moderate or severe chronic periodontitis (moderate chronic periodontitis, clinical attachment loss (CAL) = 3–4 mm; severe chronic periodontitis, CAL ≥ 5 mm with at least two periodontal pockets of ≥5 mm), and patients in the control group were 51 individuals with healthy periodontal tissue or gingivitis. Participants filled a questionnaire regarding their general health history and smoking habits, and then their clinical parameters of probing depth, bleeding on probing, and clinical attachment loss (CAL) were recorded.

Patients were then referred to the laboratory and a blood sample of 3 cc for analyzing triglyceride, FBS glucose, and LDL-HDL cholesterol was collected.

LDL cholesterol was calculated using total HDL cholesterol and for measuring triglycerides according to Friedwald et al. (1972).\(^15\)
A. Ashouri Moghadam, M. Malekzadeh, R. Tavakoli

\[ \text{LDL} = \text{TC} - (\text{HDL} - \frac{\text{TG}}{5}) \]

\( \text{TG} = \text{Triglyceride.} \)
\( \text{TC} = \text{Total cholesterol.} \)
\( \text{HDL} = \text{High-density lipoprotein cholesterol.} \)
\( \text{LDL} = \text{Low-density lipoprotein cholesterol.} \)

Blood samples were used only if they were collected on a fasting state and with a TG of <400.

**Table 1.** The table below shows the normal blood lipid

<table>
<thead>
<tr>
<th>Hyper lipidemia</th>
<th>Normal</th>
<th>Lipid</th>
</tr>
</thead>
<tbody>
<tr>
<td>TG</td>
<td>40-160</td>
<td>&gt;160</td>
</tr>
<tr>
<td>TC</td>
<td>125-200</td>
<td>&gt;200</td>
</tr>
<tr>
<td>HDL</td>
<td>29-80</td>
<td>&gt;80</td>
</tr>
<tr>
<td>LDL</td>
<td>66-178</td>
<td>&gt;178</td>
</tr>
</tbody>
</table>

**Table 2.** The table below shows the blood glucose levels based on laboratory data.

<table>
<thead>
<tr>
<th>Blood Glucose</th>
<th>Normal (70-100 mg/dl)</th>
<th>High (&gt;100 mg/dl)</th>
</tr>
</thead>
</table>

Pathological values for TG, cholesterol, LDL, and blood sugar (glucose) were higher than normal, whereas they were lower than normal for HDL. It should be noted that a fasting glucose level should be >100 mg/dl but <125 mg/dl (meaning it is placed in the division of prediabetes and it shows that the person has a high risk for developing type II diabetes), and if the blood glucose level in a fasting state is 126 mg/dl, it further indicates that the person is diabetic.

The collected data were analyzed using independent t-test and chi-square test. The Statistical Package for Social Sciences (SPSS) version 21.0 was used for analysis and processing of data at \( p < 0.05 \).

**Results**

A total of 26 females and 25 males comprised the test group and 24 females and 27 males comprised the control group. The mean age was 48.65 \( \pm \) 10.23 years for men and 46.22 \( \pm \) 13.76 years for women. Regarding plasma lipids and blood glucose levels, LDL and HDL were not significantly different from each other in healthy or periodontitis group, but blood glucose, blood cholesterol, and blood triglyceride levels were significantly different (\( p < 0.001 \)) (Table 3).

Comparison of plasma lipids and blood glucose levels of men in both groups showed no statistical differences, as shown in Table 4 (blood glucose, cholesterol, and triglyceride: \( p = 0.001, p < 0.0001, \) and \( p = 0.027 \) respectively). Similar results were obtained for women, as shown in Table 5 (\( p = 0.002, p < 0.0001, \) and \( p = 0.002 \) for blood glucose, cholesterol, and blood triglyceride, respectively). Comparison of age among both study groups revealed that blood glucose level had a direct relation with the age of the subjects (Figure 1). An increase in plasma lipids, however, did not occur with age.

**Table 3.** Plasma lipids and blood glucose in the two study groups

<table>
<thead>
<tr>
<th>Group Factor</th>
<th>Unhealthy mean ( \pm ) standard deviation</th>
<th>Healthy mean ( \pm ) standard deviation</th>
<th>( P ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBS</td>
<td>103.98 ( \pm ) 25.30</td>
<td>86.65 ( \pm ) 9.93</td>
<td>0.0001</td>
</tr>
<tr>
<td>CHOL</td>
<td>186.86 ( \pm ) 29.20</td>
<td>158.04 ( \pm ) 23.49</td>
<td>0.0001</td>
</tr>
<tr>
<td>TG</td>
<td>183.16 ( \pm ) 72.90</td>
<td>141.17 ( \pm ) 38.38</td>
<td>0.0001</td>
</tr>
<tr>
<td>HDL</td>
<td>41.24 ( \pm ) 8.41</td>
<td>39.50 ( \pm ) 6.52</td>
<td>0.244</td>
</tr>
<tr>
<td>LDL</td>
<td>106.51 ( \pm ) 27.77</td>
<td>98.87 ( \pm ) 22.52</td>
<td>0.127</td>
</tr>
</tbody>
</table>

**Table 4.** Plasma lipids and blood glucose in men of both groups

<table>
<thead>
<tr>
<th>Group Factor</th>
<th>Unhealthy mean ( \pm ) standard deviation</th>
<th>Healthy mean ( \pm ) standard deviation</th>
<th>( P ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBS</td>
<td>101.14 ( \pm ) 20.13</td>
<td>86.29 ( \pm ) 11.78</td>
<td>0.001</td>
</tr>
<tr>
<td>CHOL</td>
<td>188.76 ( \pm ) 32.52</td>
<td>155.25 ( \pm ) 25.23</td>
<td>0.0001</td>
</tr>
<tr>
<td>TG</td>
<td>195.14 ( \pm ) 82.29</td>
<td>156.18 ( \pm ) 38.74</td>
<td>0.027</td>
</tr>
<tr>
<td>HDL</td>
<td>40.04 ( \pm ) 8.08</td>
<td>38.07 ( \pm ) 6.55</td>
<td>0.319</td>
</tr>
<tr>
<td>LDL</td>
<td>106.32 ( \pm ) 26.92</td>
<td>94.79 ( \pm ) 23.88</td>
<td>0.093</td>
</tr>
</tbody>
</table>
A comparison of Blood Serum Levels and Fasting Blood Sugar in Patients

Table 5. Plasma lipids and blood glucose in women of both groups

<table>
<thead>
<tr>
<th>Group Factor</th>
<th>Unhealthy mean ± standard deviation</th>
<th>Healthy mean ± standard deviation</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBS</td>
<td>108.57 ± 31.46</td>
<td>87.08 ± 7.44</td>
<td>0.002</td>
</tr>
<tr>
<td>CHOL</td>
<td>187.24 ± 21.19</td>
<td>159.13 ± 21.62</td>
<td>0.0001</td>
</tr>
<tr>
<td>TG</td>
<td>16781 ± 57.60</td>
<td>123.67 ± 30.17</td>
<td>0.002</td>
</tr>
<tr>
<td>HDL</td>
<td>43.05 ± 8.90</td>
<td>41.17 ± 6.20</td>
<td>0.411</td>
</tr>
<tr>
<td>LDL</td>
<td>107.14 ± 30.15</td>
<td>103.62 ± 20.28</td>
<td>0.644</td>
</tr>
</tbody>
</table>

Discussion

Chronic periodontitis is a topical chronic infection that causes alteration in cytokine plasma density and hormone as well as in transferring bacteria into the blood stream (bacteremia). Moreover, Plasma LDL cholesterol activates monocyte/macrophage response to bacterial lipopolysaccharide and thus high levels of LDL in daily diet can trigger a higher discharge of destructive inflammatory cytokines by monocyte/macrophage. This not only causes atheromatous lesions but can also initiate a greater periodontal destruction in chronic periodontitis.

Results of this study showed that patients with chronic periodontitis had significantly higher levels of cholesterol and triglyceride. Consistent with these results, Moeintaghvai et al. found that in people with periodontal problems, mean cholesterol and triglyceride levels were significantly higher than those in healthy people. Their LDL and HDL levels were higher than those of the control group as well, though not significant. In another trial, Parsa et al. focused on the connection between periodontitis, blood cholesterol, and cardiovascular diseases. They sorted their study groups based on their age, gender, smoking habits, and diet and found that people with periodontitis had a higher level of blood cholesterol compared to...
Tetracycline, along with scaling and root planning, is the single most useful drug for antimicrobial treatment for periodontal diseases. In addition, in cases when the patients’ blood sugar control is poor and they need periodontal surgery, prophylactic antibiotics are prescribed. Regarding type II diabetes and periodontal diseases, Poplawska et al. (13) showed that 83.5% of type II diabetics were suffering from periodontitis, which shows a direct connection between these two and is consistent with the results of the current study. (26) Nabegh et al. (22) reported that in comparison to fasting blood sugar of non-diabetics with chronic periodontitis and non-diabetics with no periodontal disease, an increase in gingival inflammation results in a higher blood sugar in people with periodontitis. Katz (27) reported a connection between periodontitis and increased levels of glucose serum, as well.

In a study regarding cholesterol, LDL, HDL, CRP, fibrinogen, IgG levels against six known periodontal pathogens, glucose, albumin, and iron in two groups of healthy and periodontitis-affected individuals, Craige et al. (28) concluded that although serum glucose had a tendency to increase in the case group, it was not statistically significant. It must be mentioned, however, that in the mentioned study, blood sugar measurement was not done in a fasting state, also, glucose was reflecting both blood sugar and patients’ recent diet.

**Conclusion**

This study shows that there exists a direct connection between chronic periodontitis and increased levels of cholesterol, triglyceride, and fasting blood glucose. In addition, although LDL and HDL levels of case group were higher than those of control group, the difference was not statistically significant. Therefore, there is a relationship between hyperlipidemia/hyperglycemia and chronic periodontitis.

**Acknowledgments**

This work was supported by Guilan University of medical sciences (Thesis No: 1479).
References

