Relationship between hemoglobin level and severity of chronic periodontitis
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Abstract: Anemia of chronic disease, a cytokine-mediated anemia, is a frequent complication of many chronic inflammatory conditions. Periodontitis is a chronic infectious condition of the supporting tissues of the teeth that is caused by sub-gingival microbial colonization in susceptible hosts. The aim of this study is to investigate the association between hemoglobin level and the severity of chronic periodontitis. A total of 80 systemically healthy male patients were included in the study. Of these, 20 patients were healthy controls and 60 patients had chronic periodontitis and were divided into three groups of mild, moderate and severe periodontitis. Blood samples were collected to measure the hemoglobin level. Data analysis shows that patients with chronic periodontitis had lower values of hemoglobin compared to healthy controls. Results of the present study show that patients suffering from chronic periodontitis have lower values of hemoglobin compared to healthy controls. Thus, based on these results it can be concluded that, like any other chronic condition, chronic periodontitis can lead to anemia.

Keywords: Anemia, Hemoglobin, Inflammation, Periodontitis

Introduction
Periodontitis is a chronic infectious condition of the supporting tissues of the teeth that is caused by a complex mix of anaerobic, Gram-negative bacteria. The clinical symptoms of this infection include swollen red gingiva, gingival bleeding and suppuration; formation of periodontal pocket; gingival recession, and loss of alveolar bone. Epidemiologic studies suggested that periodontal deterioration increases the risk of systemic problems such as cardiovascular diseases, atherosclerosis, diabetes mellitus, and preterm low birth weight of infants. These associations suggest that periodontal diseases have systemic effects. The converse side of the relationship between systemic health and oral health has also been demonstrated. This means that there may be potential effects of periodontal disease on a wide range of organ systems. The sub-gingival microbiota in patients with periodontitis provides a significant and persistent gram-negative bacteria challenge to the host. These organisms and their products, such as lipopolysaccharide (LPS), have ready access to the periodontal tissues and to the circulation via the sulcular epithelium, which is frequently ulcerated and discontinuous. It has therefore been speculated that periodontitis results in a low grade systemic inflammation. Traditionally, an elevation in the number of peripheral leukocytes and a variation in the levels of serum proteins identified, as acute-phase proteins are characteristic of infectious conditions. Changes in blood components may also be detected in patients with periodontitis. In a study conducted by Hutter et al., lower erythrocyte numbers and lower hemoglobin (Hb) levels were reported in periodontitis patients. Down regulation of the erythropoiesis in bone marrow by pro-inflammatory cytokines could be responsible for decreased blood counts. Systemic circulation of cytokines originating from local inflammation suppresses erythropoiesis. It has also been reported that levels of white blood cells and plasma levels of C-reactive protein are elevated in individuals with periodontitis. Anemia is defined as a state of reduced hemoglobin concentration, reduced number of circulating erythrocytes in the blood, or both. In the literature, early studies reported anemia in periodontitis. Except for one report, the authors suggested that anemia was one of the causes of destructive periodontitis, not a consequence. Anemia of chronic disease is defined as anemia occurring in chronic infections, inflammatory conditions or neoplastic disorders that are not due to marrow deficiencies or other diseases, and occurring despite presence of adequate iron stores and vitamin. A characteristic finding of the disorders associated with ACD was the increased production of the cytokines that mediate the
immune or inflammatory response. All the processes involved in the development of ACD can be attributed to these cytokines and these cytokines are also released by periodontal tissues in response to bacterial infection. There are only a few studies that investigated the red blood cell parameters, especially hemoglobin level, in relation to periodontitis. The aim of the present study is to investigate the association between hemoglobin level and the severity of chronic periodontitis.

Materials and Methods

Eighty adult, male patients in the age range of 30–60 years, who reported to the Department of Periodontics, Rajah Muthiah Dental College, Tamil Nadu, India were enrolled in the study. The study protocol was approved by the institutional ethical committee. Informed consent was obtained from patients. A full mouth periodontal examination was conducted. Clinical periodontal parameters were recorded with a Williams graduated probe at six sites on each tooth for both case and control groups. These were probing depth (PD), clinical attachment loss (CAL), and bleeding on probing (BOP), as recorded on visual examination after 30–60 sec of probing. Based on the clinical examination, selected patients were grouped into case and control groups.

Group-I: is the control group of 20 male subjects with clinically healthy gingiva.

Group-II: Twenty patients with at least 30% of sites with a CAL of 1-2 mm were diagnosed with mild chronic periodontitis.

Group-III: Twenty patients with 2-3mm of sites with CAL were diagnosed with moderate chronic periodontitis and made up the.

Group-IV: Were diagnosed with severe chronic periodontitis with a CAL of 5mm or more.

Patients with any systemic disorder that may affect the periodontal tissue (such as diabetes, pregnancy and immunological disorders), present or past smokers, anemic patient, patients who have undergone periodontal treatment six months prior to the study were excluded from the study.

Blood collection and analysis

Ten ml venous blood samples were collected by venipuncture under aseptic conditions in the antecubital fossa without excessive venous stasis for both case and control group patients. The blood was transferred into ethylenediaminetetraacetic acid containing bulbs. The hematological parameters assessed in the present study were hemoglobin (Hb) (in g% by Sahli’s method).

Statistical analysis

SYSTAT, 12 software program were used to analyze all data. Analysis of Variance (ANOVA) statistical test was applied to compare the mean values of haemoglobin among the four groups. Bonferroni Multiple Correlation test was applied to find statistical significance among the groups studied.

Results

Table 1 compares the mean Hb among subjects with varying severity of periodontitis in the total sample. The mean Hb level was significantly higher for subjects with severe as compared to mild periodontitis. Table 2 compared the mean hemoglobin concentration values between groups. The significant p-value (≤0.001) showed that the hemoglobin concentration differs between the four groups. The Bonferroni Multiple Correlation test results showed that group I, group II, group III and group IV differed from each other. The mean hemoglobin concentration in-group IV was lower than group III and in-group II was lower than group I, concluding that chronic periodontitis influenced hemoglobin concentration.

Table 1: Mean (± SD) hemoglobin level (mmol/L) among patients with varying severity of periodontitis.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>14.50</td>
<td>0.30</td>
</tr>
<tr>
<td>Group II</td>
<td>13.65</td>
<td>0.30</td>
</tr>
<tr>
<td>Group III</td>
<td>12.30</td>
<td>0.26</td>
</tr>
<tr>
<td>Group IV</td>
<td>11.03</td>
<td>1.01</td>
</tr>
</tbody>
</table>

Table 2: Comparison of mean hemoglobin concentration values between groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Hb Concentration</th>
<th>SD</th>
<th>Anova Results</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>4.50</td>
<td>0.30</td>
<td>F=128.575</td>
<td>≤0.001</td>
</tr>
<tr>
<td>Group II</td>
<td>3.65</td>
<td>0.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group III</td>
<td>2.50</td>
<td>0.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group IV</td>
<td>1.03</td>
<td>1.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph 1: Group wise descriptive statistics of hemoglobin concentration
Discussion

The current study investigates the correlation between hemoglobin level and the severity of periodontitis in systemically healthy patients with generalized chronic periodontitis. Anemia of chronic disease is the second most prevalent form of anemia after nutritional, iron-deficiency anemia, and can coexist together, causing additional anemic burden. ACD is a cytokine-mediated anemia characterized by hypoferraemia, with adequate reticuloendothelial iron stores and normal-to-elevated ferritin concentrations. It is a known, frequent complication of chronic inflammatory conditions. Chronic periodontitis is an infectious disease resulting in inflammation within the supporting tissues of the teeth and progressive attachment and bone loss. It is recognized as the most frequently occurring form of periodontitis. The association of anemia and periodontitis has been explored since the early 20th century. Earlier reports have suggested anemia to be a cause, and not a consequence, of destructive periodontitis. Lainson et al., was one of the first authors to implicate anemia as a systemic cause of periodontitis. Chawla et al., suggested that anemia is an important factor in the etiology or pathogenesis of periodontal disease. Most of these authors believed that anemia was one of the causes of periodontitis rather than being the consequences. The hypothesis that infection will lead to anemia is possible. Strong evidence indicates that pathogenic bacteria or their products can stimulate cells such as fibroblasts, keratinocytes, and macrophages, which are present in periodontal tissue, to release a number of inflammatory cytokines, such as tumor necrosis factor-alpha (TNF-α); prostaglandin E2; interleukins (IL-1β, IL-6, and IL-12); The elevation in cytokine and chemokine by cells within the gingival connective tissue in chronic periodontitis lesion may result in the increased level of these mediators in the blood circulation, where they can induce or perpetuate systemic effect. Numerous studies have tried to evaluate the relationship between periodontitis and hemoglobin. Hutter and Thomas et al. found that periodontitis patients have lower hematocrit, lower numbers of erythrocytes, lower hemoglobin levels and higher erythrocyte sedimentation rates when compared to healthy controls. A ten-week intervention study by Rai et al., found an increase after scaling and root planing in hemoglobin and RBC levels in patients with severe periodontitis. Agarwal et al., in his study showed a significant improvement in hemoglobin value and erythrocyte count after periodontal treatment, including surgery in patient with generalized chronic periodontitis with anemia. On the other hands, Wakai et al., failed to show any association between hemoglobin levels and periodontal status. Havemose-Poulsen et al., failed to show any association between hemoglobin levels and periodontal status in patients with localized aggressive periodontitis, generalized aggressive periodontitis, juvenile idiopathic arthritis, and rheumatoid arthritis. The present study excludes tobacco smokers and chewers, because they present confounding factors. According to a study by Erdemir et al., smokers with chronic periodontitis had a lower number of erythrocytes, a lower value of hemoglobin, and lower hematocrit and iron compared to non-smokers with chronic periodontitis. In India, anemia is more prevalent in females because of poor nutrition, increased menstrual losses, high incidence of tropical and intestinal infections. Iron deficiency anemia is the most common type of anemia seen in India. Females are also prone to hormonal imbalance during puberty, during the reproductive phase, and toward menopausal age. The microbial flora and host immune response are altered leading to exaggerated response of the periodontal tissues to local factors. Therefore, to eliminate bias, only male patients were included in the study. The finding, which was observed in the present study, showed a lower level of hemoglobin in patients with severe chronic periodontitis as compared to moderate or mild periodontitis. The change in hemoglobin in the present study is statistically significant but the difference is not as striking as observed in anemia caused by other inflammatory conditions, such as rheumatoid arthritis, neoplastic conditions, and fungal or parasitic infections. This may be explained by the fact that chronic periodontitis is a milder inflammatory condition compared to other systemic infections or conditions. Further studies need to be conducted to correlate the amount of periodontal inflammation and its effects on the systemic health of an individual.

Conclusion

Systemic infections, especially chronic conditions, have a direct effect on the general health and well being of an individual. The present study provides evidence that periodontitis, like other chronic conditions, may tend towards anemia, as the levels of hemoglobin are lower in affected patients. Generalized, severe, chronic periodontal disease is positively associated with decreased levels of hemoglobin suggesting that mild ACD is induced by the systemic effects of periodontal inflammation in patients with severe periodontal disease. Being a low-grade infection, the signs may not be as severe as seen in other systemic conditions, but they definitely cannot be ignored.
References


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