# WHITE BLOOD CELL COUNT IN DIFFERENT STAGES OF CHRONIC PERIODONTITIS

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SUMMARY – Periodontal disease is considered to be an inflammatory disorder that is related to the accumulation of oral microbial biofilm and the host response to this accumulation. The host reaction to gingival microorganisms is characterized in part by increase in the polymorphonuclear leukocyte counts, which is one of the most important steps in host defense. Exaggerated leukocytes and neutrophils of host response are a very important component in the pathogenesis of periodontal disease. The purpose of this study was to investigate the relationship between white blood cell count and periodontal disease in subjects with moderate and severe periodontitis and in control subjects with healthy periodontal tissues. Leukocytes for the present study were obtained from peripheral venous blood of 50 patients with moderate periodontitis, 50 patients with severe periodontitis and 25 healthy subjects. The clinical parameters of periodontitis including plaque index, bleeding on probing and gingival index were determined in all study subjects. In both moderate and severe periodontitis, the results indicated a significantly higher count of neutrophils ($P<0.001$), as well as of both lymphocytes and total leukocytes ($P<0.05$). The values of clinical parameters (plaque index, gingival index and bleeding on probing) also showed significant between-group differences ($P<0.005$ and $P<0.001$, respectively). It is possible that there is a significant relationship between total leukocyte count, neutrophil count and different forms of periodontal disease.

Key words: *Chronic periodontitis; Leukocytes; Neutrophils; Inflammation*

## Introduction

In recent years, great attention of the world researchers has been focused on the possible association between oral health and systemic diseases, so that numerous contradictory results can be found in the literature[1-4]. The presence of infection in a body can bring about an increased risk of systemic diseases as a result of bacteria and bacterial products' translocation, such as endotoxin (lipopolysaccharide) or the effects of synthesized mediators[5,6]. These infections are usually well-known, but can also be the "infections of unknown etiology".

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Received November 2, 2010, accepted July 8, 2011

In addition, the association between periodontal disease (PD) and systemic health has been emphasized recently, based on inflammatory changes in periodontal tissues caused by bacteria from the oral biofilm. Therefore, a stronger association has been noticed between periodontitis as a risk factor and systemic diseases such as cardiovascular diseases, premature birth of children with small body weight, and diabetes[7-10]. The importance of the association between periodontal disease as a local infection and systemic diseases requires further investigations and opens new possibilities for an old concept of "focal infection"[11,12].

As the etiologic role of bacteria has been clarified *in vitro* and *in vivo*, researchers have started to point to the connection between the local and systemic inflammatory reactions as pathologic responses to the initial commensal microflora, while periodontal in-

fection serves as a reservoir of gram-negative bacteria, lipopolysaccharides and inflammatory mediators[13,14].

Some studies have shown an increased release of inflammatory mediators into peripheral blood of patients with periodontitis, which is the result of bacterial lipopolysaccharide effects[15]. Since recently, there has been a new supposition that poor oral hygiene can cause an increased systemic response of inflammatory mediators in peripheral blood of patients with periodontitis, elevating the leukocyte count as well, but still there have not been many papers dealing with this topic[16].

Leukocytes, before all polymorphonuclear leukocytes are the major systemic cells of phagocytosis and the first cells of the host defense mechanism against infective agents[17]. During periodontitis as a bacterial infection, neutrophils are initially predominant cells of the host defense mechanism, and have a significant role in inflammation and pathogenesis[18,19]. As already reported, aggressive periodontitis is strongly associated with the impaired neutrophil function, which even more emphasizes the importance of neutrophils in the pathogenesis of periodontal disease[10,20]. It is supposed that there is a difference in the count of these cells in periodontitis of various severity due to the accumulation of the oral biofilm when compared to healthy subjects.

Periodontal inflammation can deteriorate systemic conditions through the pathology caused by leukocytes[4]. Leukocytes, especially neutrophils, produce a number of specific molecules being directly responsible for the inflammatory response, inducing, besides local, also systemic response of the host as well, thus bringing them into a mutual connection. Changes in total leukocyte and neutrophil counts in the leukocyte formula point to the presence of infection and inflammation, which can be the risk factors for systemic conditions and diseases[21]. The importance of leukocytes and their count in different levels of periodontitis severity have not yet been sufficiently investigated, and papers dealing with this topic have been recently published.

The aim of this pilot study was to investigate and compare total count of leukocytes and polymorphonuclear cells (neutrophils) in the peripheral blood of patients suffering from chronic periodontitis of different severity. The study was conducted with the aim to prove the possible connection between periodontitis as a local oral infection and general health condition, that is systemic diseases.

## Material and Methods

### *Patient selection*

The study included 125 patients selected among patients presenting to Department of Periodontology and Oral Medicine, Dental Clinic, Medical Faculty in Niš, for the first time. The patients were divided into three groups. Group I included 25 subjects without periodontitis; group II included 50 subjects with the diagnosis of moderate form of chronic periodontitis; and group III included 50 subjects suffering from severe and generalized form of chronic periodontitis. The mean age of study subjects was 38.47 years.

Subjects suffering from any systemic disease, smokers, pregnant women, subjects being under periodontal therapy, subjects taking antibiotics or having taken antibiotics six months prior to the research were excluded. All these conditions were considered to possibly influence leukocyte count.

Clinical criteria for patient inclusion in the research procedure and for the diagnosis of periodontitis severity were as follows: depth of periodontal pockets which, in severe forms, were deeper than 5 mm, and 4 mm or less in the moderate form of periodontitis. Radiological analysis revealed bone defects to affect more than 50% of the root length in more severe forms of periodontitis, and 30% in moderate forms of periodontitis[22]. None of the subjects had received periodontal therapy for 12 months or more prior to the study.

All patients gave their oral consent to participate in the study; the protocol of investigation was approved by the Scientific Ethics Committee of Medical Faculty in Niš (No. 01-2800-5).

### *Periodontal research*

All patients were examined initially, when they presented to Dental Clinic for the first time. Clinical study included measurement of the depth of periodontal pockets (DPP) at six points *per* tooth, gingival index (GI), plaque index (PI), and bleeding on probing (BOP).

*Biochemical analysis*

Peripheral venous blood samples for determination of total leukocyte and neutrophil counts in the leukocyte formula were collected by standard methods in the morning hours and processed at the Central Laboratory for Biochemical Research, Niš Clinical Center. The values used on analysis were mean values obtained for these cells: for total leukocyte count $6.5x10^9$/L, and for fractions in the leukocyte formula the values were $4.7x10^9$/L for neutrophils and $2.4x10^9$/L for lymphocytes.

After taking history data, periodontal examination and blood sampling for biochemical analysis, study patients underwent periodontal therapy performed in line with the treatment protocol, which involved removal of the oral biofilm, supra- and subgingival plaque, treatment of periodontal pockets, and antiseptic irrigation. All patients were instructed how to maintain proper oral hygiene.

*Statistical analysis*

Statistical analysis was performed by descriptive and analytical statistical methods using the standard program for data processing, MS Excel and program package SPSS version 10.0.

Changes in leukocyte, neutrophil and lymphocyte counts following periodontal therapy were used as the primary outcome variables. All data were expressed either as mean ± standard deviation (SD), or with frequencies and percents. Differences in mean values between groups were compared using Student's t-test, while $\chi^2$-test was used as a nonparametric test. Significance of differences between the means obtained before and after periodontal treatment was determined by using ANOVA analysis for paired samples. *P* values below 0.05 were considered to indicate significance.

## Results

*Periodontal clinical parameters*

In both groups of subjects suffering from periodontitis, there were evident changes in the values of clinical parameters of periodontitis compared to the group of subjects with healthy periodontium. The elevated values of PI, BOP GI and PPD are presented in Table 1.

In both groups of subjects with PD, the values of clinical parameters of periodontitis were elevated compared to the group of subjects with healthy gums. There was a difference in these values between the groups of PD subjects, i.e. the values of clinical parameters were considerably higher in the severe form of periodontitis in comparison to its moderate form.

The subjects with severe form of PD, when compared to those with moderate form of periodontitis, had deeper periodontal pockets (III 5.14±1.04; II 4.68±1.11), higher values of gingival index (III 1.76±0.43; II 1.76±0.43), bleeding on probing (III

*Table 1. Mean values of clinical parameters in study subjects before therapy*

| Variable | I Healthy (n=25) | II Moderate PD (n=50) | III Severe PD (n=50) | ANOVA *P*-value |
|---|---|---|---|---|
| PI | 0.52±0.42 | 1.64±0.53[a***] | 1.90±0.58 [a***] | F=58.650 *P*<0.001 |
| BOP | 0.40±0.38 | 1.72±0.45[a***] | 1.70±0.46 [a***] | F=86.971 *P*<0.001 |
| GI | 0.40±0.38 | 1.76±0.43[a***] | 1.76±0.43 [a***] | F=103.795 *P*<0.001 |
| PPD, mm Sv(x) | 1.90±0.55 | 4.68±1.11[a***] | 5.14±1.04[a,b***] | F=94.454 *P*<0.001 |
| <5 | 25 (100%) | 33 (66%) | 26(52%) | $\chi^2$=17.48 |
| ≥5 | | 17 (34%)[a***] | 24(48%)[a***] | *P*<0.001 |

[a]*vs* I; [b]*vs* II; **P*<0.05; ***P*<0.01; ****P*<0.001; n.s. = statistically nonsignificant; PD = periodontal disease; PI = plaque index; BOP = bleeding on probing; GI = gingival index; PPD = periodontal pocket depth; Sv(x)

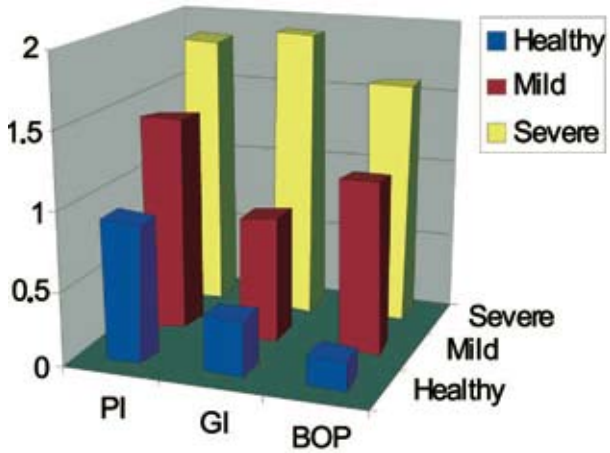


*Fig. 1. Values of periodontal clinical parameters according to disease severity.*

1.70±0.46; II 1.72±0.45), and higher plaque index (III 1.90±0.58; II 1.64±0.53), which is in conformity with clinical definition of both forms of periodontitis.

The values obtained for the group of subjects with healthy gums confirmed a relatively healthy periodontium (PI 0.52±0.42; BOP 0.40±0.38; GI 0.40±0.38; DPP 1.90±0.55). The values of periodontal clinical parameters according to disease severity are shown in Figure 1.

***Results of biochemical analysis***

Both groups of subjects with periodontitis, with evident clinical symptoms of periodontitis as determined by clinical parameters had elevated total leukocyte and neutrophil counts (III 11.86x10$^9$/L; II 8.74x10$^9$/L; and III 7.89x10$^9$/L; II 8.74x10$^9$/L) compared to the group of healthy subjects (I 7.07x10$^9$/L; I 4.05x10$^9$/L).

The mean value of total leukocyte count of 6.5x10$^9$/L, according to data of the Central Laboratory for Biochemical Research, Niš Clinical Center, was used for comparative analysis of the results obtained in the study. The mean value of total leukocyte count was higher in group III subjects suffering from severe form of periodontitis compared to group II with moderate form of periodontitis. The difference was statistically significant ($P$<0.005). In both groups, the values were higher when compared to the group of healthy subjects (7.07x10$^9$/L), in which the mean values were close to the one used for comparison (6.5x10$^9$/L).

Mean values of biochemical parameters in all study subjects are shown in Table 2.

The mean value of neutrophils, in the leukocyte formula, in patients with severe form of periodontitis, was 7.89x10$^9$/L, compared to 7.01x10$^9$/L recorded in the group with moderate form of periodontitis. Both values were higher when compared to the values of healthy subjects (4.05x10$^9$/L) and the mean value given by the Central Laboratory for Biochemical Research, Niš Clinical Center (2.4x10$^9$/L), which served for comparison.

There was a statistically significant increase in neutrophil count in subjects with severe form of periodontitis compared to its moderate form (Table 2); the neutrophil count in subjects with periodontitis was higher compared to the neutrophil count of healthy subjects, and the difference was statistically significant.

Considering lymphocyte count, the results showed that there was a difference between the groups with

*Table 2. Mean values of biochemical parameters in study subjects*

| Variable | I Healthy (n=25) | II Moderate PD (n=50) | III Severe PD (n=50) | ANOVA *P*-value |
|---|---|---|---|---|
| Leukocytes 10$^9$/L | 7.07±2.16 | 8.74±3.03$^{a**}$ | 11.86±8.19$^{ab***}$ | F=7.165 *P*<0.005 |
| Neutrophils | 4.05±2.02 | 7.01±2.50$^{a****}$ | 7.89±4.79$^{ab****}$ | F=9.956 *P*<0.001 |
| Lymphocytes | 2.26±0.697 | 2.87±1.70$^{a*}$ | 3.48±2.52$^{a*}$ | F=3.435 *P*<0.05 |

$^{a}$*vs* I; $^{b}$*vs* II; $^{c}$*vs* III; **P*<0.05; ***P*<0.01; ****P*<0.005; *****P*<0.001; PD = periodontal disease; n.s. = statistically nonsignificant

*Table 3. Values of clinical periodontal parameters after therapy in study groups*

| Variable | I Healthy (n=25) | II Moderate PD (n=50) | III Severe PD (n=50) | ANOVA *P*-value |
|---|---|---|---|---|
| PI | 0.48±0.60[a*] | 0.81±0.46[a*] | 0.84±0.63[a*] | F=34.536, *P*<0.001 |
| BOP | 0.34±0.39[a*] | 0.42±0.46[a*] | 0.43±0.37[a*] | F=124.91, *P*<0.001 |
| GI | 0.34±0.39[a*] | 0,56±0.46[a*] | 0.48±0.37[a*] | F=114.12, *P*<0.001 |
| PPD (mm) | 1.08±0.69[a*] | 3.13±0.57[a*] | 3.21±0.53[a*] | F=51.472, *P*<0.001 |

[a]*vs* before therapy; **P*<0.001; PD = periodontal disease; n.s. = statistically nonsignificant;
PI = plaque index; BOP = bleeding on probing; GI = gingival index; PPD = periodontal pocket depth

periodontitis (III 3.48x10$^9$/L; II-2.87x10$^9$/L) compared with the group of healthy subjects (I 2.26x10$^9$/L).

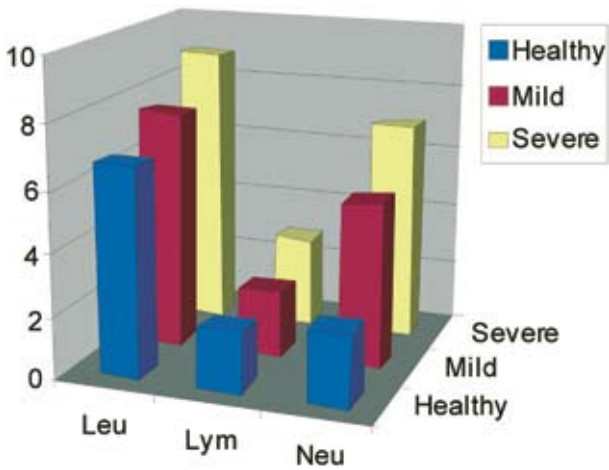


*Fig. 2. Values of biochemical parameters according to the severity of periodontitis.*

In addition, erythrocyte count was decreased, pointing to the liability of these patients to anemia, although it was beyond the scope of the present study and these data are not presented.

It was obvious that there was a positive correlation between the clinical parameters of periodontitis showing the severity of disease and total leukocyte and neutrophil counts in peripheral blood, as shown in Figure 2.

After periodontal treatment, the values of clinical parameters were significantly reduced. After therapy, all study subjects, i.e. those with periodontitis and healthy ones, had decreased values of all clinical parameters compared with the values recorded before therapy (Table 4).

Values of clinical periodontal parameters after therapy in study groups are shown in Table 3.

Concerning the tested leukocyte, neutrophils and lymphocyte counts, the values were higher in the periodontitis groups at baseline compared to controls. The values of leukocytes, neutrophils and lymphocytes in study groups after therapy are shown in Table 4.

After treatment, a statistically significant reduction was recorded in the tested leukocyte and neutrophil counts (*P*<0.001, *P*<0.05). Leukocyte count decreased to 6.86x10$^9$/L after periodontal treatment. Median values of neutrophils decreased from baseline value

*Table 4. Values of leukocytes, neutrophils and lymphocytes after therapy in study groups*

| Variable | I Healthy (n=25) | II Moderate PD (n=50) | III Severe PD (n=50) | ANOVA *P*-value |
|---|---|---|---|---|
| Leukocytes | 6.41±1.62[a**] | 7.22±1.75[a**] | 6.86±0.93[a**] | F=8.583, *P*<0.001 |
| Neutrophils | 3.35±1.93[a*] | 5.30±1.67[a*] | 4.85±1.28[a*] | F=12.482, *P*<0.05 |
| Lymphocytes | 1.61±1.29 | 2.95±1.43 | 2.53±0.93 | F=1.125, n.s. |

[a]*vs* before therapy; **P*<0.05; ***P*<0.001; n.s. = statistically nonsignificant; PD = periodontal disease

of 7.89x10$^9$/L to 4.85x10$^9$/L in the group with severe periodontitis and from 7.01x10$^9$/L to 5.30x10$^9$/L in the group with moderate periodontitis. After treatment, lymphocytes decreased to 2.53x10$^9$/L in the severe periodontitis group and to 2.95x10$^9$/L in the moderate periodontitis group, but this difference between the values at baseline and after therapy was not statistically significant ($P$>0.05).

## Discussion

Our study results showed an increase in total leukocyte and neutrophil counts in patients with severe form of chronic periodontitis (III 11.86x109/L; III 7.89x109/L), compared to subjects with moderate form of periodontitis. The findings obtained in the present study confirmed the concept according to which stronger inflammation of the periodontium (II 8.74x109/L; II 7.01x109/L), found in the group of subjects with severe form of periodontitis (PI 1.90; BOP 1.72; GI 1.76), could be the result of enhanced response of total leukocyte and neutrophil counts in peripheral blood, which is in conformity with the basic function of leukocytes in infection and inflammation[23].

In addition, the results of this study are in accordance with the results of other authors. Kweider *et al.*[24] have shown that patients suffering from periodontitis have significantly higher levels of fibrinogen and leukocytes when compared to control subjects. Inflammatory oral diseases such as periodontitis can influence total leukocyte and neutrophil counts in the circulation considerably. Total leukocyte and neutrophil counts as indicators of inflammation at the same time show the association between oral disease, especially periodontitis, and systemic diseases in which the infection is an etiologic factor (cardiovascular diseases, especially myocardial infarction)[25,26].

In his review paper, Loos presents current knowledge on the levels of certain markers of inflammation in periodontitis, among them the accompanying cellular factors of peripheral blood: total leukocyte, erythrocyte and platelet counts, as well as other plasma proteins (C-reactive protein, CRP)[27]. The majority of systemic factors of inflammation, among which leukocytes are predictable factors, are markers of systemic diseases[28].

Following these data, our study was conducted to confirm the hypothesis that oral diseases, especially periodontitis, can be a risk factor for systemic diseases. The starting ground was that periodontitis is a local chronic inflammation occurring in response to a long-term presence of specific bacteria in the oral biofilm, causing systemic consequences as well[29].

The changes in terms of total leukocyte count increase, although statistically nonsignificant, as well as the increase in leukocyte count, show a significant connection between these mediators and poor oral hygiene (PI 1.90), which was also confirmed in the present study. Changes in the values of these markers in patients with periodontitis can be part of explanation, as periodontitis is associated with systemic diseases. It is assumed that possible daily episodes of bacteremia, which originate from periodontal lesions, can cause changes in the values of systemic markers in the course of periodontitis[30]. As cited by Wu *et al.*, the association between periodontitis and total cholesterol is much looser than the association with leukocytes[25].

It is a well-known fact that significant bacterial population and their challenge can be noted in patients suffering from both moderate and severe forms of chronic periodontitis. In patients with severe form of periodontitis, there are great surfaces of ulcerated epithelium of periodontal pockets[27], which enable greater changes and influence of bacterial challenge to the host response. On the one hand, this condition is responsible for an increased response of the host to bacterial presence, manifested through increased inflammatory response in the form of increased leukocyte and neutrophil counts, which was proved in this study. On the other hand, it clarifies numerous mechanisms connecting periodontal disease and systemic diseases, particularly cardiovascular diseases, as they are known to be followed by an increase in leukocytes and other mediators of inflammation[31]. Dorn *et al.*[32] suggest that the capacity of the oral biofilm bacteria to invade not only periodontal tissues but also the tissues of coronary arteries makes them possible factors connecting periodontitis and coronary artery disease.

In the inflamed periodontal tissue, the cellular and molecular mechanisms are interconnected, so that such interaction and its consequences are not restricted to periodontal tissue only; they also cause systemic effects. Changes in leukocyte count (total leukocyte and

neutrophil counts) presented in this paper and other reports[33,34] can be considered as qualitative markers of periodontal inflammation, while periodontal inflammation is associated with other systemic conditions, being of low intensity and hardly perceived as a problem by patients.

The subgingival biofilm bacteria activate the acute phase hepatic response, which further increases total count of leukocytes and other inflammatory markers, which can predispose the patient to systemic diseases[23,35]. These mediators, along with bacteria and their products, can play a significant role in the pathogenesis of atheroma and thrombus formation. Thus, Offenbacher *et al.*[36] suggest that both diseases can constitute a syndrome which would stand for "periodontitis-atherosclerosis syndrome". The mechanism involved in this syndrome is the inflammatory reaction caused by the oral biofilm in periodontal tissues, and its potential consequences.

This study presented two forms of periodontitis according to the severity of disease as two oral conditions in which the severe form of periodontitis showed a stronger inflammatory response measured by the increase in total leukocyte and neutrophil counts. Regression analysis indicated that the greatest importance for the outcome neutrophil and leukocyte variable was attached to the dependent variable group (severity of disease).

This prospective study provided important evidence that near-complete elimination of periodontal infection by comprehensive local periodontal therapy was associated with a significant decrease in total leukocyte count, neutrophil and lymphocyte counts in otherwise healthy individuals affected with both severe and moderate generalized periodontitis. This study showed an improvement in these values in patients who responded better to periodontal therapy.

Therapy was highly effective ($P<0.001$) for all clinical parameters analyzed. The clinical results showed that the mean values of the sites with bleeding on probing, periodontal probing depth, gingival and plaque index were significantly reduced in the study groups after periodontal treatment. These data indicated that periodontitis contributed to the systemic inflammatory responses in these patients, and that periodontal therapy is critical in the context of the design and implementation of a definitive trial.

Analysis of these data confirms previous observations that otherwise healthy subjects suffering from chronic periodontitis display a moderate increase in systemic inflammation[37]. Moreover, systemic markers of inflammation, fibrinogen and leukocyte count are also predictors of the present and future cardiovascular events and disease[38].

There was a statistically significant difference between baseline values and values of all inflammatory markers after periodontal therapy. Further analysis with a repeated measure indicated that there was a significant association between clinical outcomes of periodontal treatment and the values of leukocytes, neutrophils and lymphocytes after treatment. Our observation that serum inflammatory markers are decreased by periodontal therapy is consistent with the finding of D'Aiuto *et al.*[39], who measured serum inflammatory markers in 94 subjects before and after nonsurgical therapy for severe generalized periodontitis.

Periodontitis with all its clinical symptoms and consequences can pose a potential risk of systemic exposure to inflammatory stress with increased values of the markers of inflammation (leukocytes and neutrophils), and thus create close connection with the systemic status of the patient[40].

Therefore, oral diseases and systemic inflammatory response should be incorporated into the signs and symptoms in the definition of health status. Finally, these findings suggest the necessity of additional investigations regarding the association between periodontitis and systemic diseases, particularly the possible influence of periodontal therapy on the reduction of the mediators of inflammation, which would possibly decrease the risk of systemic diseases.

## Conclusion

In conclusion, the analysis of the data presented in this paper confirms the concept that the increase in total leukocyte and neutrophil counts in patients with chronic periodontitis, especially its severe form, can be an indicator of the possible exposure of the body to some systemic disease. In addition, it should be a warning to doctors treating systemic diseases (cardiologists, doctors of internal medicine, etc.) to refer their patients to a dentist, that is a specialist in periodontology.

## References


1. CHUN Y-KJ, CHUN K-RJ, OLGUIN DA, WANG HL. Biological foundation for periodontitis as a potential risk factor for atherosclerosis. J Periodontal Res 2005;40:1-87.
2. HUJOEL PP, DRANGSHILT M, SPIEKERMAN C, DeROUEN TA. Periodontal disease and coronary heart disease risk. JAMA 2000;37:445-50.
3. BECK J, GARCIA R, HEISS G, VOKONAS PS, OFFENBACHER S. Periodontal disease and cardiovascular disease. J Periodontol 1996;67:1123-37.
4. YAMALIK N, CAGLAYAN F, KILINE K, KILINE A, TUMER C. The importance of data presentation regarding gingival cervicular fluid myeloperoxidase and elastase-like activity in periodontal disease and health status. J Periodontol 2000;71:460-7.
5. SEYMOUR RA, PRESHAW PM, THOMASON JM, ELLIS JS, STEELE JG. Cardiovascular diseases and periodontology. J Clin Periodontol 2003;30:279-92.
6. RIDKER PM, CUSHMAN M, STAMPFER MJ. Inflammation, aspirin, and the risk of cardiovascular disease in apparently healthy men. N Engl J Med 1997;336:973-9.
7. SLADE DE, GHEZZI EM, HEISS E, BECK DJ, RICHE E, OFFENBACHER S. Relationship between periodontal disease and C-reactive protein among adults at atherosclerosis risk in communities study. Arch Intern Med 2003;163:1172-9.
8. RICHE LE, BOGGESS AK, LIEFF S, MURTHA PA. Periodontal disease increases the risk of preterm delivery among preeclamptic women. Ann Periodontol 2002;7:95-101.
9. SALVI GE, YALDA B, COLLINS JG. Inflammatory mediator response as a potential risk marker for periodontal diseases in insulin-dependent diabetes mellitus patient. J Periodontol 1997;68:127-31.
10. KATSURAGI Y, MATSUDA N, NAKAMURA M, MURAYAMA Y. Neutrophil functions in patients with severe periodontal disease. Adv Dent Res 1088;2:359-63.
11. MESKIN LH. Focal infection – back with a bang. JADA 1998;128:12-4.
12. PEJČIĆ A, PEŠEVSKA S, GRIGOROV I, BOJOVIĆ M. Periodontitis as a risk factor for general disorders. Acta Facult Med Naiss 2006;23:59-65.
13. RAJASUO A, PERKI K, NYFORS S, JOUSIMIES-SOMER H, MEURMAN J. Bacteriemia following surgical dental extraction with an emphasis on anaerobic strains. J Dent Res 2004;83:170-4.
14. KINANE FD, LAPPIN FD. Immune processes in periodontal disease. Ann Periodontol 2002;7:62-71.
15. BLAKEY GH, MARCIANI RD, HAUG RH. Periodontal pathology associated with asymptomatic third molar. J Oral Maxillofac Surg 2002;60:1227-31.
16. JOSHIPURA KJ, RIMM EB, DOUGLASS CW. Poor oral health and coronary heart disease. J Dent Res 1996;75:1631-6.
17. AGARWAL S, HUANG PJ, PIESCO NP, SUYUKI JB, RICCELLI AE, JOHNS LP. Altered neutrophil function in localized juvenile periodontitis: intrinsic or induced? J Periodontol 1996;67(Suppl):337-44.
18. MIYASAKI KT. The neutrophil: mechanisms of controlling periodontal bacteria. J Periodontol 1991;62:761-4.
19. KURITA-OCHIAI T, FUKUSHIMA K, OCHIAI K. Lipopolysaccharide stimulates butyric acid- induced apoptosis in human peripheral blood mononuclear cells. Infect Immun 1999;67:22-9.
20. DANIEL MA, Van DYKE TE. Alterations in phagocyte function and periodontal infection. J Periodontol 1996;67:1070-5.
21. SLOTS J. Update on general health risk of periodontal disease. Intern Dent J 2003;53:200-7.
22. PAGE RC. Critical issues in periodontal research. J Dent Res 1995;74:1118-28.
23. RUDIN SR. Laboratory tests and their significance in Walter Hall. Crit Decs Periodontol 2003;8:4-6.
24. KWEIDER M, LOWE GD, MURRAY GD, KINANE DF, McGOWAN DA. Dental disease, fibrinogen and white cell count; links with myocardial infarction. Scott Med J 1993;38:73-4.
25. WU T, TREVISAN M, GENCO RJ, FALKNER KL, DORN JP, SEMPOS CT. Examination of the relation between periodontal health status and cardiovascular risk factor: serum total and high density lipoprotein cholesterol, C-reactive protein, and plasma fibrinogen. Am J Epidemiol 2000;151:273-82.
26. HANSEN PR. Role of neutrophils in myocardial ischemia and reperfusion. Circulation 1995;91:1872-85.
27. LOOS BG. Systemic markers of inflammation in periodontitis. J Periodontol 2005;76(11-s):2106-15.
28. MADJID M, AWAN I, WILLERSON TJ, CASSCELLS W. Leukocyte count and coronary heart disease. J Am Coll Cardiol 2004;44:195-6.
29. De NARDIN E. The role of inflammatory and immunological mediators in periodontitis and cardiovascular disease. Ann Periodontol 2001;6:30-40.
30. BECK JD, OFFENBACHER S, WILLCAMS R, GIBBS P, GARCIA R. Periodontitis: a risk factor for coronary heart disease? Ann Periodontol 1998;3:127-41.
31. EBERSOLE JL, MACHEN RL, STEFFEN MJ, WILLMANN DE. Systemic acute-phase reactants, C-reactive protein and haptoglobin, in adult periodontitis. Clin Exp Immunol 1997;107:347-52.
32. DORN BR, DUNN WA, PROJULSKE-FOX A. Invasion of human coronary artery cells by periodontal pathogens. Infect Immun 1999;67:5792-808.
33. BUCHMANN R, HASILIK A, Van DYKE TE, NUNN M, LANGE DE. PMN responses in chronic periodontal disease: evaluation of gingival crevicular fluid enzymes and

elastase-1-proteinase inhibitor complex. Clin Periodontol 2002;29:556-65.

34. BUCHMANN R, HASILIK A, Van DYKE TE, LANGE DE. Amplified crevicular leukocyte activity in aggressive periodontal disease. J Dent Res 2002;81:716-21.
35. American Academy of Periodontology. Parameter on chronic periodontitis. J Periodontol 2000;71:853-5.
36. OFFENBACHER S, MADIANOS PN, CHAMPAGNE CM. Periodontitis-atherosclerosis syndrome: an expanded model of pathogenesis. J Periodontol Res 1999;34:346-52.
37. LOOS BG, CRAANDIJK J, HOEK FJ, WERTHEIM-van DILLEN PM, van der VELDEN U. Elevation of systemic markers related to cardiovascular diseases in the peripheral blood of periodontitis patients. J Periodontol 2000;71:1528-34.
38. KOENING W. Heart disease and the inflammatory response. BNJ 2000;321:187-8.
39. D'AIUTO F, READY D, TONETTI MS. Periodontal disease and C-reactive protein-associated cardiovascular risk. J Periodontal Res 2004;39:236-41.
40. BECK DJ, OFFENBACHER S. Relationships among clinical measures of periodontal disease and their association with systemic markers. Ann Periodontol 2002;7:79-89.

Sažetak

## BIJELA KRVNA SLIKA U RAZLIČITIM STADIJIMA KRONIČNOG PARODONTITISA

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Parodontna bolest je upalni poremećaj koji je povezan s akumulacijom oralnog mikrobnog biofilma i odgovorom domaćina na tu akumulaciju. Reakciju domaćina na gingivne mikroorganizme karakterizira donekle i povećanje broja polimorfonuklearnih leukocita, koji je jedan od najvažnijih koraka u odgovoru domaćina. Povećanje leukocita i neutrofila u okviru odgovora domaćina je veoma važna komponenta u patogenezi parodontne bolesti. Cilj ovoga istraživanja bio je ispitati vezu između broja bijelih krvnih zrnaca i parodontne bolesti kod ispitanika s blagom i uznapredovalom parodontopatijom i kontrolnih ispitanika sa zdravim parodontnim tkivom. Uzorak krvi za ispitivanje broja leukocita u ovom se istraživanju uzimao iz periferne venske krvi 50 ispitanika s umjerenom, 50 ispitanika s uznapredovalom parodontopatijom i 25 kontrolnih ispitanika. Klinički parametri parodontopatije, tj. plak indeks, indeks krvarenja i gingivni indeks određivali su se kod svih ispitanika. Kod obje skupine s parodontopatijom rezultati su pokazali značajno povećan broj neutrofila ($P$<0,001). Rezultati su također pokazali kako postoji značajnost između limfocita i ukupnog broja leukocita ($P$<0,05) među skupinama. Vrijednosti kliničkih parametara (plak indeks, gingivni indeks i indeks krvarenja) pokazale su značajnu razliku ($P$<0,005, $P$<0,001) među skupinama. U zaključku, moguće je da postoji značajna veza između ukupnog broja leukocita, broja neutrofila i različitih oblika parodontne bolesti.

Ključne riječi: *Kronični parodontitis; Leukociti; Neutrofili; Upala*