Research Article

Association between anemia of inflammation and hematological parameters of aggressive periodontitis

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ABSTRACT

Introduction: Anemia of inflammation formerly also called anemia of chronic disease, a cytokine-mediated anemia is a frequent complication of many inflammatory conditions or neoplastic disorders which are not due to decreased action of bone marrow or other diseases. It occurs despite the presence of adequate iron stored and vitamins. Periodontitis is an inflammatory disease of the periodontal tissues (the supporting tissues of the tooth) caused by specific microorganisms. Periodontal infections most often involve anaerobes such as *Treponema denticola* and *Porphyromonas gingivalis*. Studies show that reduced hemoglobin levels, erythrocyte counts, and increased white blood cells count are observed in patients with chronic generalized periodontitis, suggesting that this condition may be associated with anemia of chronic disease. This study was an attempt to determine the association between anemia of inflammation and the blood parameters of patients with aggressive periodontitis. **Materials and Methods:** Patients were selected from those attending the outpatient department of Saveetha Dental College and Hospitals and divided into two groups. Informed consent was obtained from the patient before sample collection. 3 ml of venous blood was collected and distributed in ethylenediaminetetraacetic acid collection tubes and centrifuged in 3000 rpm for serum. Then, serum was separated and analyzed by Mindray Hematology Analyzer for erythrocyte count, hemoglobin, leukocyte count, mean corpuscular volume, mean corpuscular hemoglobin concentration (MCHC), erythrocyte sedimentation rate, and packed cell volume (PCV). **Conclusion:** The present study showed that periodontal inflammation results in a decrease in a number of erythrocytes and levels of hemoglobin. This implies that aggressive periodontitis like other chronic conditions may lead to anemia. This anemia is mild to moderate, and inflammatory cytokines may also play a role in its pathogenesis.

KEY WORDS: Aggressive periodontitis, Anemia of inflammation, Diagnosis, Gingiva, Hematology

INTRODUCTION

Aggressive periodontitis is a rare form of inflammatory periodontal disease, which is characterized by a rapid onset and progression, resulting in rapid attachment and considerably higher bone loss. It has an early onset, predominantly found in young adults ranging 18–25 years.[1] The predominant causative organisms for periodontal diseases are anaerobes such as *Treponema denticola* and *Porphyromonas gingivalis*.[2] Anemia of inflammation was previously known as anemia of chronic disease, is a mild to moderately severe anemia with the hemoglobin levels rarely <8 g/dl. This condition usually develops at the setting of infections, inflammatory reactions, or malignancies.[3] The defining biochemical features of anemia of inflammation include low serum iron levels, despite adequate systemic iron stores. The concentration of serum transferrin is also reduced during chronic inflammation.[4] The erythrocytes are normal sized, with normal hemoglobin content, but the total number of the cells is reduced. Hence, this type of anemia is termed as normocytic, normochromic anemia.[5] Recent studies have discovered that prolonged anemia of inflammation results in decrease in the erythrocyte size and its hemoglobin content in many cases.[6] Some conditions related to anemia of inflammation include anemia of critical illness and anemia of chronic renal disease, which are seen in hospitalized chronic patients with similar symptoms and findings.[7] The traditional gold standard for the diagnosis of anemia of inflammation is anemia with hypoferremia or with low transferrin saturation. Serum ferritin levels are also measured to rule out low systemic iron stores.[8]

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Anemia of chronic disease is caused by cytokines release during chronic inflammation. The release of IL-6 during inflammatory reactions causes an increase in hepcidin release in the liver and decreased hepcidin excretion by the kidneys. This causes an increase in the rate of destruction of erythrocytes by the spleen. Some cytokines also have a direct erythropoiesis suppression activity, thereby leading to a decrease in the rate of erythropoiesis. Hence, this cumulatively leads to a decrease in erythrocyte count in the peripheral blood.[9] Prolonged increased hepcidin levels cause the destruction of ferritin and cellular ferroportin, leading to a secondary hypoferremia in chronic inflammatory patients.[10] Treatment for anemia of inflammation includes treating the underlying condition, erythropoietin transfusion, and erythrocyte transfusion for acute symptoms. Studies show that reduced hemoglobin levels, erythrocyte counts, and increased white blood cells count are observed in patients with chronic generalized periodontitis, suggesting that this condition may be associated with anemia of chronic disease.[11] Many studies have studied generalized chronic periodontitis in detail, but very little is known about aggressive periodontitis and its effects on systemic health. This study was an attempt to determine the association between anemia of inflammation and the blood parameters of patients with aggressive periodontitis.

MATERIALS AND METHODS

Patients were selected from those attending the outpatient department of Saveetha Dental College and Hospitals and divided into two groups as follows: Group I consists of normal healthy individuals (30) and Group II consists of individuals with aggressive periodontitis (30). Patients with aggressive periodontitis, age group – 18–25 years, non-smokers, and no prevalent systemic diseases were included in this study. Chronic and general periodontitis patients, smokers, minors and senior citizens, and individual with systemic diseases such as diabetes, hypertension, and hypotension were excluded from this study.

SAMPLE COLLECTION

Informed consent was obtained from the patient before sample collection. 3 ml of venous blood was collected and distributed in ethylenediaminetetraacetic acid collection tubes and centrifuged in 3000 rpm for serum. Then, serum was separated and analyzed by Mindray Hematology Analyzer for erythrocyte count, hemoglobin, leukocyte count, mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), erythrocyte sedimentation rate, and packed cell volume (PCV).

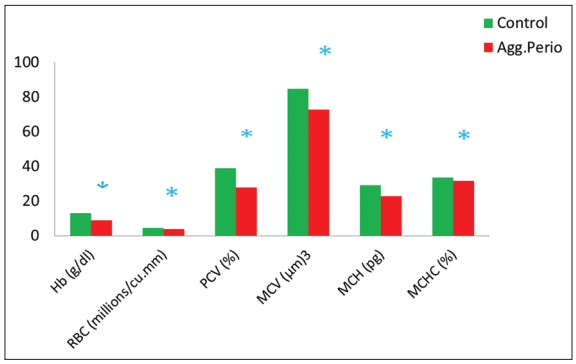
RESULTS

Haemoglobin levels, red blood cell (RBC) count, PCV, MCV, and mean corpuscular hemoglobin (MCH) are considered to be significant [Graph 1]. Neutrophil and eosinophil showed slight increase in aggressive periodontitis but not significant from control. Lymphocyte count was decreased in aggressive periodontitis [Graph 2]. TLC count had been slightly decreased but platelet was increased in aggressive periodontitiswhen compared to normal control values [Graph 3].

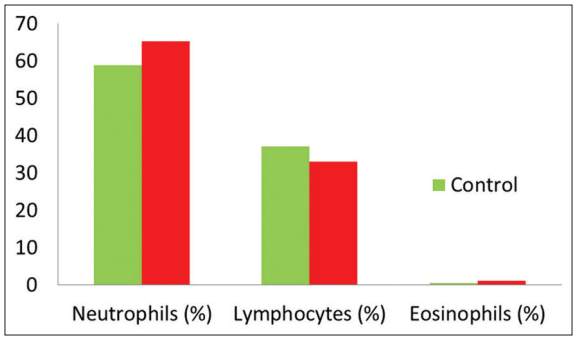
Table 1: Mean value of all haematological parameters among control and aggressive periodontitis

S. No	Parameters	Control	Agg. periodontitis	*P* value
		Mean±SD	Mean±SD	
1	Hb	13.1±1.31	8.78±1.32	<0.0001
2	RBC	4.61±0.45	3.91±0.6	<0.0001
3	PCV	38.84±4.69	27.88±3.45	<0.0001
4	Plt	305.8±101.77	353.43±116.7	0.09
5	WBC	8833.33± 2090.59	8743.33± 2430.65	0.88
6	Neu	58.93±6.88	65.33±10.53	0.007
7	Lym	37.2±7.01	32.97±10.56	0.07
8	Esino	0.57±0.86	1.23±1.04	0.009
9	MCV	84.88±4.94	72.76±12.32	<0.0001
10	MCH	28.98±2.82	22.92±3.71	<0.0001
11	MCHC	33.51±0.85	31.52±2.45	0.005

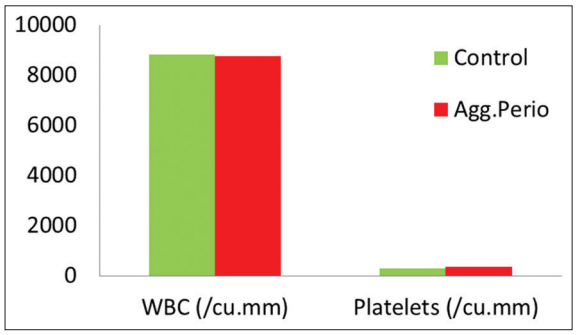
Hb: Hemoglobin, RBC: Red blood cell, PCV: Packed cell volume, WBC: White blood cells, MCV: Mean corpuscular volume, MCH: Mean corpuscular hemoglobin, MCHC: Mean corpuscular hemoglobin concentration



Graph 1: Haematological parameters among control and aggressive periodontitis



Graph 2: Types of WBC among control and aggressive periodontitis



Graph 3: WBC and platelets among control and aggressive periodontitis

DISCUSSION

The hematological parameters hemoglobin levels, red blood cell (RBC) count, PCV, MCV, and mean corpuscular hemoglobin (MCH) are considered significant in this study [Table 1]. Localized infections of periodontal tissues which result in periodontitis can have a significant effect on the systemic health of an individual.[12] As the periodontal tissues mount an immune inflammatory response to bacteria and their products, systemic challenges with these agents also induce a major vascular response.[13] Infections, malignant cells, and autoimmune dysregulation all lead to the activation of the immune system and production of inflammatory cytokine, leading to the development of anemia. It is possible that the cytokine-mediated immune response is responsible for the lowering of the erythrocyte count, leading to low hemoglobin levels.[14]

The correlation between periodontitis and anemia has been studied since the latter part of the 20th century by various researchers.[15] While few studies investigated anemia as a risk factor of periodontitis and periodontitis as an etiological cause, it has been stated that anemia is a systemic cause of periodontitis.[16]

Recent studies have tried to evaluate the relationship between anemia and periodontitis but have yielded out conflicting results. While some studies have shown that periodontal patients have a lower hematocrit, RBC, and hemoglobin levels,[17] some studies have failed to show any relationship between the two.[18]

The study shows vast difference in the hemoglobin levels, RBC count, PCV, MCV, and MCHC.

While the hemoglobin levels in the control group were around 13.1–14.3 g/dL, the aggressive periodontitis patients had much lower levels of 8.78–9.9 g/dL. The RBC count of the control group was averaged to 4.61 million/cu.mm while the aggressive periodontitis patients had an average of 3.61 million/cu.mm.

The PCV percentages of the control group and the aggressive periodontitis groups were found to be 38.84% and 27.88%, respectively. The MCV values of the control and the aggressive periodontitis patients were found to be 84.88 and 72.76 µm^3, respectively.

The MCH values of the control and the aggressive periodontal patients were found to be 28.98 and 22.92 pg, respectively.

As the aggressive periodontitis patients were not found to have any systemic disorders, it is safe to rule out iron deficiency anemia or any other nutrient-dependent deficiency anemias. The significantly lower PCV % is a clear indicator of less RBCs in peripheral blood due to decreased production or increased destruction of erythrocytes.[19] The MCV volume is also found to be significantly lower, indicating that the erythrocytes are smaller in comparison to normal, while the lower MCH indicates that the relative concentration of hemoglobin per erythrocyte is less. Hence, it is possible that the smaller size might be due to lesser hemoglobin availability, ruling out microcytic and hypochromic anemias.[20] This implies that periodontitis like other chronic conditions may lead to anemia. This anemia is mild to moderate, and inflammatory cytokines may also play a role in its pathogenesis.

CONCLUSION

The present study showed that periodontal inflammation results in a decrease in a number of erythrocytes and levels of hemoglobin. This implies that aggressive periodontitis like other chronic conditions may lead to anemia. This anemia is mild to moderate, and inflammatory cytokines may also play a role in its pathogenesis.

REFERENCES

1. Merchant SN, Vovk A, Kalash D, Hovencamp N, Aukhil I, Harrison P, *et al.* Localized aggressive periodontitis treatment response in primary and permanent dentitions. J Periodontol 2014;85:1722-9.
2. Albandar JM, Tinoco EM. Global epidemiology of periodontal diseases in children and young persons. Periodontol 2000 2002;29:153-76.
3. Nemeth E, Ganz T. Anemia of inflammation. Hematol Oncol Clin North Am 2014;28:671-81, vi.
4. Cartwright GE, Lee GR. The anaemia of chronic disorders. Br J Haematol 1971;21:147-52.
5. Katz JH. Iron and protein kinetics studied by means of doubly labeled human crystalline transferrin. J Clin Invest 1961;40:2143-52.
6. Corwin HL, Krantz SB. Anemia of the critically ill: "acute" anemia of chronic disease. Crit Care Med 2000;28:3098-9.
7. Pettersson T, Kivivuori SM, Siimes MA. Is serum transferrin receptor useful for detecting iron-deficiency in anaemic patients with chronic inflammatory diseases? Br J Rheumatol 1994;33:740-4.
8. Ferraro S, Mozzi R, Panteghini M. Revaluating serum ferritin as a marker of body iron stores in the traceability era. Clin Chem Lab Med 2012;50:1911-6.
9. Cozzi A, Santambrogio P, Privitera D, Broccoli V, Rotundo LI, Garavaglia B, *et al.* Human L-ferritin deficiency is characterized by idiopathic generalized seizures and atypical restless leg

syndrome. J Exp Med 2013;210:1779-91.
10. Cazzola M, Ponchio L, de Benedetti F, Ravelli A, Rosti V, Beguin Y, *et al.* Defective iron supply for erythropoiesis and adequate endogenous erythropoietin production in the anemia associated with systemic-onset juvenile chronic arthritis. Blood 1996;87:4824-30.
11. Anumolu VN, Srikanth A, Paidi K. Evaluation of the relation between anemia and periodontitis by estimation of blood parameters: A cross-sectional study. J Indian Soc Periodontol 2016;20:265-72.
12. Pradeep AR, Anuj S. Anemia of chronic disease and chronic periodontitis: Does periodontal therapy have an effect on anemic status? J Periodontol 2011;82:388-94.
13. Lainson PA, Brady PP, Fraleigh CM. Anemia, a systemic cause of periodontal disease? J Periodontol 1968;39:35-8.
14. Hutter JW, van der Velden U, Varoufaki A, Huffels RA, Hoek FJ, Loos BG. Lower numbers of erythrocytes and lower levels of hemoglobin in periodontitis patients compared to control subjects. J Clin Periodontol 2001;28:930-6.
15. Seigel EH. Total erythrocyte, leucocyte and differential white cell counts of blood in chronic periodontal disease. J Dent Res 1945;24:270.
16. Wakai K, Kawamura T, Umemura O, Hara Y, Machida J, Anno T, *et al.* Associations of medical status and physical fitness with periodontal disease. J Clin Periodontol 1999;26:664-72.
17. Kowolik MJ, Dowsett SA, Rodriguez J, De La Rosa RM, Eckert GJ. Systemic neutrophil response resulting from dental plaque accumulation. J Periodontol 2001;72:146-51.
18. Loos BG. Systemic markers of inflammation in periodontitis. J Periodontol 2005;76:2106-15.
19. Yamamoto T, Tsuneishi M, Furuta M, Ekuni D, Morita M, Hirata Y. Relationship between decrease of erythrocyte count and progression of periodontal disease in a rural Japanese population. J Periodontol 2011;82:106-13.
20. Pejcić A, Kesić L, Pesić Z, Mirković D, Stojanović M. White blood cell count in different stages of chronic periodontitis. Acta Clin Croat 2011;50:159-67.

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