One Health Journal of Nepal

Original Article Open Access

Association of Periodontal Therapy on Hemoglobin and Erythrocyte Levels in Chronic Periodontitis Patients visiting a Tertiary Care Hospital, Nepal

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ABSTRACT

Introduction: Periodontitis is an inflammatory condition primarily triggered by persistent bacterial infection. Anemia of chronic disease, which is an anemia driven by cytokines, commonly occurs alongside various chronic inflammatory disorders. The objective of this study is to assess the impact of periodontal treatment on hemoglobin and erythrocyte levels in patients with chronic periodontitis.

Methods: The study included forty patients aged 30 to 60 years diagnosed with chronic periodontitis. At baseline, several blood parameters were recorded, including hemoglobin (Hb), erythrocyte count (RBC), erythrocyte sedimentation rate (ESR), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC). The initial periodontal parameters documented included: plaque index, gingival index, probing pocket depth, and clinical attachment level. All participants underwent non-surgical periodontal treatment (scaling and root planing). Blood and periodontal parameters were measured again after 3 months.

Results: The findings indicated that the resolution of periodontal inflammation led to a notable increase in hemoglobin levels and erythrocyte counts. The hemoglobin level rose by 0.32±0.24 gm/dl, while the erythrocyte count increased by 0.10±0.07 million cells/mm3. The erythrocyte sedimentation rate decreased, indicating the alleviation of periodontal inflammation. Nevertheless, the values for MCV, MCH, and MCHC did not show significant changes. There were significant improvements in the plaque index (PI), gingival index (GI), probing depth (PD), and clinical attachment level (CAL) with a reduction in probing depth of 1.35 mm and a gain in clinical attachment level of 1.27 mm ($p<0.001$).

Conclusion: The findings from this study demonstrate that periodontal treatment contributes to improved hematological parameters in patients suffering from chronic periodontitis.

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Submitted Date: 2025-05-02
Accepted Date: 2025-07-28

ORCID of corresponding author:
0009-0007-7242-8056

Keywords : *Chronic periodontitis; Erythrocyte level; Hemoglobin; Periodontal therapy*

INTRODUCTION

Periodontal disease is an infectious disease characterized by inflammation and subsequent destruction of the supporting structures of the teeth[1]. Infections lead to the activation of the immune system and production of

cytokines[2]. These inflammatory cytokines can depress erythropoietin production leading to the development of anemia[3,4].

Nonsurgical periodontal therapy (NSPT) is the cornerstone of periodontal therapy and the first recommended approach to the control of periodontal infections. It aims not only to preserve periodontal tissues but also to limit the oral source of inflammation contributing to overall systemic well–being[5].

There are only a few studies that investigated the red blood cell parameters, especially hemoglobin level and erythrocyte count, in relation to periodontitis. Most of the studies undertaken in the past to clarify the association between periodontal diseases and the lowered hematological parameters were either cross-sectional or longitudinal and described only the co-existence of the two. Thus, the present interventional study was carried out to find out whether the improvement in periodontal status after periodontal therapy could result in any change of the hematological parameters.

METHODS

Study Design

This study was a hospital-based study aimed at assessing the impact of non-surgical periodontal treatment on hematological parameters in individuals suffering from chronic periodontitis.

Study Setting

The research took place among patients attending the Department of Periodontology and Oral Implantology at B.P. Koirala Institute of Health Sciences (BPKIHS) in Dharan, Nepal.

Study Population

Patients aged 30 to 60 years with chronic periodontitis and a minimum of 20 natural teeth (excluding third molars) were selected for the study. Pregnant individuals, smokers, patients diagnosed with aggressive periodontitis, those with acute or chronic inflammatory medical issues (excluding chronic periodontitis), and participants who had received periodontal treatment or antibiotics or oral supplementation within six months prior to the study were excluded. The severity of chronic periodontitis was categorized as mild, moderate, or severe based on clinical attachment loss (CAL) and probing pocket depth (PPD).

Sample Size Calculation

The sample size was determined utilizing a study by A.R. Pradeep et al. using the following formula:

$n = 2(Z\alpha+Z\beta)^2\sigma^2 / d^2$

In this formula: Zα at 5% significance level = 1.96, Zβ at 80% power = 0.84, σ = 0.75, and d = 0.49. By substituting these values:

$n = 2(1.96+0.84)^2 (0.75)^2 / (0.49)^2 = 36.73$

Incorporating an additional 10% to account for possible dropouts, the total sample size was calculated to be 40.

Sampling Technique

Convenience sampling method

Participant Recruitment

Patients who fulfilled the inclusion criteria were approached and informed about the study's objectives and procedures. Written informed consent was secured before their enrollment.

Data Collection and Tools

Baseline data encompassed both periodontal and hematological parameters. The periodontal parameters documented included plaque index (PI), gingival index (GI), probing depth (PD), and clinical attachment level (CAL). The hematological parameters assessed included hemoglobin (Hb), erythrocyte count (RBC), erythrocyte sedimentation rate (ESR), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC).

All participants underwent non-surgical periodontal therapy, which consisted of scaling and root planing (SRP). The first session involved the ultrasonic removal of both supra- and subgingival calculus, while the second session, conducted after one month, included SRP using Gracey curettes (Hu-Friedy) applying light pressure and overlapping strokes to achieve smooth root surfaces. Periodontal and hematological parameters were reassessed three months after the therapy's completion.

Data Analysis

The gathered data were entered into Microsoft Excel 2010 and analyzed using the Statistical Package for the Social Sciences (SPSS), version 11.5. Descriptive statistics included frequency, percentage, mean, and standard deviation. A paired t-test was utilized for paired data, whereas ANOVA with multiple comparisons was applied as needed. A p-value <0.05 was deemed statistically significant.

Ethical Consideration

Ethical approval was granted by the Institutional Review Committee of BPKIHS, Dharan (Ref. No. 325/076/077-IRC). Written informed consent was acquired from all participants prior to their enrollment.

RESULTS

The study showed that among 40 patients of chronic

periodontitis 47.5% were males and 52.5% were females. Among the patients enrolled most of them were in the age group 51- 60 years (37.5%) followed by 30-40 years (32.5%) and 41-50 years (30%).Patients were grouped into mild, moderate and severe periodontitis using AAP/CDC criteria. Mild periodontitis accounted to be 35%, moderate 25% while severe periodontitis was 40%.

Analysis of clinical parameters at baseline and 3 months

Mean and SD's of clinical parameters (PI, GI, PD, CAL) is shown in Table 1. All clinical parameters showed statistically significant changes from baseline to 3 months.

Table 1: Mean and SDs of clinical parameters at baseline and 3 months

PARAMETERS	BASELINE		AT 3 MONTHS		DIFFERENCE		P* value
	Mean	S.D.	Mean	S.D.	Mean difference	S.D.	
PI	2.01	0.34	1.18	0.21	0.83	0.39	<0.001
GI	1.88	0.33	1.05	0.19	0.82	0.35	<0.001
PD (mm)	5.39	0.76	4.03	0.92	1.35	0.28	<0.001
CAL (mm)	4.83	1.64	3.55	1.72	1.27	0.48	<0.001

*paired t-test

Analysis of hematological parameters at baseline and 3 months

Means and SD's of hematological parameters (Hb, RBC count, PCV, MCV, MCH, MCHC, ESR) showed improvement at 3 months during comparison with baseline.(Table 2.)

Table 2: Means and SDs of hematological parameters at baseline and 3 months

PARAMETERS	BASELINE		AT 3 MONTHS		DIFFERENCE		P* value
	Mean	S.D.	Mean	S.D.	Mean difference	S.D.	
Hb (gm/dl)	13.40	1.37	13.72	1.29	-0.32	0.24	<0.001
RBC (million cells/mm3)	4.49	0.42	4.59	0.41	-0.10	0.07	<0.001
PCV (%)	40.55	4.08	41.80	4.07	-1.25	1.22	<0.001
MCV (fl)	90.34	3.18	90.64	3.10	-0.3	0.99	0.060
MCH (pg)	29.90	1.06	29.90	0.96	0.00	0.28	0.868
MCHC (%)	33.01	0.54	32.96	0.56	0.05	0.39	0.448
ESR (mm/hr)	26.38	11.78	14.15	6.08	12.23	7.35	<0.001

* paired t-test

Association between hematological parameters and severity of periodontitis

The hematological parameters were compared among patients with mild, moderate and severe periodontitis using one way analysis of variance (ANOVA) test.There was statistically significant association between Hb, RBC count, PCV, MCV, ESR with severity of periodontitis as shown by ANOVA.(Table 3.)

Table 3: Association of hematological parameters with severity of chronic periodontitis

Periodontitis	Hb (Baseline)		RBC (Baseline)		PCV (Baseline)		MCV (Baselne)		MCH (Baseline)		MCHC (Baseline)		ESR (Baseline)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Mild	14.40	1.16	4.77	0.39	43.38	3.51	91.12	2.68	30.18	1.10	33.13	0.48	15.14	4.57
Moderate	13.43	1.57	4.60	0.37	40.48	4.88	88.23	4.92	29.28	1.49	32.90	0.55	23.80	10.21
Severe	12.51	0.70	4.16	0.24	38.04	1.89	90.98	1.27	30.05	0.43	32.97	0.59	37.81	4.32
P Value	<0.001		<0.001		<0.001		0.049		0.090		0.556		<0.001	

Change of parameters in males and females

Mean and SD's of hematological parameters (Hb, RBC count, PCV, MCV, CH, MCHC, ESR) at baseline and 3 months in males and females.(Table 4)

Table 4: Mean and SD's of hematological parameters at baseline and 3 months in males and females.

Parameters	Visit	Males		Females	
		Mean	S.D.	Mean	S.D.
Hb	Baseline	14.51	1.07	12.40	0.65
	3 Months	14.80	1.00	12.75	0.52
RBC	Baseline	4.81	0.35	4.19	0.23
	3 Months	4.91	0.34	4.30	0.18
PCV	Baseline	43.72	3.40	37.69	1.99
	3 Months	44.81	3.39	39.08	2.36
MCV	Baseline	91.10	2.31	89.65	3.73
	3 Months	91.21	2.36	90.13	3.62
MCH	Baseline	30.21	0.95	29.63	1.10
	3 Months	30.15	0.84	29.66	1.03
MCHC	Baseline	33.12	0.38	32.90	0.64
	3 Months	33.04	0.44	32.89	0.64
ESR	Baseline	21.58	10.24	30.71	11.60
	3 Months	10.89	5.30	17.10	5.26

Mean difference in hematological parameters at baseline and 3 months in males and females.

There was statistically significant improvement in Hb, RBC count, PCV and ESR in males and females from baseline to 3 months whereas MCV showed statistically significant improvement in females only. No statistically significant improvement in MCH and MCHC values in both genders.**(Table 5)**

Table 5: Mean difference in hematological parameters at baseline and 3 months in males and females

Parameters	Males			Females		
	M.D.	S.D.	P* Value	M.D.	S.D.	P* Value
Hb	-0.28	0.22	<0.001	-0.35	0.25	<0.001
RBC	-0.10	0.07	<0.001	-0.10	0.08	<0.001
PCV	-1.01	0.82	<0.001	-1.39	1.51	<0.001
MCV	-0.11	1.03	0.633	-0.47	0.94	0.032
MCH	0.05	0.28	0.429	-0.03	0.28	0.596
MCHC	0.07	0.33	0.312	0.01	0.44	0.847
ESR	10.68	6.65	<0.001	13.61	7.82	<0.001

*paired t-test

DISCUSSION

The concept of periodontal diseases as localized entities affecting only the teeth and supporting apparatus has been revised, as it has been seen that rather being confined to the periodontium, periodontal diseases have a wide-ranging systemic effects like cardiovascular diseases, diabetes mellitus and stroke[9-11].

This study was accomplished in order to find the effect of periodontal therapy on hemoglobin and erythrocyte levels in chronic periodontitis patients. Furthermore, it also compares with age, gender and severity of periodontitis.

Clinical parameters PI, GI, PD, and CAL were included in the study for the assessment of the inflammatory state of the gingival tissues, the progression of the periodontal disease, and the therapeutic effect of the treatment. There was a significant reduction of scores of GI and PI and decrease in probing pocket depth, increase CAL gain 3 months after nonsurgical periodontal therapy. The result was in accordance with study done by Pradeep[6] et al and Agarwal[12] et al. This could be attributed to effective mechanical debridement, which reduced the bacterial load decreasing the local inflammation and oral hygiene maintenance of the patient postoperatively[5].

The hematological parameters like total Hb, RBC count, PCV, MCV, MCH, and MCHC were included for evaluation, as these are indicative of the anemic state of the patient and also the type of anemia based on the morphology of the cell[13,14]inflammatory conditions or neoplastic disorders which are not due to marrow deficiencies or other diseases, and occurring despite the presence of adequate iron stores and vitamins. Periodontitis is one of the most prevalent chronic inflammatory diseases in humans. This study aimed at finding out if periodontitis, like other inflammatory conditions, could lead to anemia.\\n\\nMATERIALS AND METHODS: Thirty chronic generalized periodontitis male patients with hemoglobin levels below 15 mg/dl and serum ferritin values above 30 ng/ml were selected. The various blood parameters recorded at baseline were hemoglobin levels(Hb. ESR was evaluated as it is considered a valuable parameter for any inflammatory process[13].

There was a statistically significant improvement in Hb level 3 months after non-surgical periodontal therapy. The rise in Hbpost periodontal therapy could be due to removal of bacterial etiology by periodontal therapy which results in decrease of cytokines[15]. The results of the present investigation are favorably comparable to the study carried out by Rai[16]et al, Agarwal[12], Pradeep[6] et al and Malhotra[5] et al. However, a study by Klasi[17] et al. showed a significant and unexplained decrease in an average of Hb from 12.80 g% to 12.71 g% 21 days after periodontal therapy.

The RBC count at baseline was 4.49±0.42 million/mm^3. The down regulation of the erythropoiesis in bone marrow by pro-inflammatory cytokines such as IL-1, IL-6 and tumour necrosis factor could be responsible for a decrease in number of erythrocytes. There was significant increase in RBC count 4.59±0.41 million/mm^3 postoperatively. This could be attributed to the effect of nonsurgical therapy, which caused resolution of inflammation. The results are similar with the results of previous studies carried out by Rai[16]and Agarwal[12] et al.

There was significant decrease in ESR levels from baseline to 3 months after nonsurgical periodontal therapy which is in accordance with study done by Agarwal[12] et al and Pradeep[6] et al. It is explained by the fact that ESR is considered a valuable parameter for any inflammatory process. Elevated values of ESR at baseline suggested that chronic periodontitis has an inflammatory component in it and the decrease in ESR over time was due to a reduction of the periodontal inflammation after nonsurgical periodontal therapy.

There was significant increase in PCV levels from baseline to 3 months after nonsurgical periodontal therapy. Similar results were reported by Pradeep[6] et al. The increase PCV is due to rise in levels of RBC count after nonsurgical periodontal therapy. Mean corpuscular Hb, MCHC and MCV followed a non-significant rise from baseline to 3 months after the periodontal therapy.

The hematological parameters were compared among patients with mild, moderate and severe periodontitis using one way analysis of variance (ANOVA) test. There was statistically significant association between Hb, RBC count, PCV, MCV, ESR with severity of periodontitis. However, the study by Aljohani[18] et al failed to show any association between hemoglobin level and severity of chronic periodontitis.

A statistically significant improvement was noted in Hb, RBC count, PCV and ESR in males and females from baseline to 3 months whereas MCV showed statistically significant improvement in females only. No statistically significant improvement in MCH and MCHC values in both genders were seen.

All parameters showed improvement from baseline to 3 months with reductions in periodontal inflammation. The resolution of periodontal inflammation with improvements in RBC parameters provided evidence that NSPT alone can improve the hematological status of patients with chronic periodontitis.The limitations of this study are outcome of single center experience and smaller sample size.

CONCLUSION

Within the limits of the study, the data from this study indicates a significant effect of periodontal therapy on hemoglobin and erythrocyte level in chronic periodontitis patients. However, as the sample size was small and follow-up interval was only 3 months, a large prospective study could have yielded substantial results.

ACKNOWLEDGEMENT

None

CONFLICT OF INTEREST

None

FUNDING

This study was funded with the authors' own contributions.

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