Original Article

Comparative evaluation of role of hs C -reactive protein as a diagnostic marker in chronic periodontitis patients

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Abstract

Background and Aim: C-reactive protein (CRP) is a type I acute phase protein, which can increase up to 1000 fold after the onset of a stimulus. It is a phylogenetically highly conserved plasma protein with homolog in vertebrates and many invertebrates that participate in systemic response to inflammation. Serum C-reactive protein levels are raised in patients with myocardial infarction and periodontitis, providing a potential mechanism to link destructive periodontal disease with an increased risk for other atherosclerotic complications. The purpose of the present study was to estimate and compare the levels of hs- C Reactive protein in chronic periodontitis patients before and after non-surgical periodontal therapy. **Methods:** The study sample consisted of 45 individuals of age group 30-60 years that was divided into two groups Group I (control) and Group II (patients with chronic generalized periodontitis). The clinical parameters such as plaque index, calculus index, gingival index, probing pocket depth, clinical attachment level, and serum hs-CRP levels were recorded for these individuals. **Results:** The patients with healthy gingiva possessed a mean hs-CRP level of 0.252 ± 0.0393 which was lower as compared to the patients with chronic periodontitis. In periodontitis patients mean levels of hs-CRP was 0.106 ± 0.029 which reduced to 0.044 ± 0.027 after periodontal therapy. A significantly elevated CRP level was found in subjects with periodontitis compared to the controls. **Conclusion:** The serum levels of C-reactive protein were elevated in patients with periodontitis and this might be a diagnostic marker for cardiovascular diseases.

Keywords: Gingiva, hs-CRP, periodontitis

Introduction

Periodontitis is defined as the inflammatory disease of supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with pocket formation, recession or both.[1] The pathogenic role of the subgingival microbiota in the initiation and progression of periodontitis is widely accepted. Periodontal pathogens affect local and systemic immune and inflammatory responses. The local inflammatory response to these bacteria or bacterial products is characterized by infiltration of the periodontal tissues by inflammatory cells including polymorphonuclear neutrophils (PMNs), macrophages, lymphocytes and plasma cells.[2] Activated macrophages release cytokines and some individuals respond to microbial challenge with an abnormally high delivery of such inflammatory mediators as PGE_2, IL-1 and TNF. These cytokines are involved in the destruction of both the periodontal connective tissue and alveolar bone.[3,4]

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Several reports have implicated long standing periodontal disease in the development of cardiovascular disease, cerebrovascular accidents and preterm low birth weight infants.[5] A growing body of evidence supports the concept that chronic infections and inflammation such as periodontal disease may play a role in the initiation and progression of coronary artery disease.

Chronic infections such as periodontal disease may lead to atherogenesis by two different pathways:

1. A direct invasion of the arterial wall as evidenced for chlamydial organisms and some periodontal pathogens.[6]
2. The release of some systemic inflammatory mediators and acute phase reactants with atherogenic effects e.g. TNF α, IL-1, IL-6, CRP, serum amyloid A etc.[7]

The acute-phase reaction represents an early and highly complex reaction of the organism to a variety of injuries such as bacterial, viral or parasitic infection, mechanical or thermal trauma, tissue necrosis, inflammation or malignant growth. Acute-phase proteins are defined as proteins whose serum concentration is altered by at least 25% in response to inflammation.[8] Most acute-phase proteins are synthesized primarily by the liver hepatocytes in response to pro-inflammatory cytokines including interleukin (IL)-1α, IL-β, IL-6 etc., The major acute-phase proteins include C-reactive protein (CRP), serum amyloid A, fibrinogen, and haptoglobin, whose concentration increase with inflammation, and albumin and transferrin, whose concentrations decreases with inflammation.[9,10]

Serum CRP concentration rises rapidly in the acute-phase response and can exceed 300 mg/l by 48 h after a sever stimulus, such as myocardial infraction, acute systemic bacterial infection, major trauma, or surgery. Until recently, CR*P* values <10 mg/L were considered normal, while acute bacterial infections have been reported in 80% to 85% of patients with CR*P* values >100 mg/L. However CR*P* values previously considered as high normal have been reported to be predictive of atherosclerotic complications.[11] A positive association between CRP and destructive periodontal disease was found in an analysis of third National Health and Nutrition Examination survey (NHANES III), providing a potential mechanism to link destructive periodontal disease with an increased risk of atherosclerotic complications.[12]

Host response to periodontal infection results in the local production of cytokines and biological mediators including interleukins and prostaglandins. These cytokines are involved in destruction of periodontal tissues. They also initiate a systemic acute-phase response. Recent studies have shown that serum C-reactive protein levels in patients with periodontal disease are elevated, providing a potential mechanism to link destructive periodontal disease with an increased risk for other atherosclerotic complications.

Non-surgical periodontal therapy reduces pathogenic biofilm, but it could not affect the depth of the pockets and thereby is not considered as effective in the treatment of deep pockets. The existence of periodontal pathogens which belong to red and orange complexes leads to persistence bleeding on probing and pocket depth in these patients. Considering this fact, there is an increasing interest towards adjunctive treatment modalities to enhance periodontal therapy and reduce periodontal microbial biofilm in the long-term. Adjunctive treatment for periodontal therapy has been antibiotic therapy for many years. The use of amoxicillin and metronidazole in addition to scaling and root planning decreased the number of pathogenic microbiota in deep pockets.[13]

According to American Heart Association (AHA) and Center for Diseases Control (CDC), subjects with CRP concentrations more than 3 mg/L are considered to be at high risk for future cardiovascular events.[14] The efficacy of mechanical debridement in the treatment of periodontal diseases is well documented. But the consequence of periodontal therapy on the potential reduction of risk for CVD using serum hs CR*P* values as a substitute endpoint is unclear.

However, since destructive periodontal diseases are treatable, some studies suggest that it may be possible to lower CR*P* values and the associated risk of atherosclerotic complications through the effective management of destructive periodontal disease. Therefore, the present study intends to evaluate the relationship between periodontitis and periodontal treatment upon the serum levels of C-reactive protein.

Methods

The present study was conducted in the Department of Periodontics and Implantology at D.J College of Dental sciences and Research, Modinagar, on subjects to estimate and compare the levels of hs-C-reactive protein in the peripheral blood of the chronic periodontitis patients before and after scaling and root planing. A sample size of 45 patients of age group 30-60 years with good systemic health diagnosed with chronic periodontitis were selected from OPD. The patients were asked to sign a written consent after the procedure was explained to them. Study approval was obtained by Ethical Committee of D.J College of Dental Sciences and Research, Modinagar. Patients so selected were equally divided into two groups i.e. Group A and Group B.

Group A: (Control group) i.e. patients with healthy gingiva with no changes in color, no signs of redness, edema and no bleeding on probing.

Group B: (Test group) chronic generalized periodontitis.

The inclusion criteria included patients who had good oral hygiene, patients diagnosed with healthy gingiva, chronic

periodontitis on basis of gingival index (GI), plaque index (PI), probing depth (PD), Clinical attachment level (CAL), patients with minimum of 20 teeth and those with good systemic health and mental health status.

The exclusion criteria included patients having systemic diseases like diabetes mellitus, rheumatoid arthritis, cardiovascular diseases, gastrointestinal disorders, respiratory diseases, and patients with a history of smoking or any periodontal surgery in past 6 months, pregnant and lactating females.

On the first visit, a detailed case history of the patient including clinical parameters (plaque index, calculus index, gingival index, probing pocket depth, clinical attachment level (with the help of Williams graduated periodontal probe to the nearest millimeter), and serum hs-CRP levels were recorded. This was followed by a comprehensive phase I therapy, which included patient education and motivation, plaque control, scaling and root planning.

Patients were given oral hygiene instructions and then advised of meticulous home care including mechanical plaque control. The patients were asked to use modified Bass brushing method. Serum C- reactive protein levels were assessed by means of a commercial high sensitive Enzyme linked immunosorbent assay (Calbiotech, Inc. CBI) at baseline for subjects in the two groups and 1 month after completion of periodontal therapy for subjects in test group.

From the selected patients 5 ml of blood sample was collected into sterile tube/vial without anticoagulant from a single, clean venipuncture with minimal stasis from antecubital fossa for the assessment of serum hs- CRP level. The blood sample was allowed to clot at room temperature for 1-2 hours. The collected blood sample was centrifuged in the centrifugation machine at 2000 rpm for 5 minutes. Serum was separated carefully from the centrifuged sample and was then stored in freezer till analysis. Samples were analyzed at the Department of Microbiology, Subharti Medical College, using Enzyme linked immunosorbent assay.

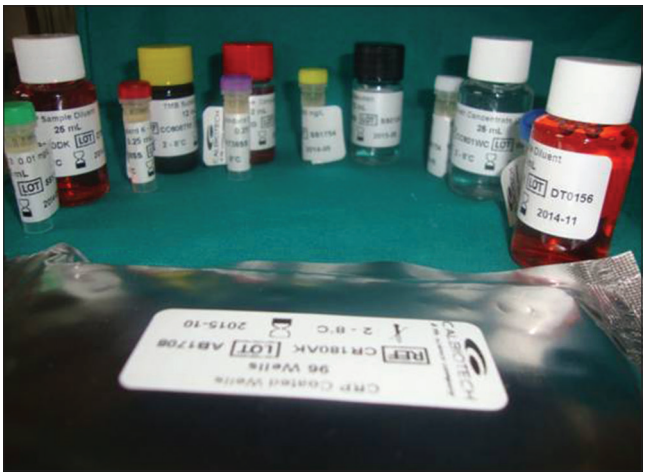


Figure 1: Contents of HS-CRP ELISA kit

Estimation of hs C - reactive protein

Serum concentrations of hs CRP were quantified using a commercially available ELISA kit for high sensitive determination of C-reactive protein (DRG® CRP hs ELISA EIA-4584). Diagnostic reagent kit was used for the invitro detection of CRP in human serum. [Figure 1] The samples and anti-CRP-HRP conjugate were added to the wells coated with MAb to CRP. [Figure 2] CRP in the patient's serum binds to anti-CRP MAb on the well and the anti-CRP second antibody then binds to CRP. Unbound protein and HRP conjugate were washed off by wash buffer. Upon the addition of the substrate, the intensity of color was proportional to the concentration of hs-CRP in the samples. A standard curve is prepared relating color intensity to the concentration of the hs-CRP.

All the values of plaque index, gingival index, probing depth, clinical attachment level and hs C-reactive protein concentration in control group and experimental group (pre operative and post operative) were expressed in terms of mean and standard deviation respectively and were analyzed using the Statistical Package for Scientific Studies for Windows (SPSS 20, IBM, Armonk, NY, USA) at a statistical significance level of $P \leq 0.05$. Statistical analysis was carried out using paired and unpaired *t*-test.

Results

The age of the patients ranged between 30-60 years. The percentage of females and males in control group were 45% and 55%, and in test group were 60% and 40%. None of the patients had any known systemic conditions, infections or any other factors known to increase the CRP level. As stated earlier, all the parameters (Plaque index, Gingival Index, Pocket Depth and Clinical Attachment Level) were assessed at the baseline for subjects in the two groups and 1 month after completion of periodontal therapy for subjects in test group.

With a thorough basic therapy followed by regular maintenance, the plaque control in all the patients was satisfactory. The plaque index in the control group was found to be 0.8542± 0.1155. At baseline the plaque index in the test group was 1.87±

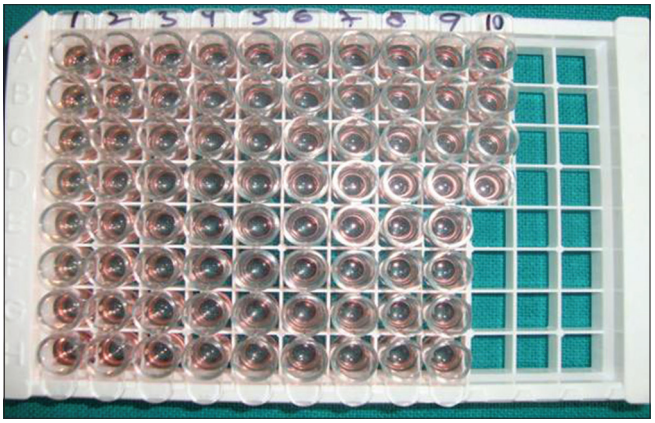


Figure 2: 10 μl of diluted sample is added to the appropriate wells

0.3289 which after treatment improved to 0.9076± .2353. This was found to be statistically significant ($P < 0.05$) by paired *t*-test. [Table 1A]. Statistically significant ($P < 0.05$) results were found by unpaired *t*-test in control group and pre operative test group of the plaque index. [Table 1B]. The gingival index in the control group was found to be 0.2450±0.1012. At baseline the gingival index scores in the test Group was 2.1664± 0.29 which after treatment improved to 0.8468± .2620. A significant difference ($P < 0.05$) was found by paired *t*-test in the gingival index. [Table 2A]. Statistically significant ($P < 0.05$) results were found by unpaired *t*-test in control group and pre operative test group of the gingival index. [Table 2B].

Periodontal pockets vary in their location and depth, hence changes in the mean probing depths for the entire mouth may not provide a realistic information. Accordingly, the mean probing depths for the entire mouth of the control group was found to be 1.6195± 0.1533. The mean probing depths for the entire mouth at the beginning of the study for test group 5.1884± 0.2938, which reduced after treatment to 2.1696± .2577. This was found statistically significant ($P < 0.05$) by paired *t*-test. [Table 3A]. Statistically significant ($P < 0.05$) results were found by unpaired *t*-test in control group and pre operative test group of the probing pocket depth. [Table 3B]. There was a significant gain in clinical attachment. The mean attachment loss of the control group was found to be 0.5646± 0.1443. The mean attachment loss of the test group was found to be 6.07± 0.4533 at baseline which improved after treatment to 2.9108± .3415. A significant difference ($P < 0.05$) was found by paired *t*-test in the clinical attachment level. [Table 4A and Graph 1]. Statistically significant ($P < 0.05$) results were found by unpaired *t*-test in control group and pre operative test group of the clinical attachment level. [Table 4B and Graph 1]. The hs-CRP concentrations in control group were found to be 0.025± 0.0393. The hs-CRP concentrations in the test group at baseline were found to be 0.106± 0.029 which reduced after treatment to 0.044± .027. A significant difference ($P < 0.05$) was found by paired *t*-test in the hs-C reactive protein level. [Table 5A and Graph 2]. Statistically significant ($P < 0.05$) results were found by unpaired *t*-test in control group and pre-operative test group of the plaque index. [Table 5B and Graph 2].

Discussion

C-reactive protein (CRP) is a very strong acute phase protein. In healthy, young subjects and resting situations the serum concentration is <1.5 mg/l. In acute phase situations, however, the concentration can increase up to a thousand-fold.[15] CRP is synthesized mainly in hepatocytes, but mRNA and CRP have been shown to be present in monocyte-derived macrophages in atherosclerotic plaques, lymphocytes and alveolar macrophages.[16] Its synthesis is regulated mainly by inteleukin (IL)-6, IL-1 and tumor necrosis factor. Peak values of CRP usually disappear within a few days of the inflammatory stimulus.

Table 1A: Mean & standard deviation of pre & post scores of plaque index & its significant difference using paired'*t*' test)

CLINICAL PARAMETER	(MEAN±S.D)		DIFFERENCE (MEAN±S.D)	PROBABILITY OF PAIRED '*t*' TEST	*P*/SIGNIFICANCE
	PRE CORES	POST SCORES			
PLAQUE INNDEX	1.87±0.3289	0.9076±0.2353	0.9624±0.2709	0.0000*	*P*<0.05 (SIGNIFICANT)

*SHOWS A SIGNIFICANT DIFFERENCE AT.05 LEVEL OF SIGNIFICANCE

Table 1B: Mean & standard deviation of pre & post scores of plaque index & its significant difference b/w pre score & control group using un paired'*t*' test)

CLINICAL PARAMETERS	MEAN±S.D.		CONTROL GROUP (MEAN±S.D.)	PROBABILITY OF UNPAIRED '*t*' TEST	*P*/SIGNIFICANCE
	PRE SCORE	POST SCORE			
LAQUE INDEX	1.87±0.3289	0.9076±0.2353	0.8542±0.1155	0.0000*	*P*<0.05 (SIGNIFICANT)

*SHOWS A SIGNIFICANT DIFFERENCE AT.05 LEVEL OF SIGNIFICANCE

Table 2A: Mean & standard deviation of pre & post scores of gingival index & its significant difference using paired'*t*' test)

CLINICAL PARAMETER	(MEAN±S.D)		DIFFERENCE (MEAN±S.D)	PROBABILITY OF PAIRED '*t*' TEST	*P*/SIGNIFICANCE
	PRE CORES	POST SCORES			
GINGIVAL INNDEX	2.1664±0.2904	0.8468±0.2620	1.3196±0.2270	0.0000*	*P*<0.05 (SIGNIFICANT)

*SHOWS A SIGNIFICANT DIFFERENCE AT.05 LEVEL OF SIGNIFICANCE

Table 2B: Mean & standard deviation of pre & post scores of gingival index & its significant difference b/w pre score & control group using un -paired'*t*' test

CLINICAL PARAMETERS	MEAN±S.D.		CONTROL GROUP (MEAN±S.D.)	PROBABILITY OF UNPAIRED '*t*' TEST	*P*/SIGNIFICANCE
	PRE SCORE	POST SCORE			
GINGIVAL INDEX	2.1664±0.2904	0.8468±0.2620	0.2450±0.1012	0.0000*	*P*<0.05 (SIGNIFICANT)

*SHOWS A SIGNIFICANT DIFFERENCE AT.05 LEVEL OF SIGNIFICANCE

Table 3A: Mean & standard deviation of pre & post scores of probing depth & its significant difference using paired'*t*" test

CLINICAL PARAMETER	(MEAN±S.D)		DIFFERENCE (MEAN±S.D)	PROBABILITY OF PAIRED '*t*" TEST	*P*/SIGNIFICANCE
	PRE CORES	POST SCORES			
POCKET DEPTH	5.1884±0.2938	2.1696±0.2577	3.0188±0.1986	0.0000*	*P*<0.05 (SIGNIFICANT)

*SHOWS A SIGNIFICANT DIFFERENCE AT.05 LEVEL OF SIGNIFICANCE

Table 3B: Mean & standard deviation of pre & post scores of probing depth & its significant difference b/w pre score & control group using un -paired'*t*' test

CLINICAL PARAMETERS	MEAN±S.D.		CONTROL GROUP (MEAN±S.D.)	PROBABILITY OF UNPAIRED '*t*' TEST	*P*/SIGNIFICANCE
	PRE SCORE	POST SCORE			
POCKET DEPTH	5.1884±0.2938	2.1696±0.2577	1.6195±0.1533	0.0000*	*P*<0.05 (SIGNIFICANT)

*SHOWS A SIGNIFICANT DIFFERENCE AT.05 LEVEL OF SIGNIFICANCE

Table 4A: Mean & standard deviation of pre & post scores of c.a.l. & its significant difference using paired'*t*" test

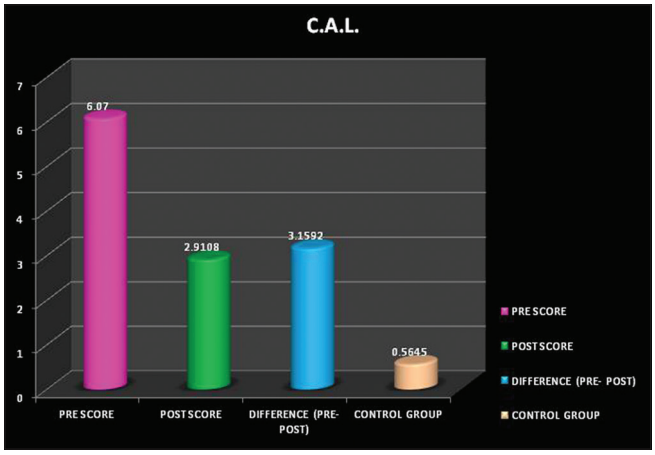
CLINICAL PARAMETER	(MEAN±S.D)		DIFFERENCE (MEAN±S.D)	PROBABILITY OF PAIRED '*t*" TEST	*P*/SIGNIFICANCE
	PRE CORES	POST SCORES			
CLINICAL ATTACHMENT LEVEL	6.07±0.4533	2.9108±0.3415	3.1592±0.4296	0.0000*	*P*<0.05 (SIGNIFICANT)

*SHOWS A SIGNIFICANT DIFFERENCE AT.05 LEVEL OF SIGNIFICANCE

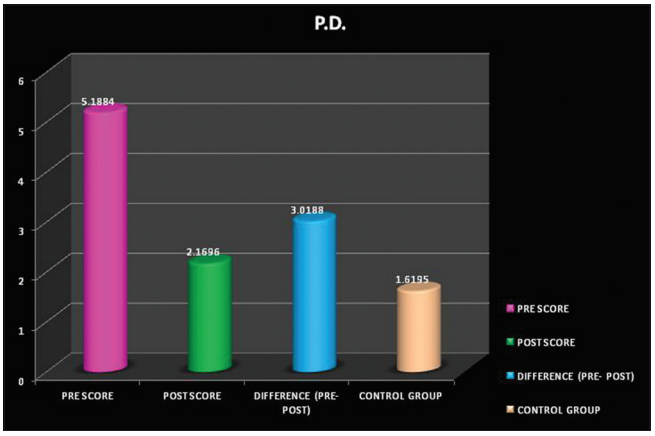
Table 4B: Mean & standard deviation of pre & post scores of C.A.L & its significant difference b/w pre score & control group using un -paired'*t*' test)

CLINICAL PARAMETERS	MEAN±S.D.		CONTROL GROUP (MEAN±S.D.)	PROBABILITY OF UNPAIRED '*t*' TEST	*P*/SIGNIFICANCE
	PRE -SCORE	POST - SCORE			
CLINICAL ATTACHMENT LEVEL	6.07±0.4533	2.9108±0.3415	0.5645±0.1443	0.0000*	*P*<0.05 (SIGNIFICANT)

*SHOWS A SIGNIFICANT DIFFERENCE AT.05 LEVEL OF SIGNIFICANCE



Graph 1: Bar graph diagram for probing depth of test group (pre and post), their difference and control group



Graph 2: Bar graph diagram for hs-crp of test group (pre and post), their difference and control group

The CRP concentration is associated with cardiovascular disease and with other inflammatory diseases, such as rheumatoid arthritis. Also, several components of the insulin-resistance syndrome, such as obesity and increased blood pressure, are associated with altered CR*P* values and which has been confirmed by several other groups.[17] Also, patients with insulin-dependent diabetes mellitus have increased CRP levels.

Periodontal disease influences one's wellbeing. Indeed higher CRP concentrations have been observed in patients with periodontitis versus healthy controls.[18,19] Besides, in a random sample of the general population the periodontal health status was associated with the CRP concentration.

Cardiovascular disease has several risk factors and it well documented that chronic infection and inflammation such as periodontal disease may play a role in the initiation and progression of coronary artery disease.[20] Several cross sectional studies[2,7,12] have reported associations between periodontal disease and elevated CRP, a systemic marker of inflammatory status.

Table 5A: Mean & standard deviation of pre & post scores of hs- crp level & its significant difference using paired'*t*' test

CLINICAL PARAMETER	(MEAN±S.D)		DIFFERENCE (MEAN±S.D)	PROBABILITY OF PAIRED '*t*' TEST	*P*/SIGNIFICANCE
	PRE CORES	POST SCORES			
HS-CRP	0.106±0.029	0.044±0.027	0.0619±0.0340	0.0000*	*P*<0.05 (SIGNIFICANT)

*SHOWS A SIGNIFICANT DIFFERENCE AT.05 LEVEL OF SIGNIFICANCE

Table 5B: Mean & standard deviation of pre & post scores of hs-crp level & its significant difference b/w pre score & control group using un -paired'*t*' test

CLINICAL PARAMETERS	MEAN±S.D.		CONTROL GROUP (MEAN±S.D.)	PROBABILITY OF UNPAIRED '*t*' TEST	*P*/SIGNIFICANCE
	PRE SCORE	POST SCORE			
HS-CRP	0.106±0.029	0.044±0.027	0.0252±0.0393	0.0000*	*P*<0.05 (SIGNIFICANT)

*SHOWS A SIGNIFICANT DIFFERENCE AT.05 LEVEL OF SIGNIFICANCE

Ridker *et al.* conducted a study that showed inflammation plays an important role in the pathogenesis of CVD.[21] Elevated CRP is a well recognized risk factor of atherosclerotic complications and the hepatic synthesis of CRP is upregulated by pro-inflammatory cytokines released locally at sites of infection/inflammation. It has been suggested that CRP promotes atherosclerotic lesion formation and induces adhesion molecule expression in human endothelial cells.[22] Therefore the possibility exists that atherosclerotic complications may be closely associated with severe periodontal diseases.

The present study determines whether the presence of periodontitis and periodontal treatment could influence the serum levels of C-reactive protein. The results of the present study highlight 3 points. Firstly, an increase in serum CRP level concomitantly with the severity of the disease. Secondly, a properly performed periodontal therapy results in the improvement of the periodontal parameters irrespective of the state of the disease. Thirdly, a reduction in systemic inflammation as evidenced by the reduction in CRP level with periodontal therapy.

In a very early study conducted by Boucher *et al.*,[23] it was apparent from the results that CRP appears in the serum of patients with some forms of inflammatory oral disease. This study was one of the earliest studies to determine a relationship between the levels of CRP and oral diseases. In the present days, the levels of CRP have been correlated with many systemic conditions such as AMI, angina, diabetes mellitus, malignancies etc.

Recent evidence has indicated that patients with severe periodontitis have increased serum levels of CRP, when compared with control population.[24] But they fall short in indicating that periodontitis was the cause for the observed serum CRP levels as CRP levels fluctuate with various confounding factors like aging, high blood pressure, alcohol, smoking, low levels of physical activity, chronic fatigue, estrogen, high protein diet, sleep disturbances and depression.[25]

In the present study, an attempt has been made to estimate and compare the levels of hs- C Reactive protein in chronic periodontitis patients before and after non-surgical periodontal therapy. A study was designed in which total 45 chronic periodontitis patients were selected which were allocated into 2 groups – Control Group (20) and test group (25). Hs-CRP levels were assessed in control group and in test group at baseline and 1 month after non-surgical periodontal therapy.

The mean hs-CRP level in control group was. 0252 ± 0.393 and in test group was. 106± 0.029 at baseline which reduced to. 044± 0.027 after completion of non-surgical periodontal therapy. When the mean hs-CRP levels were compared between two group, there was statistical significant difference observed. The healthy group demonstrates a near normal hs- CRP levels indicating little or no risk for CVD. This is in accordance with the findings of the earlier studies done by Noack *et al.* and Slade *et al.*[2,12]

Fredriksson *et al.*[26] in a study, estimated a median CRP of 2 mg/l for periodontitis patients, 0 mg/l among controls. In another study, Loos *et al.*[7] observed the highest CR*P* values in patients with a generalized form of periodontitis (median 1.45 mg/l); for patients with a more localized form of periodontal disease, the median CR*P* value was 1.30 mg/l, while healthy controls presented with a median of 0.90 mg/l.

In the present study, the CRP levels in periodontitis patients reduced significantly after periodontal therapy. This is in agreement with other studies that reported a significant reduction in serum CRP level after treatment. This significant decrease in CRP level is comparable with some of the most promising medications such as statins and anti-inflammatory agents. The medical significance of these changes is further emphasized by the fact that such changes would substantially decrease the predicted risk for future cardiovascular events based on serum CRP concentrations.

Grace Onyenashia Alade *et al.*[13] evaluated the association between chronic periodontitis and C-reactive protein (CRP) levels in a group of hypertensive individuals and concluded that there was a significant association between the severity of chronic periodontitis in the hypertensive individuals with elevated CRP

levels. Thus, increased CRP levels in this category of hypertensive participants may place them at a higher risk for CVD.

Torrungruang K *et al.*[27] in their study involving 799 individuals, who were aged 50-73 years, concluded that severe periodontitis and poor oral hygiene were associated with elevated sST2 and CRP levels ($p < 0.05$).

D Aiuto *et al.*[28] conducted a study and observed a median decrease in serum CRP of 0.5 mg/l 6 months after completion of periodontal therapy. It was concluded that control of periodontitis can be achieved with non-surgical periodontal therapy, significantly decreasing the serum mediators and markers of acute phase response.

In contrast to the above study, Ide *et al.*[29] conducted a study to know whether the circulating acute phase protein level decrease following the treatment of periodontal disease, but failed to observe a reduction in circulating CRP following non-surgical periodontal therapy. Also after the periodontal treatment some residual disease sites remained and this may have had some bearing on the results obtained in their study. A possible explanation as to why CRP remains elevated even after SRP is that SRP is insufficient to control periodontal disease progression in all periodontitis subjects. Also, it may not be possible to eliminate all the microorganisms from deep inaccessible pockets. Removal of deposits and microorganisms from these locations may require surgical intervention and/or the use of antimicrobial agents. Many investigators have found much higher levels of CRP as compared to the present study.

Ebersole *et al.*[18] observed relatively high levels of CRP, 9 mg/l in chronic periodontitis versus 2 mg/l in controls which was much higher as compared to the levels in our study. This could be caused by investigation of more severe cases of periodontitis in their study. Thus, it was seen that a positive association existed between the presence of chronic periodontitis and high serum CRP levels because cytokines are released under the condition of periodontitis and cause the de novo hepatic production of acute phase reactants like C-reactive protein.

Another aspect of the present study was the correlation between individual parameters and CRP level. Parameters such as plaque index, gingival index, probing pocket depth and clinical attachment level gain showed a positive correlation with changes in CRP after one month following treatment. Since these parameters showed a positive correlation, they can be used as predictors for changes in CRP level.

One of the factors that could have influenced the results of this study was the age factor of the participants. Also, hidden factors such as genetics and undiagnosed conditions were not taken into cognizance in this study.

Some studies indicate that, independent of inflammation, genetic variations in the CRP gene, as well as in the IL-6 and IL-1 genes, influence circulating CRP concentrations. Marsik *et al.*[30] in a study genetically-determined regulators of CRP concentrations which modulates the individual response to key inflammatory stimulus, endotoxin. This genetic determination could explain the discrepant results indicating that carriers of CRP gene variants clearly associated with increased basal CRP concentrations.

The results of the present study reinforce the observations of the previous studies indicating that periodontal diseases are associated with elevation in serum CRP levels and that periodontal therapy as simple as nonsurgical scaling and root planning bring down the levels of the latter. Theoretically, this should help in reducing the incidence of cardiovascular diseases. However, whether such benefit is translated in the long term in reducing the cardiovascular risk, its morbidity and mortality can only be assessed by well controlled longitudinal trials. In the present study, we excluded subjects with systemic factors known to increase the CRP level. But in the general population, in subjects with presence of known risk factors for cardiovascular disease, presence of periodontitis may add to the cumulative effect thus further increasing the risk. This aspect has to be examined further in future studies.

Implications for clinical practice

Clinical measurement of serum CRP is valuable as a screening test for disease and as a sensitive objective index of disease activity and response to therapy in some inflammatory conditions like periodontal disease. An elevated serum concentration of CRP is an evidence of active tissue damaging process and CRP is an indicator of current disease activity. The elevated inflammatory factors may increase inflammatory activity in atherosclerotic lesions and potentially increasing the risk for cardiovascular events. Periodontitis is treatable; moreover, it is preventable. Experimental conformation of this shows that another widely prevalent and preventable contributor to the burden of cardiovascular disease would be added to the options available of the clinicians and public health practitioners for the control of the epidemic of cardiovascular disease.[27]

Conclusion

C - reactive protein is an acute phase reactant released by the body in response to acute injury or other inflammatory stimuli, and is a fundamental response of the body to injury. The present study envisaged to determine the relationship between periodontitis and periodontal treatment upon the serum levels of C-reactive protein. In the present study, the patients with healthy gingiva had lower mean hs-CRP levels as compared to the patients with chronic periodontitis. In periodontitis patients, mean levels of hs-CRP decreased after the periodontal therapy. It is concluded that periodontal therapy could be one of the important aspects in the prevention of adverse cardiovascular events.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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