ORIGINAL RESEARCH

The Effect of Periodontal Debridement on C-reactive Protein in Chronic Periodontitis: A Comparative Study

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ABSTRACT

Background: C-reactive protein (CRP) is a serum protein synthesized by liver only during an inflammatory condition. The study was carried out in chronic periodontitis patients to quantitatively evaluate the serum level of CRP, before and after periodontal debridement therapy and compare the values with that obtained from patients who practiced meticulous home care alone.

Methods: A total of 40 untreated chronic periodontitis patients were selected and randomly placed into two groups: Group I (Control) and Group II (Study), each comprising of 20 subjects. The study parameters evaluated were oral hygiene status, gingival index, probing pocket depth, clinical attachment loss, and serum levels of CRP. From Group I patients, blood samples for estimating CRP levels were collected on the 1st day and only oral hygiene instructions were given such as brushing twice daily by modified bass method and rinsing with 0.2% chlorhexidine gluconate mouthwash twice daily after brushing. At the end of 1 month, blood samples for estimating CRP levels were again collected. For Group II patients, blood samples for CRP estimation were collected for determining the baseline value before the initiation of periodontal therapy. Scaling and root planning (SRP) was performed. Furthermore, patients were then instructed to begin meticulous home care, similar to Group I patients. After 1 month from the date of performing SRP, blood sample was again collected for estimating CRP levels.

Results: The baseline CRP levels were similar in both groups (Group I: 2.39 and Group II: 2.64 mg/L). After 1 month post-operative, mean CRP value for Group II was reduced to 0.85 ± 0.66 compared to 2.40 ± 0.96 in Group I. This reduction in CRP value for the Group II, who had undergone periodontal therapy is very highly significant.

Conclusion: Periodontal debridement therapy can be employed as an effective tool in reducing the level of elevated CRP. From this study, it can be confirmed that debridement therapy gives excellent results in reducing the level of elevated systemic inflammatory markers compared to personal plaque control measures.

Keywords: Chronic Periodontitis, C-reactive protein, Periodontal debridement

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INTRODUCTION

Periodontitis is defined as an infectious disease of the periodontium caused by a specific microorganism or groups of microorganisms resulting in progressive destruction of supporting structures of the teeth. Accumulation of plaque initiates a host response. Periodontal infections serve as reservoirs for Gram-negative anaerobic organisms, lipopolysaccharides, and inflammatory mediators which may have consequences that extend beyond the periodontal tissue themselves.[1] Changes during the acute phase of inflammation particularly, the increase in the concentration of certain proteins of the blood were of great interest in this century because they served as diagnostic indicators for the presence and extent of infectious and inflammatory processes.

The acute phase response defines a characteristic pattern of alteration in the concentration of plasma proteins that occurs following a variety of different forms of inflammation. The acute phase proteins are present in detectable levels at baseline in humans and can rise during tissue trauma or during the infectious process like sepsis. These responses have both pro-inflammatory and anti-inflammatory effects. Periodontitis has been linked to various systemic diseases such as cardiovascular diseases, cerebrovascular ischemia, and respiratory diseases, although mechanisms responsible for this association are obscure.[2,3]

C-reactive protein (CRP) is a serum protein synthesized by liver only during an inflammatory condition. Tillet and Francis in 1930 reported the discovery of CRP. It is usually present as a trace constituent of plasma in a range of 0–0.6 mg/L. Blood levels of CRP increases in association with inflammation and the levels decrease

after the inflammation subsides. The rate of CRP synthesis and secretion increases within hours of an acute injury or the onset of inflammation probably under the influence of humoral mediators.

Clinical measurement of serum CRP is valuable as a screening test for organic diseases and as an index of disease activity and response to therapy in some inflammatory, infective, and ischemic conditions. The present study intends to quantitatively evaluate the serum level of CRP, before and after periodontal debridement therapy and compare them with that of controls who practiced thorough brushing and chemical plaque control measures alone, within a specific period of study.

MATERIALS AND METHODS

The study was conducted in the Department of Periodontics, Government Dental College, Thiruvananthapuram; in association with Advanced Clinical Research Laboratory, Medical College Hospital, Thiruvananthapuram.

Inclusion Criteria

The following criteria were included in this study:

1. Patients with generalized moderate to severe periodontitis with clinical attachment loss of ≥4 mm.
2. Age group of study subjects was 25–60 years
3. Presence of at least 15 natural teeth
4. Patients who had not received periodontal treatment for past 6 months
5. Patients who have not taken antibiotics/anti-inflammatory agents within past 1 month
6. Physical and mental ability to control plaque to a clinically acceptable level.

Exclusion Criteria

The following criteria were excluded from this study:

1. Pregnant women
2. Individuals with uncontrolled acute or chronic medical illness
3. Any acute dental infections requiring drainage, antibiotics, extraction, or endodontic treatment
4. Patients with bleeding or coagulation disorders
5. Patients with cardiac pacemakers
6. Smokers (including previous history of smoking).

Grouping of Patients

A total of 40 untreated chronic periodontitis patients were selected for the study. Those who met the inclusion criteria were listed randomly into two groups: Group I (Control) and Group II (Study), each comprising of 20 subjects.

CLINICAL EVALUATION

Detailed medical and dental history of the study subjects were collected using a pro forma. Examination of the oral cavity was performed using mouth mirror, Shepherd's hook explorer, and Williams graduated periodontal probe.

The following parameters were recorded at baseline:

1. Oral hygiene status: Simplified oral hygiene index (OHI-S: Greene and Vermilion 1964)
2. Gingival index (Silness and Loe 1964)
3. Probing pocket depth
4. Clinical attachment loss
5. Serum levels of CRP.

The pocket depth was measured using Williams graduated probe on all the four surfaces of the tooth. The facial surfaces equidistant between the mesial and distal surfaces, mesiofacial, and distofacial line angles at the interproximal contact area and lingual surface. The third molars are excluded from the study.

Oral hygiene status is assessed by OHI-S which has two components:

1. DI-S (Debris index-simplified)
2. CI-S (Calculus index-simplified)

The oral hygiene index per person is the total of the Debris index score and the Calculus index score.

Materials used for blood sampling

Tourniquet, isopropyl alcohol 70% scrub, disposable 2cc syringe with 22 gauge needle, collecting and storage vial (5 ml), and cotton were used.

The reagent included Quantia-CRP activation buffer (RI), Quantia - CRP (R2), and Quantia - CRP calibrator.

Procedure

Group I (control group)

This group comprised 20 chronic periodontitis patients who satisfied the inclusion criteria. The blood samples for estimating CRP levels were collected on the 1st day, and only oral hygiene instructions were given then. The subjects were demonstrated and advised in this visit to practice excellent plaque control measures as, brushing twice daily by modified Bass method. They were instructed to rinse with 0.2% chlorhexidine gluconate mouthwash twice daily after brushing. Thereafter each patient is recalled weekly to monitor the effectiveness of plaque control. At the end of 1 month, blood samples for estimating CRP levels were again collected.

Group II (study group)

This group comprised 20 chronic periodontitis patients who satisfied the inclusion criteria. On the 1st day, blood

samples for CRP estimation were collected for determining the baseline value before the initiation of periodontal therapy. These subjects were given oral hygiene instructions and were asked to return after 1 week. On this visit scaling and root planning (SRP) was performed, if this procedure could not be completed in a single appointment, they were recalled within 2 days to complete the treatment. The patients were then instructed to begin meticulous home care, brushing twice daily by the modified Bass method followed by rinsing with 0.2% chlorhexidine gluconate mouthwash. After 1 month from the date of performing SRP, blood sample was again collected for estimating CRP levels.

For both groups, nonfasting venous blood was collected in a plain vial for CRP estimation between 8.30 and 10.30 am. The samples were analyzed immediately, if not they were stored at 2–8°C, for a maximum of 1 week and analyzed then. The serum separated using centrifugation at 2000 rpm for 15 min were used for CRP level estimation.

CRP estimation was done in Quantitative automatic analyzer (Tulip Diagnostics(P) Ltd.), which is an interferential filter analyzer completely managed by microprocessors.

RESULTS AND OBSERVATION [TABLE 1-7]

The study population consisted of 40 patients with chronic generalized Periodontitis between 25 – 60 years of age which were grouped into study and control groups. The study group consisted of 9 males and 11 females and the control group were of 11 males and 9 females. The age distribution was <30 years, 30-40 years, 40-50 years and >50 years. Of the total 40 patients, 19 patients fall in the 40-50 age groups (47.5%). The mean age of patients in study group was 39 and that of control group of 38 years. Statistical analysis was done using Pearson Chi square and paired T test. Statistical significance was declared if 'p' value was found less than or equal to 0.05.There was no statically significant difference in age between the two groups.

The mean OHI value in the study group was 2.584 ± .2705 and in control group was 2.35± .328. In study group 19 patients (95%) fall in 'Fair' category and 1 patient in 'Poor'. No patient in control group full under poor category.

All subjects suffer from moderate to severe Periodontitis. The initial GI mean values in study group were 1.70 ± 0.289 and in control group were 1.73 ±0.262. There is no statistically significant difference between the initial GI value among study and controls. Moderate GI score was for 18 patients (60%) in control group and 17 patients (85%) in study group. Severe score was there for 2 patients (10%) in the control and 3 patients (15%) in the study group initllay. When post treatment values

Table 1: Distribution of age of subjects in control and study group

Age (years)	Group		Total
	Control	Study	
<30	1	3	4
30–40	9	5	14
40–50	8	11	19
>50	2	1	3
Total	20	20	20

Table 2: Sex distribution of subjects in Group I and II

Sex	Group	
	Control	Study
Male	11	9
Female	9	11

Table 3: Oral hygiene status of Group I and II

Oral hygiene status	Group		Total
	Control	Study	
Fair	20	19	39
Poor		1	1
Total	20	20	40

Table 4: Gingival index of Group I and II

Gingival index	Baseline		After 1 month	
	Control	Study	Control	Study
Mild	0	0		16
Moderate	18	17	18	4
Severe	2	3	2	0
Total	20	20	20	20

Table 5: CRP levels of Group I and II

Gingival index	Baseline		After 1 month	
	Control	Study	Control	Study
Low (<0–3 mg/l)	-	-	-	2
Normal (0.3–0.6 mg/l)	-	-	-	9
High (>0.6 mg/l)	20	20	20	9
Total	20	20	20	20

CRP: C-reactive protein

Table 6: Comparison between clinical and CRP values at baseline

Clinical parameters	Group	Mean	*t* value	*P* value
Baseline OHI	Control	2.33	−2.67	*P*<0.05
	Study	2.58		
Baseline gingival index	Control	1.73	0.29	*P*<0.05
	Study	1.70		
Baseline PPD (mm)	Control	3.57		
	Study	3.71		
Baseline CRP (mg/l)	Control	2.39		
	Study	2.64		

OHI: Oral hygiene index, CRP: C-reactive protein, PPD: Probing pocket depth

Table 7: Comparison between clinical and CRP values post-treatment

Clinical parameters	Group	Mean	*t* value	*P* value
Post R_x gingival index	Control	1.76	−2.67	*P*<0.05
	Study	0.85		
After 1 month - PPD	Control	3.56	0.29	*P*<0.05
	Study	2.85		
After 1 month - CRP (mg/l)	Control	2.40		
	Study	0.85		

CRP: C-reactive protein, PPD: Probing pocket depth

are compared after 1 month, group I showed a reduced value of 0.85 ± 0.20 and group II with 1.76 ± 0.268 which showed a very high significance.

The mean probing depth at base time in study group was 3.71±0.363 and in control group was 3.57 ±0.51. There was no statistically significant difference in probing pocket depth between two groups at base line.

Hematologic Parameters

The mean CRP levels in the group I initially was 2.64± 1.94 and that of group II were 2.39 ± 0.941. Both the patient in study (group I) and controls (group II) has the same degree of periodontal disease severity and hence there was no statistically significant difference at the base line.

Group I received debridement therapy and 0.2% the mouth washes twice daily and when CRP estimation is repeated the mean value was 0.85±0.66. The group II patients employed meticulous plaque controls measures by through brushing and 0.2% Chlorhexidine mouth wash twice daily for the prescribed time period. The mean CRP after 1 month for group II was 2. 40 ±0.96 and when compared with base line there's no significant of difference statically. Thus the group I shows significant reduction in post treatment CRP values compared to base line and this was statistically significant.

Total Count

Initial mean total count for group I was 8356.5 ± 1973.95 compared to 7686±1246 in the group II. There is no statistically significant difference seen between these values at base line. The final values for group I was 7623 ± 1221; showing a decrease of 733. While in group II the mean final value was 7751 ± 1222, showing a mean increase of 65. Both the changes were not statistically significant.

Polymorphs

Group I presented with the mean initial polymorph count of 62 ±8.7 and the group II with 56 ± 11.1. There's no difference in polymorph count between groups at base line. After 1 month the mean count for group I was 49±5.44 compared to 56.6 ± 7.9 in group I. The reduction in polymorph count after 1 month compared to base line in group I was highly significant statistically.

Lymphocytes

The patient in group I presented a mean lymphocyte count of 34. 65±9.32 at base line and group II with a mean of 39.9 ±10.78. One month post treatment value for group I is 43.8 ± 7.28 compared to 40.2 ± 8.33 for group II. Both the initial and final values were presented no significant differences.

Eosinophilis

Group I patient have the mean eosinophil count 3.85 ± 2.71 and group II patients with mean of 3.15 ± 2.20 at base line. After 1 month, when the post treatment values for group I ie, 4.2 ±3.96 compared to final value of group II 3.7 ± 3.43 there is no statistically significant difference found.

DISCUSSION

Periodontal disease is one of the most common infectious diseases in humans that result in the inflammatory destruction of the connective tissue components of the periodontium. The inflammatory response not only causes local tissue destruction and bone resorption but also a substantial systemic challenge, evident due to the noxious effects evoked by microorganism and their products. The effect includes procoagulant activity, reduced fibrinolysis, increased leukocyte adhesion, increased cytokine production, and ultimately enhanced low-density lipoprotein, and cholesterol deposition in the arterial wall.[4,5] The bacterial lipopolysaccharides and peptidoglycan fragments released into circulation lead to an increase in production of inflammatory cytokines such as prostaglandin E2, tumor necrosis factor alpha, and interleukin-1β[6-9] acute phase reactants including CRP,[10] fibrinogen, alpha 1 antitrypsin, and beta 2 macroglobulin. The increase in leukocyte count and factor VIII-von Willebrand's factors complex is also sometimes observed.

A total of 40 subjects diagnosed with chronic generalized periodontitis, according to the classification criteria by AAP - 1999 International Workshop were selected for the study and randomly listed into two groups - control (Group I) and study (Group II), each comprising 20 subjects. Of this 20 were males and 20 females. The mean age of Group I was 38.35 ± 6.29 years and Group II was 39.75 ± 7.57 years. The relationship between oral hygiene status, periodontal disease status, and

concomitant blood level of the systemic inflammatory marker the CRP was evaluated.[11] The effect of periodontal debridement therapy was assessed by analyzing the baseline and 1 month post-treatment blood values of CRP in the study group. Similarly, the efficiency of personal plaque control measures among the control group was evaluated by comparing the CRP blood levels taken at baseline and after 1 month observation period.

Keeping the above facts in view, the subjects of this study were assessed for their oral hygiene status by measuring the Debris index and Calculus index. The mean OHI in the study group was 2.58 ± 0.27 as compared to 2.33 ± 0.328 in the controlled group. The difference noted was statistically significant with $P < 0.05$. However, clinically there was no difference between oral hygiene status of the control and study group because both groups comprises subjects with the same disease process and fall in the category - Fair. Loesche *et al*.[12-16] supported that a high plaque score was found to be associated with an increased risk of coronary heart disease with a significance of 0.04.

Periodontal disease status was assessed by gingival index and probing depth. Gingival index reflects the severity of gingival inflammation and the disease activity at the time of observation. The baseline mean gingival index for the Group I was 1.73 ± 0.26 as compared to Group II which is 1.70 ± 0.28. Thus both have moderate gingivitis. Loesche *et al*.[15] suggested that higher levels of gingivitis as measured by papillary bleeding were significantly associated with coronary heart disease. This was contrary to prospective longitudinal study by De Stefano *et al.* who suggested that gingivitis did not increase the risk of coronary heart disease.

There were 18 patients (90%) in Group I and 17 patients (85%) in Group II who presented with moderate gingivitis score. Severe gingivitis score was found for 2 patients (10%) in Group I and 3 patients (15%) in Group II at baseline. After 1 month when post-treatment values were compared, Group II showed a reduced gingivitis score when compared to Group I, which was statistically very highly significant. The change in the mean glycemic index (GI) score among the Group II patients following periodontal therapy was similar to the finding of Ide *et al.*,[11] where the gingival scores were reduced ($P < 0.002$). This finding can be correlated to the suggestions of Loesche *et al*.[15] where the higher GI score was significantly associated with coronary heart disease as evident from the elevated CRP levels among the subjects with moderate GI score in the present study.

The mean baseline CRP value for Group II was 2.64 ± 1.94 and that of Group I was 2.35 ± 0.941. This value indicates an elevated level from the normal range of 0.1–0.7 mg/L. The mechanism of elevation in CRP levels for periodontitis patients as explained by Beek *et al.* and Di Napoli *et al*. was that monocytes might be hyper-responsive to bacterial antigens a phenomenon which might also be genetically determined. This hyper-responsive propensity had been postulated to contribute to elevated CRP levels subsequent to an infection or other pro-inflammatory stimuli.

After 1 month post-operative, mean CRP value for Group II was reduced to 0.85 ± 0.66 compared to 2.40 ± 0.96 in Group I. This reduction in CRP value for the Group II, who had undergone periodontal therapy is very highly significant (D´Aiuto *et al.*, Yamazaki *et al.*, Kimmo Mattila *et al.*).[18] Despite of practicing meticulous plaque control measures by thorough brushing and rinsing with 0.2% chlorhexidine mouthwash twice daily, Group I patients showed no improvement for CRP levels compared to baseline levels. This highlights the importance of periodontal debridement therapy as an efficient tool in the reduction of inflammatory conditions clinically as well as biochemically.[19] In a study by Ebersole, a mean CRP for localized periodontitis case was found lower than for generalized periodontitis cases.[19] Furthermore, very aggressive and rapid periodontitis case groups showed a mean of 9 mg/dl compared to 2 mg/dl in control.

The control Group I showed no significant change in CRP values after 1 month in this study. Even though these subjects were practicing meticulous brushing and rinsing with 0.2% chlorhexidine mouthwash twice daily, only a slight GI score reduction for individual cases was observed. As the infective focus was left intact by this non-interventional procedure, the CRP levels remain unchanged for Group I. Moreover, some case showed even a slight elevation of CRP levels than from baseline although these changes were not statistically significant.

CRP is produced by hepatocytes in response to interleukin-6 stimulation.[20] CRP must be regarded primarily as a surrogate marker for cytokine-mediated inflammation, and there is sound experimental and pathogenic basis that these molecules are directly involved in the various process of atherogenesis.[21] CRP may also act as a procoagulant which induces the tissue factor in monocytes. CRP is found in vessel wall even in the very early stage of plaque formation[22] and is chemotactic for monocytes[23] and avidly binds to human neutrophils. It induces compliment activation and enhances tissue injury via this mechanism.[24]

CONCLUSION

The present comparative study was undertaken to evaluate the effectiveness of periodontal debridement over the personal plaque control measures in the level of systemic markers in patients with chronic periodontitis.

Following conclusion were made:

1. In chronic periodontitis patients, elevated levels of C reactive protein were observed.
2. Periodontal debridement therapy can be employed as

an effective tool in reducing the level of elevated CRP.
3. From this study, it can be confirmed that debridement therapy gives excellent results in reducing the level of elevated systemic inflammatory markers compared to personal plaque control measures.

It is natural to conclude that since CRP appears to be a strong and significant risk factor for CVD, reducing the blood level of this protein is obviously beneficial. However, this is a fallacious line of reasoning. In fact, there are no large intervention studies specifically linking CRP with adverse cardiovascular events as endpoints, where there is no question regarding other actions associated with the intervention that might reduce events, independent of the reduction by CRP.

In this study, the elevated levels of CRP in periodontitis, points toward the conclusion that the host resistance of the patient is stimulated by varying degrees of infection. This could probably be due to the various possible etiologic factors causing this infection.

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