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Serum lipid levels and periodontal status – is there any correlation

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Abstract

Periodontitis is an inflammatory disease of the supporting tissues of the tooth in response to infection caused by the gram-negative, anaerobic bacteria that colonizes the subgingival area. Localised infections characteristic of periodontitis has been found to affect the systemic health of humans, by inducing profound changes in the plasma concentrations of cytokines and hormones, that leads to an altered lipid metabolism. The aim of the present study is to evaluate the serum lipid levels in periodontitis patients and find any correlation among the two. A total of 60 patients were selected in the present study. The cases were divided into mild, moderate and severe periodontitis groups, each having 15 patients.15 healthy controls were also selected. Blood samples were drawn from each of them and sent to lab for lipid profiling to evaluate the serum lipid levels. On evaluation, it was found that the subjects with periodontitis exhibited higher serum levels of total cholesterol (p=0.001), low density lipoprotein (p=0.003),

very low density lipoprotein (p=0.003) and triglycerides (p=0.004) and low levels of serum high density lipoprotein (p=0.002) than the healthy control group subjects. The result suggested a possible link between severe periodontitis and a hyperlipidemia in otherwise healthy persons. Severe periodontitis patients has highest levels of the serum lipids (TC, LDL, VLDL and TG) and low HDL levels when compared with mild, moderate periodontitis and healthy controls, indicating that it is directly proportional to the severity of the disease.

Keywords: Serum lipids, Triglycerides, Cholesterol, Periodontitis, Inflammation.

Introduction

Periodontal diseases are group of inflammatory diseases caused by anaerobic, gram negative microorganisms present on the tooth surface. PERIODONTITIS is the most encountered periodontal disease, characterized by a progressive gingival inflammatory response to the bacteria that eventually leads to loss of the teeth.[1] These bacteria produce endotoxins in the form of Lipopolysaccharides (LPS)[2] which enter the gingival tissues leading to an inflammatory reaction resulting in high levels of cytokines which destroys the periodontal ligament and alveolar bone.[3]

The proinflammatory cytokines produced mainly are Tumour Necrosis Factor- Alpha (TNF – α), Interleukin 1 beta (IL-1β) and Interleukin 6 (IL-6).[4,5] They act by increasing the mobility of lipids from liver and adipose tissues [6] and binding of low-density lipoprotein (LDL) to the endothelium and to smooth muscles. [7] Also, there is oxidative modification of LDL, which is responsible for increased cholesterol accumulation as the modified LDL is more susceptible for uptake by the macrophages.[8]

Earlier, it was believed that the periodontal infections were localised only in the periodontium.[24] However, now it is believed that they also relates to the humoral and cellular immunity system.[10] The relationship between periodontitis and hyperlipidemia can be established with increased risk of cardiovascular system diseases because of the presence of infection related mediators, that ultimately leads to atherosclerosis, initiated in the form of an atherosclerotic plaque due to the focal accumulation of lipids, particularly LDL and cholesterol in the arterial wall.

Therefore, the state of hyperlipidemia is considered to be one of the many major risk factors for heart diseases.[11] A study was also done to reveal that on consumption of a high fat diet, periodontitis can be induced.[12]

It has also been noticed that after the treatment of periodontitis, the serum activity of lipoprotein-associated risk factor for CVS disease is significantly reduced[13] . Therefore, the periodontal health status also affects the lipid metabolism in our body.

The present study aimed to evaluate the serum lipid levels in adults with periodontitis.

Materials and method

The present observational study was performed on selected patients who fulfilled the following inclusion criteria: Either sex (Male/Female), systemically healthy subjects, patients diagnosed with chronic periodontitis with minimum 20 teeth present with 4 sites fulfilling the following criteria[14] :

a) Mild periodontitis: Probing depth (PD) - ≥3 mm and ≤ 5 mm.

Clinical Attachment Level (CAL) – 1 to 2 mm.

b) Moderate periodontitis: Probing depth (PD) - ≥5 mm and ≤ 7 mm.

Clinical Attachment Level (CAL) – 3 to 4 mm.

c) Severe periodontitis: Probing depth (PD) - ≥7 mm.

Clinical Attachment Level (CAL) ≥ 5 mm.

The patients with any systemic diseases like diabetes mellitus, cardiovascular diseases, renal diseases, cancer etc., pregnant and lactating women, smokers, alcoholics and those who used antibiotics or any drug that affects the periodontal status in past 6 months were excluded from this study.

Study subjects

A total of 60 subjects were enrolled and their blood samples were collected for the estimation of their lipid profile that included serum cholesterol, serum High Density Lipoprotein, serum Low Density Lipoprotein, serum Very Low-Density Lipoprotein and serum triglycerides level.

Study groups

The subjects were categorised into the following four groups on the basis of examination:

Group 1 (15 Mild periodontitis patients)

Group 2 (15 Moderate periodontitis patients)

Group 3 (15 Severe periodontitis patients) and

Group 4 (Control group that included 15 healthy patients without any periodontal conditions such as visible plaque, bleeding on probing and clinical attachment loss).

Evaluation parameters

A case sheet was used to record the information from the patient that included his basic information. The oral cavity was examined and all the patients with periodontitis were selected to be a part of the study. The indices used in this study for the evaluation of periodontitis included:

1. **Plaque index:** Developed by Silness and Loe in 1964 for scoring the plaque. [15]

2. Modified gingival index: Developed by Lobene et al in 1986 for assessing the severity of gingivitis[15].

3. Pocket probing depth: It is the distance between gingival margin and bottom of the pocket assessed using a UNC 15 Periodontal probe.

4. Clinical attachment level: It is defined as the distance from CEJ to the base of the pocket. It was measured using UNC 15 Periodontal probe.

Blood sampling

As the intent of the study was to evaluate the serum lipid level, 2.5 ml blood sample of the patient was drawn by venous puncture from the antecubital vein with a sterile syringe and was then transferred into a test tube, left undisturbed in the standing position and allowed to clot at room temperature for 30 minutes before centrifugation. The sample was then centrifuged for 15 minutes at 3000 rpm to separate the serum from blood, which was then collected with the help of a clean pipette in plain tube labelled by the patient's name, age, gender and date and kept in deep freezer till used for subsequent biochemical analysis of serum lipid profile.

Statistical analysis

The data collected was sent for the statistical analysis which was done using SPSS. The comparison of study parameters among the four study groups was done using **Analysis of Variance (ANOVA)**, followed by **post-hoc Tukey's test** for multiple comparisons. The level of significance for the present study was fixed at a p-value of less than 0.05.

Results and Discussion

On comparison of serum **total cholesterol (TC)** levels, it was seen that TC levels were highest in Group 3, followed by Group 2, Group 1 and the least in Group 4. Statistically significant difference in TC level was observed between Group 3 and Group 4 ($P<0.001$). **(Table 1).**

On comparison of serum **high-density lipoprotein (HDL)** levels, it was observed that HDL levels were

highest in the Group 4, followed by Group 2, Group 1 and were least in Group 3. Statistically significant difference in HDL level was seen between Group 1 and Group 3 (P=0.009), Group 2 and Group 3 (P=0.000) and Group 3 and Group 4 (P=0.000) **(Table 2).**

On comparison of serum **low-density lipoprotein (LDL)** levels, it was observed that LDL levels were highest in Group 3, followed by Group 2, Group 1 and least in Group 4. Statistically significant difference in LDL level was noticed between Group 3 and Group 4 (P=0.001) **(Table 3)**.

On comparison of **very low-density lipoprotein (VLDL)** levels, it was observed that VLDL levels were highest in Group 3, followed by Group 1, Group 2 and least in Group 4. Statistically significant difference of the mean VLDL level was observed between Group 1 and Group 4 (P=0.031), Group 2 and Group 4 (P=0.38) and Group 3 and Group 4 (P=0.001) **(Table 4)**.

On comparison of the serum **triglycerides (TG)** levels, it was seen that TG levels were highest in Group 3, followed by Group 2, Group 1 and least in Group 4. Statistically significant difference of the mean TG level was seen between Group 1 and Group 4 (P=0.046), Group 2 and Group 4 (P=0.044) and Group 3 and Group 4 (P=0.003) **(Table 5).**

On comparison of serum total cholesterol levels, it was observed that they were highest in Group 3, followed by Group 2, Group 1 and the least in Group 4. (Table 1).

This result is in accordance with a study done by **Loesche et al (2000)**[3], where they observed that compared to controls, subjects with periodontitis had higher plasma levels of TC, LDL cholesterol and TG. They attributed this to the fact that the increased production of various pro inflammatory cytokines at the inflamed periodontal tissue site which are known to interfere with lipid metabolism.

Joseph Katz et al (2002)[16] conducted a cohort study to evaluate the association between the presence of periodontal pockets and elevated blood lipid levels and said that the presence of periodontal pockets (Periodontitis) has a positive relationship with the TC and LDL cholesterol levels in men. They attributed this positive relation to the presence of pathogenic microorganisms harbouring in the periodontal pockets.

Athough there is a compelling evidence to support the positive relationship between periodontitis and hyperlipidemia, including this current study, certain studies has also reported contrary findings.

Machado A C et al (2005)[17] performed a study to verify the relationship between severe and moderate periodontal disease and blood lipid levels. They concluded that even though mean levels of TC and TG in periodontitis patients were higher than in controls, but the result was not statistically different. Therefore, they concluded that there is no significant relationship between periodontal disease and blood lipid levels.

In the same year, another group, **Giedre Valentaviciene et al**[18] also established that there is no difference in the blood serum concentration of total cholesterol, triglycerides, HDL cholesterol, and LDL cholesterol between people with healthy periodontium and those with gingivitis or periodontitis, thus contradicting the present study's result.

On comparison of serum high density lipoprotein levels, it was observed that they were highest in the Group 4, followed by Group 2, Group 1 and were least in Group 3 (Table 2).

Certain studies have been done which showed similar findings. **Nibali et al (2007)**[1] in their study demonstrated lower HDL cholesterol levels in periodontitis cases than in healthy controls. **Johansson et al (1994)**[19] reported that low HDL was associated

with total tooth loss, independently of smoking and other cardiovascular risk factors. Another study by **Wakai et al (1999)**[20] suggested that lower serum HDL was associated with a higher Community Periodontal Index of Treatment Needs score, i.e. periodontitis patient.

On comparison of serum low density lipoprotein levels, it was found that they were highest in Group 3, followed by Group 2, Group 1 and least in Group 4. (Table 3).

This was in accordance with a study done by **Nibali et al (2007)**[1] where they demonstrated higher LDL cholesterol and lower HDL cholesterol levels in periodontitis cases than in healthy controls. **Joseph katz et al (2002)**[16] after completion of their study, stated that there is a positive association between the serum LDL cholesterol levels and periodontitis. **Ramesh et al(2010)**[21] also concluded that there are higher LDL levels in periodontitis patients than in controls and they observed pro-atherogenic changes in plasma lipids and blood glucose levels in periodontitis patients, which may provide some evidence for the association between periodontitis and cardiovascular disease.

However, a study done by **Biju Thomas et al** in 2017[22] indicated that there is no significant positive relation between the presence of periodontitis and high LDL levels in serum, thus going against the result of the present study.

On comparison of very low density lipoprotein levels, it was observed that they were highest in Group 3, followed by Group 1, Group 2 and least in Group 4. (Table 4).

The result show a consistency with the results of a previously done study by **Biju Thomas et al**[22] in the year 2017, in which they observed that higher serum VLDL levels are there in periodontitis patients when compared with healthy controls.

On comparison of the serum triglyceride levels, it was seen that they were highest in Group 3, followed by Group 2, Group 1 and least in Group 4 (Table 5).

This result can be supported by a study done by **Cutler C W et al (1999)**[2] where they examined the relationship between periodontitis and hyperlipidemia in patients and concluded that there is a significant positive relationship between the presence of periodontal disease and elevated serum levels of triglycerides and IgG antibody against P. gingivalis LPS. **Moeintaghavi et al (2005)**[23] also confirmed the positive association between periodontitis and higher TG levels in serum in their study.

On the contrary, **Joseph katz et al (2002)**[16] found that even though there were higher serum TG levels among the periodontitis patients, their relation was not statistically significant. **Machado A C et al (2005)**[17] also concluded that there is no statistically significant relationship between the serum TG levels and periodontitis status of an individual.

In the present study, higher level of lipids and the lower HDL levels among the case groups as compared to the control group is indicative of the fact that periodontitis can alter the lipid metabolism increasing the serum TC, LDL, VLDL, TG levels and decreasing the HDL levels, thus causing a state of dyslipidaemia in patients, and this is more evident in case of severe periodontitis patients.

Table 1. Intergroup comparisons for the mean TC levels of different groups.

Group	Group	Mean Difference	P value	95% Confidence Interval	
				Lower Bound	Upper Bound
Mild Periodontitis	Moderate Periodontitis	1.86667	.999	-35.9904	39.7237
Mild Periodontitis	Severe Periodontitis	-30.66667	.152	-68.5237	7.1904
Mild Periodontitis	Control	30.66667	.152	-7.1904	68.5237
Moderate Periodontitis	Severe Periodontitis	-32.53333	.116	-70.3904	5.3237
Moderate Periodontitis	Control	28.80000	.195	-9.0571	66.6571
Severe Periodontitis	Control	61.33333*	<.001*	23.4763	99.1904

*Statistically significant (P<0.05, Tukey's post-hoc test)

Table 2. Intergroup comparisons for the mean HDL levels of different groups.

Group	Group	Mean Difference	P value	95% Confidence Interval	
				Lower Bound	Upper Bound
Mild Periodontitis	Moderate Periodontitis	-0.4000	0.944	12.3966	-13.1966
Mild Periodontitis	Severe Periodontitis	13.2667	0.009*	0.5367	26.1299
Mild Periodontitis	Control	-5.4667	0.368	-18.2633	7.3299
Moderate Periodontitis	Severe Periodontitis	13.6667	0.000*	0.9367	26.5299
Moderate Periodontitis	Control	-5.0667	0.307	-17.8633	7.7299
Severe Periodontitis	Control	-18.7333	0.000*	6.0034	31.5966

*Statistically significant (P<0.05, Tukey's post-hoc test)

Table 3. Intergroup comparisons for the mean LDL level of different groups.

Group	Group	Mean Difference	P value	95% Confidence Interval	
				Lower Bound	Upper Bound
Mild Periodontitis	Moderate Periodontitis	-.26667	1.000	-29.7483	29.2150
Mild Periodontitis	Severe Periodontitis	-24.86667	.127	-54.3483	4.6150
Mild Periodontitis	Control	19.40000	.312	-10.0816	48.8816
Moderate Periodontitis	Severe Periodontitis	-24.60000	.133	-54.0816	4.8816
Moderate Periodontitis	Control	19.66667	.300	-9.8150	49.1483
Severe Periodontitis	Control	44.26667*	.001*	14.7850	73.7483

*Statistically significant (P<0.05, Tukey's post-hoc test)

Table 4. Intergroup comparisons for the VLDL level of different groups.

Group	Group	Mean Difference	P value	95% Confidence Interval	
				Lower Bound	Upper Bound
Mild Periodontitis	Moderate Periodontitis	.40000	1.000	-12.3966	13.1966
Mild Periodontitis	Severe Periodontitis	-5.06667	.722	-17.8633	7.7299
Mild Periodontitis	Control	13.73333*	.031*	.9367	26.5299

Moderate Periodontitis	Severe Periodontitis	-5.46667	.672	-18.2633	7.3299
Moderate Periodontitis	Control	13.33333*	.038*	.5367	26.1299
Severe Periodontitis	Control	18.80000*	.001*	6.0034	31.5966

*Statistically significant (P<0.05, Tukey's post-hoc test)

Table 5. Intergroup comparisons for the mean TG level of different groups.

Group	Group	Mean Difference	P value	95% Confidence Interval	
				Lower Bound	Upper Bound
Mild Periodontitis	Moderate Periodontitis	-.33333	1.000	-64.0197	63.3530
Mild Periodontitis	Severe Periodontitis	-22.86667	.778	-86.5530	40.8197
Mild Periodontitis	Control	64.53333*	.046*	.8470	128.2197
Moderate Periodontitis	Severe Periodontitis	-22.53333	.785	-86.2197	41.1530
Moderate Periodontitis	Control	64.86667*	.044*	1.1803	128.5530
Severe Periodontitis	Control	87.40000*	.003*	23.7137	151.0863

*Statistically significant (P<0.05, Tukey's post-hoc test)

Conclusion

Within the limit of this study, on comparing the lipid profiles among the four groups, it was seen that severe periodontitis patients (Group 3) had highest levels of the serum lipids when compared with rest of the groups indicating that periodontal status have a positive correlation with the serum lipid levels in a person. However, it cannot yet be confirmed if periodontitis causes elevation of the lipids, or high levels of lipid makes a person more prone to the development of periodontitis. More longitudinal studies are needed to be done to shed some clear light upon this in detail.

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