Association of Serum Lipid Profile and Chronic Periodontitis: A Case Control Study

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Abstract**—***Periodontal disease is a destructive inflammatory disease inducing profound changes in the plasma concentrations of cytokines leading to a catabolic state characterized by altered lipid metabolism and hypertriglyceridemia. This study was conducted with the aim find out association of chronic periodontitis with serum lipid parameters. Study group consist of 30 cases of chronic periodontitis (case group) and control group consist of 30 healthy individuals. Age range was kept 25-60 years to avoid extreme ages. Periodontal parameters including Plaque Index, Gingival Index, Probing Depth and Clinical Attachment Level were recorded. Lipid profile comprising of total cholesterol, Triglycerides, HDL- Cholesterol and LDL was assessed and co related with periodontal parameters. This study confirms significantly higher levels of mean cholesterol, triglycerides and LDL in periodontitis group as compared to healthy group. Also, there is significant negative co relation of HDL with probing depth and clinical attachment loss. Association of hyperlipidemia and chronic periodontitis is evident in developed state of disease. With this study, this relation is confirmed based on Factor and Outcome.*

Keywords— Periodontal disease, Serum Lipid Profile, probing pocket depth, clinical attachment level

I. INTRODUCTION

Chronic inflammatory periodontal disease represents a primarily gram negative anaerobic oral infection that leads to gingival inflammation destruction of periodontal tissues, loss of alveolar bone and eventual exfoliation of teeth in severe cases. The microorganisms that are considered major etiologic agents of periodontitis particularly Porphyromonas gingivalis produce endotoxins in the form of lipopolysaccharides (LPS) that are instrumental in generating a host mediated tissue destructive immune response[1,2].

Hyperlipidemia is a condition where there is an elevation of the serum levels of total cholesterol and triglycerides due to lipid metabolism alteration with an increase in the liver lipogenesis and lipolysis in the adipocytes. TGL are the glycerol esterified at each of its three hydroxyl groups by a fatty acid and are most abundant lipids comprising 85-90% of body lipids. Cholesterol is the most abundant steroid in animal tissues, especially food rich in animal fats circulates in the plasma complexed to proteins of various densities and plays an important role in the pathogenesis of atheroma formation in the arteries, a precursor of steroid hormones.LDL is the compound containing both lipid and protein, which transport cholesterol to tissues other than the liver.HDL is the compound containing both lipid and protein, which transport cholesterol to the liver for excretion in the bile[3].

Lipids may interact directly with the macrophage cell membrane, interfering with membrane bound receptors and enzyme systems and altering macrophage gene expression for essential polypeptide

growth factors and pro inflammatory cytokines such as Interleukin-I Beta and Tumor Necrosis Factor Alpha which are believed to be associated with periodontal disease[4].

There have been several pro-inflammatory cytokines implicated in the immunopathology of periodontitis however some of the most convincing evidence for destruction of periodontium involves IL-1β and TNF-α. These cytokines are significantly elevated in diseased periodontal ligament sites demonstrating inflammation and during periods of active tissue destruction[5].

Recently, a causal relation has been demonstrated between high serum lipid levels and periodontal disease. Recent studies illustrate the existence of a relation between periodontal disorders and hyperlipidemia, which power the probable effect of periodontal disease as an underlying factor for hyperlipidemia. This theory is presented in Loesche et al[6] study, which demonstrated higher level of TGL and lower HDL among the patients suffering from periodontitis than control group significantly, which was approved by some other studies[6-9]. Various studies have shown that P. Gingivalis can invade deep connective tissues/ vascular endothelium associated with the periodontium can be found within vascular pathological plaques and can elicit circulating antibody response[10]. This suggests that even in localised oral infection, such as periodontitis the potential exists for chronic low level systemic exposure to microorganisms/ LPS leading to generalised alteration in lipid metabolism.

Thus, it has been stated that a relationship exists between chronic periodontitis and hyperlipidemia that involves inflammatory response to LPS from periodontal pathogens such as Porphyromonas gingivalis[7.]

Therefore to further elucidate this association, this case-control type of study was conducted by comparing the levels of serum lipid parameters in periodontally diseased patients and healthy individuals.

II. METHODOLOGY

The present case-control study was done in Department of Periodontology and Oral Implantology in Rajasthan Dental College and Hospital, Jaipur. This case-control type of study was conducted on 30 patients with periodontitis were labeled as “Study Group” attended at hospital attached to supra said institute and 30 healthy individuals labeled as "Control Group" from attendants of patients were included in study.

Sample size was calculated 24 subjects for each group at 80 % study power and alpha error of 0.05 assuming minimum detectable difference in means 30 with SD 35.96 for LDL Cholesterol as observed in the study of Sharma et al[11] So for the study purpose 30 cases and 30 controls were taken.

Before proceeding further approval from Institutional Research Board and Ethical Committee of Rajasthan University of Health Sciences was taken for this present study. The study followed ethical guidelines as per Declaration of Helsinki and Good Clinical Practices.

Controls were having no recession, minimal probing depth and mean clinical attachment loss and they were matched with cases with respect to age, sex, body mass index, dietary habits and number of teeth. Body Mass Index was assessed by dividing weight (in kilograms) by (height) in meters.

All individuals were ranged between 25-60 years and any of subject having history for any systemic infection, systemic antibiotic treatment and history of drug treatment for dyslipidemia was excluded from study. None of the patients of both the groups were using tobacco in any form. Pregnancy was also excluded.

After obtaining informed written consent from all eligible study participants, a detailed medical history both general and oral was carried out on all patients at the first visit. Standard clinical periodontal parameters including bleeding on probing (Gingival index), Plaque detection (Plaque Index) and clinical attachment loss were measured using a mouth mirror, an explorer and a University of North Carolina (UNC-15) probe.

Enzymatic analysis of triglycerides , HDL and cholesterol levels was done in Department of Oral Pathology, Rajasthan Dental College and Hospital, Jaipur using venous blood samples that were obtained after 12 hours fasting period from ante cubital vein. LDL Cholesterol was assessed by Fridewald et al formula in which LDL = TC – (HDL + TG/5) According to laboratory's recommendation, normal values were taken as follows[12] –

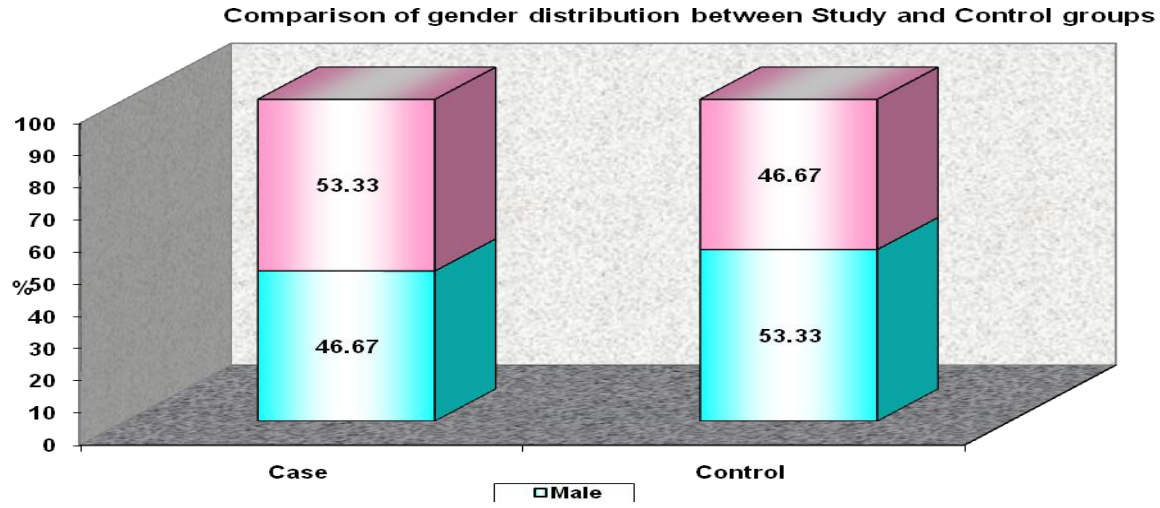
S. No.	Name of Enzyme	Normal Range Accepted
1	**Cholesterol**	130-220 mg/dl
2	**Serum triglycerides**	30- 150 mg/dl
3	**HDL**	Male: 50 -95 mg/dl Female: 65 -95 mg/dl
4	**LDL**	70-150 mg/dl

All data thus obtained was entered in MS Excel worksheet 2007 as master chart. Continuous variables were summarized as mean and standard deviation while normal/ categorical variables as percentages. Unpaired 't' test was used for comparison of continuous variables while Chi-square test was used for normal/ categorical variables. P value < 0.05 was taken as significant.

III. RESULTS

Out of total 30 patients, 16 (53.33%) were females whereas in Control group females were 14 (46.67%) but this difference in distribution of males and females in study and control group was not found significant (p=0.796). (Figure 1)

Figure: 1



Chi-square Test = 0.067 with 1 degree of freedom; **P = 0.796** **LS=NS**

When Study and Control groups were compared in other personal characteristics like age and BMI, it was found that although study group and control group had mean age 39.67 and 36 years respectively but this difference in mean age in study and control group was not found significant (p=0.065). Likewise although study group and control group had mean BMI 21.68 and 22.31respectively but this difference in mean BMI in study and control group was not found significant (p=0.187). (Table 1)

Table No. 1

Comparison of Quantitative Personal characteristics of Study and Control Group

Variables	Group	N	Mean	Std. Deviation	Std. Error Mean	t-value	P' value	Level of significance
Age	**Case**	30	39.67	7.63	1.39	2.90	0.065	**NS**
	Control	30	36.00	7.49	1.37			
BMI	**Case**	30	21.68	1.70	0.31	1.335	0.187	**NS**
	Control	30	22.31	1.99	0.36			

***Unpaired 't'Test**

When Study and Control groups were compared in clinico-dental characteristics, it was found that there was significant (p<0.001) difference in all the clinico-dental characteristics studied in this study i.e. PI, GI, PD, R and CAL. So it can be depicted that both the group were having significant (p<0.001) difference in clinico-dental characteristics i.e. clearly one group is with periodontitis (Study group) and other group is with normal range of clinico-dental characteristics (Control Group). (Table 2)

Table No. 2

Comparison of Clinico-Dental Characteristics of Study and Control Group

Variables	Group	N	Mean	Std. Deviation	Std. Error Mean	*t-value	P value	Level of significance
PI	**Case**	30	2.51	0.29	0.05	32.32	<0.001	**S**
	Control	30	0.70	0.09	0.02			
GI	**Case**	30	2.46	0.19	0.04	38.40	<0.001	**S**
	Control	30	0.74	0.15	0.03			
PD	**Case**	30	6.60	1.13	0.21	31.92	<0.001	**S**
	Control	30	0.00	0.00	0.00			
R	**Case**	30	1.13	0.73	0.13	8.50	<0.001	**S**
	Control	30	0.00	0.00	0.00			
CAL	**Case**	30	7.73	1.28	0.23	32.97	<0.001	**S**
	Control	30	0.00	0.00	0.00			

*Unpaired't'test PI= Plaque Index GI= Gingival index

When association between serum lipid profile and Periodontitis was observed it was found that study group have significantly (p<0.001) higher level of lipid profile than control group. That means periodontitis cases have significantly higher level of all the variables of lipid profile studied except for HDL i.e. Cholesterol, Triglycerides and LDL than normal healthy individuals. (Figure 2 & Table 3)

Figure 2

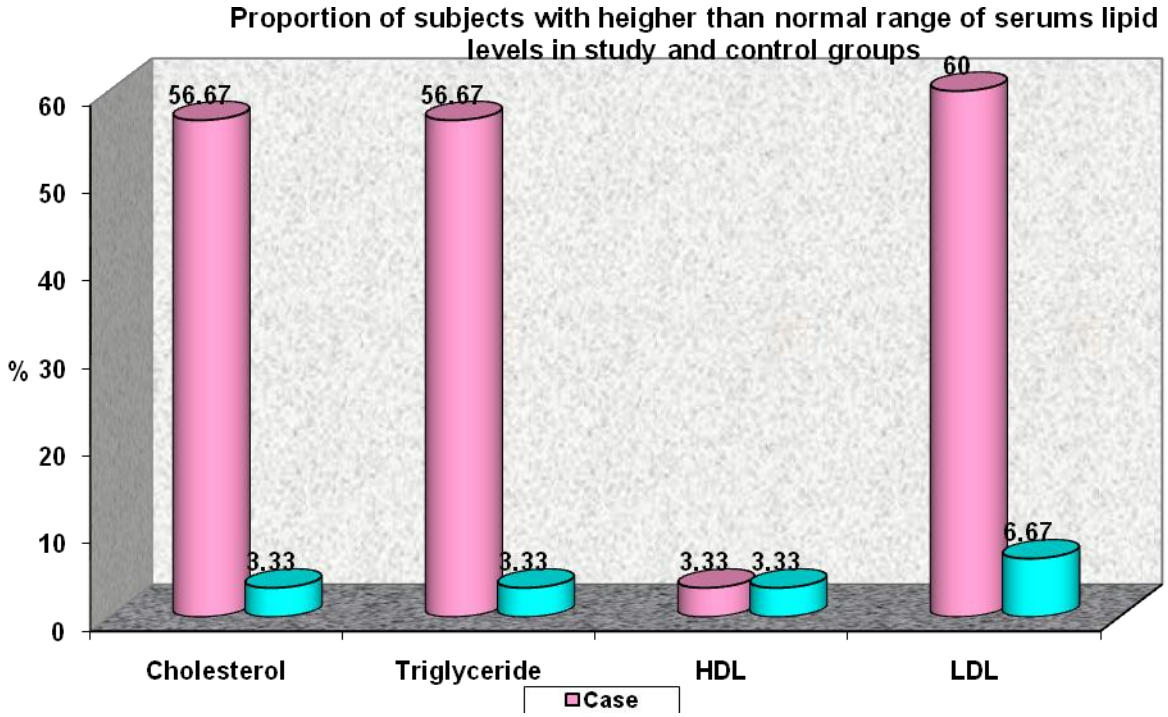


Table No. 3

Comparison of Serum Lipid Profile of Study and Control Group

Variables	Group	N	Mean	Std. Deviation	Std. Error Mean	*t-value	P value	Level of significance
Cholesterol	**Case**	30	224.57	21.44	3.91	6.74	<0.001	**S**
	Control	30	182.70	26.43	4.82			
Triglycerides	**Case**	30	143.63	39.81	7.27	6.21	<0.001	**S**
	Control	30	89.97	25.57	4.67			
HDL	**Case**	30	77.80	10.58	1.93	0.91	0.365	**NS**
	Control	30	75.23	11.18	2.04			
LDL	**Case**	30	146.77	23.49	4.29	6.18	<0.001	**S**
	Control	30	107.50	25.70	4.69			

*Unpaired't'test

Present study also revealed that PI and GI were positively co related with LDL and Cholesterol but negatively co related with triglycerides and HDL although none of these co relations were statistically significant. But this study also found that there is significant negative co relation of HDL with probing depth and mean clinical attachment loss. (Table 4)

Table 4

Correlation Matrix of Variables under Study (Number of Pairs (N)=30 for each)

Variables		Age	Cholesterol	Triglycerides	HDL	LDL	PI	GI	PD	R	CAL
Age	*r	1	0.145	0.074	-0.118	0.186	0.009	0.117	0.14	0.114	0.188
	**p		0.444	0.696	0.536	0.326	0.963	0.537	0.461	0.55	0.321
Cholesterol	*r	0.145	1	-.377*	0.044	.893**	0.126	0.132	0.122	-0.038	0.086
	**p	0.444		0.040	0.819	<0.001	0.507	0.486	0.521	0.842	0.652
Triglycerides	*r	0.074	-.377*	1	0.12	-.398*	-0.327	-0.311	-0.184	0.137	-0.084
	**p	0.696	0.040		0.529	0.029	0.077	0.094	0.331	0.471	0.658
HDL	*r	-0.118	0.044	0.12	1	-.411*	-0.246	-0.31	-.442*	-0.104	-.448*
	**p	0.536	0.819	0.529		0.024	0.190	0.096	0.015	0.586	0.013
LDL	*r	0.186	.893**	-.398*	-.411*	1	0.226	0.26	0.31	0.012	0.28
	**p	0.326	<0.001	0.029	0.024		0.231	0.165	0.095	0.950	0.134
PI	*r	0.009	0.126	-0.327	-0.246	0.226	1	.884**	0.123	-0.215	-0.014
	**p	0.963	0.507	0.077	0.190	0.231		<0.001	0.516	0.254	0.943
GI	*r	0.117	0.132	-0.311	-0.31	0.26	.884**	1	0.214	-0.354	-0.013
	**p	0.537	0.486	0.094	0.096	0.165	<0.001		0.257	0.055	0.946
PD	*r	0.14	0.122	-0.184	-.442*	0.31	0.123	0.214	1	-0.1	.825**
	**p	0.461	0.521	0.331	0.015	0.095	0.516	0.257		0.599	<0.001
R	*r	0.114	-0.038	0.137	-0.104	0.012	-0.215	-0.354	-0.1	1	.480**
	**p	0.550	0.842	0.471	0.586	0.950	0.254	0.055	0.599		0.007
CAL	*r	0.188	0.086	-0.084	-.448*	0.28	-0.014	-0.013	.825**	.480**	1
	**p	0.321	0.652	0.658	0.013	0.134	0.943	0.946	<0.001	0.007	
	N	30	30	30	30	30	30	30	30	30	30

r= Corr. Coeff. Correlation is significant at the 0.05 level (2-tailed) **p="P" Value

IV. DISCUSSION

In this study personal characteristics like age, sex and BMI were statistically comparable in both the groups i.e. study and control groups. These subjects of study group was significantly different in clinico-dental characteristics only i.e. mean GI was 2.46 in case group which was significantly higher than control group and mean PI of case group was 2.51 which was 0.77.

Mean cholesterol in present study was 224.57 mg/dl in case group where as it is only 182.70 mg/dl in control group. This difference was found statistically significant. Poussin et al[13] reported that patients with periodontitis had higher levels of lipo-polysaccharides and cholesterol compared with control patients. In addition, the case group had higher levels of HDL and also had a higher HDL/LDL ratio. It was suggested that periodontal disease had caused activation of macrophages through increase of lipopolysaccharides and decrease of LDL levels. In the present study, the triglyceride in the case group was 143.63 mg/dl which was significantly higher than the controls (89.96 mg/dl). Loesche W et al[6] determined a significant association between periodontal conditions and the concentration of triglycerides in blood.

Similarly, LDL in case group was 146.77 mg/dl while that in control was only 107.50 mg/dl which was significantly high. This was also seen in a study done by Sharma et al[11] where frequency of persons with pathologic values of LDL cholesterol was significantly higher in periodontitis patients compared with that of the controls.

The mean HDL of case group was 77.80 mg/dl which was higher than that of control group that is 77.23 mg/dl. However, this difference was not found statistically significant.

Krause S[14] et al also found that hyperlipidemia causes hyperactivity of white blood corpuscles. It was determined that hyperactivity of white blood cells (e.g. increased production of oxygen radicals) may be associated with development of periodontitis in adults.

Present study also found that PI and GI were positively co related with LDL and Cholesterol but negatively co related with triglycerides and HDL although none of these co relations were statistically significant. These findings are in accordance with Sharma et al[11] who also found that LDL and cholesterol increases as PI and GI increases.

This study also found that there is significant negative co relation of HDL with probing depth and mean clinical attachment loss. Cutler CW[12] in their article, stated that there exists a close relationship between damage to the periodontium, increased concentration of lipids in blood, and the presence of *Porphyromonas gingivalis* antibodies. Although the studied sample was small (26 people), this study showed that higher triglyceride levels might modulate the production of IL-Ib polymorphonuclear leukocytes, stimulated by *P. Gingivalis.* Noack et al[15] assessed neutrophil respiratory burst by whole blood chemiluminescence and they found significant increase in both chemiluminescence and pocket depth on a group of patients with hyperlipidemia. They suggested that association of hyperlipidemia with periodontitis could be due to the dysfunction of polymorphonuclear leukocytes. While the etiology of hyperlipidemia is multi-factorial, it is suggested to do true experimental design research to exactly confirm the effect of chronic periodontitis.

V. CONCLUSION

It can be depicted that cases of periodontitis have significantly higher levels of cholesterol, triglycerides and LDL as compared to normal healthy individuals. It was also depicted that there is significant negative co relation of HDL with probing depth and clinical attachment loss.

CONFLICT OF INTEREST

None declared till now.

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