Association between Periodontitis and Cardiovascular Diseases: A Clinicobiochemical Study

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Research Article

Abstract: **Introduction**: The periodontal tissues mount an immune inflammatory response to bacteria and their products and the systemic challenge with these agents also induce a major vascular response. Oral infection models have emerged as useful tools to study the hypothesis that infection is a cardiovascular disease (CVD) risk factor. Periodontal infections are a leading culprit, with studies reporting associations between periodontal disease and CVD. **Material and Methods**: The study was conducted on a group of 50 individuals aged 30 to 65 years, divided in five different groups depending on the type of cardiovascular disease diagnosed. These five groups were: Ischemic heart disease, bacterial endocarditis, Congestive cardiac failure, valvular heart disease and cardiomyopathies. The dental investigations comprised of Ramjford's periodontal disease severity index and clinical attachment level Laboratory investigations were done for lipid profile analysis. **Observations and Results**: Ramjford's disease severity index showed a significant difference ($p<0.05$) between Bacterial endocarditis and Valvular heart disease. This index also showed significant positive correlation with total cholesterol, triglycerides and VLDL and showed negative correlation with HDL. Attachment level was not significant between Valvular heart disease and Cardiomyopathies. However, it showed positive correlation with total cholesterol. Lipid profile showed dyslipidaemia with Ischemic Heart Disease. **Conclusion**: The study concludes that Bacterial endocarditis and Ischemic heart diseases have severe degree of periodontitis as compared to Valvular heart diseases, cardiomyopathies and congestive cardiac failure.

Keywords: periodontitis, cardiovascular disease, inflammation.

Introduction

Cardiovascular diseases are common diseases in adults.[1,2]Several risk factors for CVD includes elevated Low Density Lipoprotein (LDL), hypertension, smoking, male gender and low socioeconomic status.[3,4]A link between infection and atherosclerotic diseases has been suggested. Several bacteria and viruses have been identified as potential etiological factors in cardiovascular diseases.[5-8] Periodontitis and dental procedures can be potential factors in transient bacteremia.[9,10]Schwatzman reactions have been reported following full mouth debridement.[11] Thus gentle mastication can release bacterial endotoxins into blood stream in patients with periodontitis. In addition oral microorganisms can spread from an infected root canal into the blood stream during and after endodontic therapy.[12]Periodontal disease is characterised by chronic infection and inflammation in the periodontal tissues leading to destruction of bone surrounding the teeth and ultimately to tooth loss.[13]In recent years, chronic infection and inflammation are now increasingly considered as new risk factors for development of atherosclerotic cardiovascular diseases.[14,15]A possible proatherogenic role of chronic infection in periodontal disease has not yet been conclusively established but periodontal pathogens as for example, Bacteroidsforshythus(*Tannerellaforsythensis*), Porphyromonasgingivalis and Prevotellaintermedia, have been identified in atherosclerotic plaques[16,17]as well as in coronary and aortic endothelium.[18,19] There are also data suggesting synergism between inflammatory and infectious factors in increasing the risk for atherosclerotic vascular diseases.[20,21]Nevertheless , treatment of poor oral health (periodontal disease) has been shown to improve the systemic and haemostatic situation of coronary heart disease patients.[22]Thus heart disease patients become an important target group where oral health can have a profound effect on their general health.

Materials and Methods

A study was conducted to evaluate the association between periodontal diseases and various forms of

cardiovascular diseases among 30 to 65 years old, disease patients admitted in NKP Salve Institute of Medical sciences and research centre, Nagpur. The study was conducted for the duration of 2 months. Selection of Study Population A total of 50 participants were included in the study who were diagnosed as having cardiovascular diseases as confirmed by cardiologist(Based on clinical criteria – echocardiogram, tread mill test and angiography and serum markers) admitted to NKP Salve Institute of Medical science and Research centre in Nagpur, Maharashtra. All the patients were in the age group between 30-65 years. Following were the exclusion criteria

1. Patients suffering from other systemic diseases like chronic infectious diseases, renal diseases, thyroid dysfunction, diabetes, liver diseases, malignant disease or are on cancer chemotherapy.
2. Patients on immunosuppressant drugs, steroids.
3. Patients who have received periodontal therapy in past 6 months
4. Alcoholics
5. Smokers

The patients were divided into 5 groups depending on the type of cardiovascular diseases
Group A: Ischemic heart disease (IHD)
Group B: Bacterial endocarditis (BE)
Group C: Congestive cardiac failure (CCF)
Group D: Valvular heart disease (VHD)
Group E: Cardiomyopathies (CMP)

A specially designed case history proforma was prepared for the present study. The proforma included all the possible information, regarding patient's cardiovascular disease and oral health. In addition, ramjfords periodontal disease severity index was recorded for each patient. Laboratory investigations included lipid profile, serum cholesterol, low density lipoprotein (LDL), High Density Lipoprotein (HDL) and triglycerides (TG's). Collected data was analysed statistically using Tukey's multiple comparison test.

Observations and Results

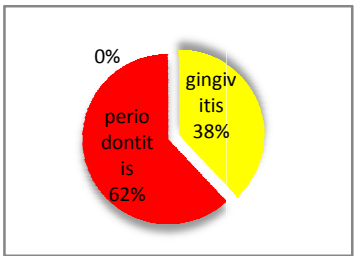

Figure 1: periodontal status of cardiovascular disease patients

In the present study, 62% patients were having periodontitis and 38% patients showed gingivitis(Fig1). However there was not even a single patient who showed completely healthy periodontal status. Thus this data suggests greater destruction of periodontal tissues in patients with cardiovascular diseases Ramjford's disease severity index showed a significant difference ($p<0.05$) between bacterial endocarditis and valvular heart diseases and between ischemic heart diseases and valvular heart diseases.

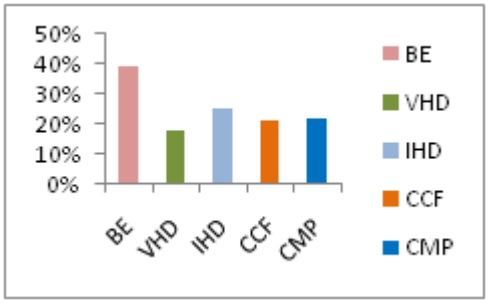

Figure 2: Plaque Component

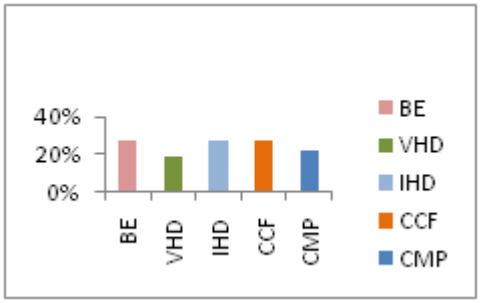

Figure 3: Calculus Component

Of Ramjford's Index of Ramjford's Index
Plaque and calculus scores were merely similar between all the groups. This can be explained on the basis of reduced plaque control measures due to prolonged hospitalization due to cardiovascular diseases. However lowest scores were seen for valvular heart diseases related to both the parameters (Figure 2 and 3).

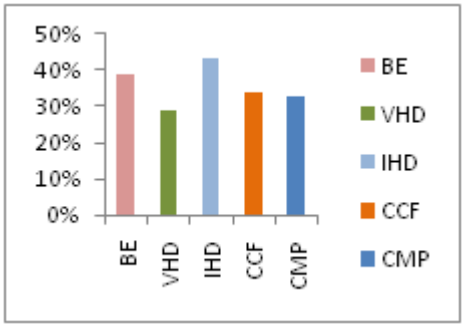

Figure 4: Gingival and periodontal

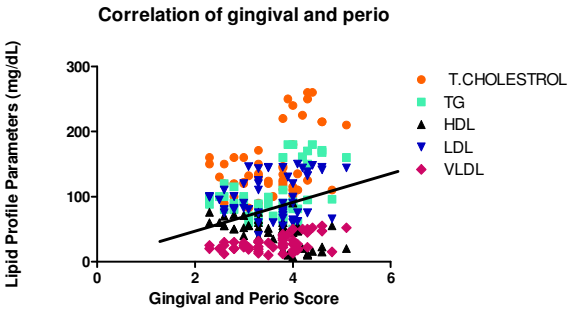

Figure 5: Correlation of gingival

Component of Ramjford's index and periodontal scores with lipid profile. The highest mean score for gingival and periodontal component was observed for Ischemic heart disease followed by bacterial endocarditis and least mean score with valvular heart diseases (Figure 4). Gingival and periodontal component of Ramjford's disease severity index showed significant POSITIVE correlation between total cholesterol, triglycerides and VLDL and showed NEGATIVE correlation with HDL (Figure 5).

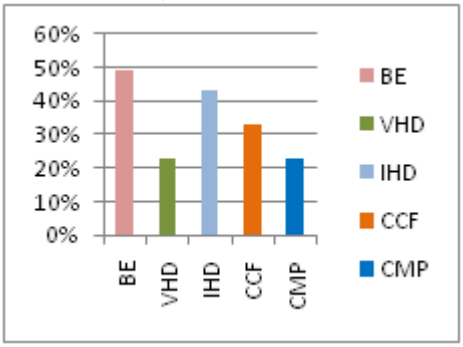

Figure 6: Clinical Attachment Level

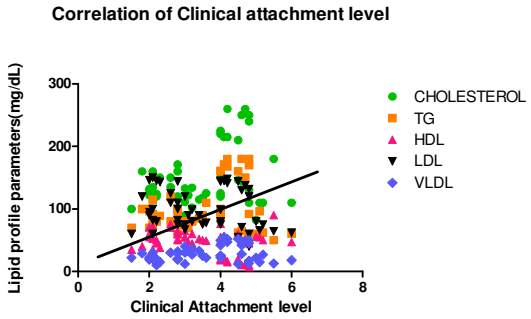

Figure 7: Correlation of Clinical Attachment

Level with Lipid Profile The highest mean score for the gingival and periodontal component was observed for the Ischemic Heart diseases and the least score (non significant) found to be with valvular heart diseases and cardiomyopathies (Figure 6 and 7). Clinical attachment level showed POSITIVE correlation with total cholesterol level. This can be explained on the basis of greater destruction in Ischemic heart diseases and Bacterial endocarditis due to increased bacteraemia along with constriction of blood vessels and reduced blood supply due to released bacterial endotoxins.

Discussion

Heart diseases are the leading cause of morbidity and mortality throughout the world despite remarkable progress in our understanding of pathogenesis and treatment of the diseases. Most commonly seen are coronary heart disease and bacterial endocarditits. Coronary heart disease is a multifactorial disease. Association have been reported of coronary heart diseases with certain gram-negative bacteria such as *Helicobacter pylori (chlamydiae pneumonia)* and with certain viruses such as *cytomegalovirus.* In recent years, key role for inflammation has been established. Several studies have suggested that chronic dental infections may be associated with coronary heart disease. The main mechanism that has been postulated is the presence of chronic infections like periodontal disease. Periodontal disease is a chronic infection and degree of inflammation in periodontal disease is clearly sufficient to cause systemic inflammatory response, as evidences by increase in C - reactive protein. The presence of periodontal infection may lead to brief episodes of bacteremia with inoculation of atherosclerotic plaques by periodontal pathogens. Subsequent growth of these bacteria would cause inflammation and plaque instability which may precipitate the ischemic attack. In present study we excluded two major confounding factors smoking and diabetes which are major risk factors for both heart diseases and periodontitis.Age is an important factor associated with both periodontitis and cardiovascular diseases as risk of both increases with age. Most of the studies done to see the association between IHD and periodontitis had included study subjects from age of 40 years. The present study included study group from 30 years of age as incidence of heart disease is increasing from 30 years of age. The age limit is restricted at the age of 65 years to avoid any possible bias due to presence of CHD related to physiological changes in older patients [24]. Also missing teeth reduces the oral infectious load

which may underestimate the association between periodontitis and heart diseases. Age group (30 to 65 years) was similar to other studies by Miyaki K, Lopez R, Cueto A et al [25-27] .Men are more likely than women to develop coronary heart disease,stroke and other cardiovascular diseases. Whether this is because ofmale hormones (androgens) which increases the risk or because of female hormones (estrogen) which protects against atherosclerosis is not completely understood. It is likely that both play a role but the protective role of estrogens is predominant factor. In the present study there was male predominance (male 62% - female 38%) as far as heart disease is concerned, similar to other studies by Lopez R, Mattilla KJ, Persson GR et al [26,28,29]. Recent studies have also shown the link between periodontitis and other oral health variables and hypertension but results are not confirmatoryPersson GR 2008[30]. In the present study significantly more number of cases had a positive history of hypertension. This was also found in studies conductedby Lopez R,CuetoA,Stein JM et al[26,27,31]. Epidemiologic studies have shown that the level of total cholesterol in blood is a strong predictor of developing coronary heart disease. The most important and best studied are High Density Lipoproteins (HDL cholesterol or HDL-C) and low density lipoprotein (LDL-C). Periodontitis has also shown to be associated with increased levels of pro- atherogenic plasma lipoproteins. Evidence suggests that low level chronic exposure to gram negative microorganisms and/or their lipopolysaccharides (LPS) can manifest a state of altered lipid metabolism, the main feature of which is hypertriglyceredimia and lipid oxidation which is due to release of TNF α and Interleukin -1β. The present study showed that 30 cases had positive history of hypercholesterolemia. This was in accordance with the studies done by Cueto A et al and others[27,32].Among 50 cases 30 subjects had higher than normal recommended level of triglycerides(> 150mg/dl) and this difference was found to be statistically significant. Also there was significant association between TG's and IHD. This was similar to the study done by Miyaki K et al and others[25]in which there was significant higher level of TG's were found among cases compared to controls whereas studies done by Stein JM et al and other authors [31,33] found no significant difference among cases and controls.In the present study periodontal health status was poor among heart disease cases. Similar observations has been reported in various other studies [27,29]. In periodontal disease and cardiovascular disease the cellular sources of inflammatory mediators are very similar. The monocyte/macrophage, lymphocytes,polymorphonuclear leucocytes,mast cells, fibroblast and endothelial cells in both diseases release these inflammatory mediators. Some differences are that the epithelial cells and osteoblasts produces inflammatory mediators in periodontal disease, while smooth muscles cells also produce these mediators in cardiovascular diseases.The hallmark of periodontal and cardiovascular diseases is a connective tissue degradation , specially collagen breakdown. The matrix metalloproteinases are the primary enzyme that leads to collagen breakdown. In periodontitis, these enzymes degrade the periodontal connective tissue which ultimately leads to tooth loss. Similarly in atherosclerosis these enzymes degrades fibrous cap, which may lead to myocardial infarction. Biologically plausible mechanism that could link periodontal and cardiovascular diseases[9] suggested that *S. Sanguis*might directly contribute to platelet aggregation and the development of thrombi, which could conceivably contribute to an acute myocardial infarction. This was also suggested by others who showed that multiple infectious agents,including *P.gingivalis and S.sanguis* may be isolated from atherosclerotic plaques taken from human carotid endarterectomyspecimen[18,19]. Among similar lines it is well known that matrix metalloproteinases including the collagenases likely play an important role in periodontal tissue breakdown[23]. Also it is known as matrix metalloproteinases also play a role in cardiovascular disease ranging from destabilization of atheromas to regulation of the development of heart failure and deleterious changes in the extracellular matrix in the myocardium. Again one sees parallelism between periodontal tissue destruction and cardiovascular disease mediated by or / and regulated by a similar pathway, in this case one associated with MMP's. In fact, there is increasing evidence that inhibition of MMP's already shown to be effective for inhibition of periodontal attachment loss can also inhibit the development of cardiac failure.

Conclusion

Overall this study suggests an association between periodontitis and heart disease. This association was strong and significant even after controlling for the classical risk factors for heart disease. Thus the study further supports the concept that chronic inflammatory conditions like periodontal disease have a significant role in heart disease.

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