

PERIODONTICS: BEYOND THE POCKET

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Chapter 3

The relationship between periodontitis and coronary heart diseases, level of total cholesterol, low-density lipoprotein and triglyceride in Health Service Centres in Indonesia

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Introduction

Many recent studies have reported that cardiovascular disease (CVD) is the main cause of death and disability. It is estimated that in 2020 heart disease will exceed infectious diseases as the main cause of death. Coronary heart disease occupies the highest rank and accounts for approximately 7.2 million deaths every year in both developing and developed countries (World Health Organization 2002). Based on The Indonesian Household Health Survey 2005 it was found that deficiencies in the circulation system are the leading cause of death with cardiovascular diseases causing 26.4% of all deaths (Department of Health Indonesia 2006). The Indonesian Household Health Survey 2001 found that oral diseases were the highest occurring, with 60% of the population experiencing dental caries or periodontal diseases (Department of Health Indonesia 2001). A survey in 2002 at the Department of Periodontology Faculty of Dentistry University of Indonesia stated that the prevalence of chronic periodontitis in 274 patients was 61.68% (Syafil 2004).

Recent evidence has shown there is a possible relationship between periodontal

diseases and Coronary Heart Disease (CHD) (Genco *et al* 2002, Persson *et al* 2003, Buhlin *et al* 2003, Spahr *et al* 2006). According to Genco *et al* (2002) periodontal infection is a risk factor for heart diseases. Most risk factors for periodontal diseases are also risk factors for CVD (Beck *et al* 1998, Matilla *et al* 2000). Poor oral health is associated with coronary heart diseases and provides evidence that inflammation could play an important role in this association (Montebugnoli *et al* 2004, Emingil *et al* 2000, Beck *et al* 1996). Other studies have stated that there is a correlation between calculus accumulation and Type 2 Diabetes Mellitus with CHD (Kemal *et al* 2000). Persson *et al* (2003) stated that there was a relation between alveolar bone damage and heart infarctions.

Several studies have reported that periodontitis is connected with hyperlipidaemia (Moeintaghavi *et al* 2005, Cutler *et al* 1999, Losche *et al* 2000). Buhlin *et al* (2003) stated there was a significant relation between periodontitis and the level of low HDL. CHD is caused by atherosclerosis or obstruction of the coronary artery by plaque atheroma. Atherosclerosis is a calcification and deposition of calcium and fat in the media tunica of the coronary artery which causes

destruction of the endothelial wall. It is known that the blood cholesterol and Low Density Lipoprotein (LDL) are risk factors for CVD. It is well recognised that Gram-negative bacteria are one of the causes of periodontitis. *P. gingivalis* and *Streptococcus sanguis* have been found in plaque atherosclerosis (DeStefano *et al* 1993). Infection with Gram-negative bacteria results in the release of various cytokines such as Interleukin-1 β (IL-1 β) and Tumor Necrosis Factor- α (TNF- α) which play a role in changing fat metabolism and may result in hyperlipidaemia (Feingold *et al* 1992). Both have also been shown to play a role in the progression of atherosclerosis (Kinane 1998, Katz *et al* 2001). Analysis of the total cholesterol, LDL and triglyceride levels of individuals with periodontal disease has shown higher levels than in healthy individuals (Loesche *et al* 2000, Posch Machado *et al* 2005). The Third National Health and Nutrition Examination Survey (NHANES III) showed that there was a weak correlation between periodontal condition and total cholesterol (Wu *et al* 2000). From the National Cholesterol Education Programme Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adult Treatment 2001 it was shown that high triglyceride, low high-density lipoprotein (HDL) increase the risk factors for CHD (Cynthia 2006). Most of the risk factors for periodontal diseases are also as risk factors for CVD (Beck *et al* 1998). The mechanisms of the relationship between periodontitis and hyperlipidaemia are still unclear as to whether periodontitis-related hyperlipidaemia is one of the risk factors for CHD.

The purpose of this study was to evaluate the relationship between periodontitis and Coronary Heart Disease, the Level of total cholesterol, low density lipoprotein and triglycerides.

Materials and methods

A case control study was carried out in Bekasi Public Hospital West Java Indonesia. The study was approved by the Ethics Committee, Faculty of Dentistry University of Indonesia.

Consecutive sampling was performed to determine patients with Coronary Heart Disease who attended the Cardiac Clinic Bekasi Public Hospital, that were a match with the inclusion criteria. The test group consisted of 26 male subjects with clinically confirmed CHD, and the control group consisted of 23 male subjects without CHD. All subjects were aged between 38 and 69 years. The diagnosis of Coronary Heart Disease in the test group was determined by a Cardiologist based on a standard 12 impulse electrocardiogram or coronary angiography. Exclusion criteria for the selection of CHD subjects consist of the presence of Diabetes Mellitus, and other systemic diseases, CHD patients with a previous history of stroke and those with a smoking habit. All subjects gave informed consent. All subjects completed a written questionnaire relating to their health and smoking habits. Standardized clinical periodontal status was determined using the Plaque Index of Sillness and Loe, Papillary Bleeding Index of Muhleman, Calculus Index of Ramfjord, Pocket Depth and Loss of Attachment from cemento enamel junction using a Hu-Freidy probe.

Blood samples were taken and the level of total cholesterol at least <200 mg/dl, LDL level of at least <160 mg/dl, and triglyceride level of at least <160 mg/dl were determined using a Hitachi 917 analyzer (Roche AG Diagnostics, Mannheim, Germany).

Statistical analysis was carried out using Fisher Exact Test and Pearson Chi-Square Test to describe the correlation of periodontal condition, total cholesterol, LDL, and triglyceride in CHD and non-CHD patients.

Chronic Periodontitis	CHD	Non-CHD	Total
Mild	7 (14.29%)	18 (36.73%)	25 (51.0%)
Moderate	16 (32.65%)	5 (10.20%)	21 (42.9%)
Severe	3 (6.12%)	0 (0.0%)	3 (6.12%)
Total	26 (53.06%)	23 (46.94%)	49 (100%)

Table 1. The distribution of severity of chronic periodontitis in CHD and non-CHD patients

Results and discussion

Fisher Exact test showed that there was a significant correlation between the severity of periodontitis in CHD and non-CHD patients, $p=0,001$ (Table 1). In 26 CHD patients 32.65% had moderate periodontitis, and 6.12 % had severe periodontitis. In comparison, in 23 non-CHD patients, 36.73 % had mild periodontitis, and no severe periodontitis was recorded. This study showed that there was a possible relationship between periodontal diseases and Coronary Heart Disease (CHD) similar to other previous studies (Genco *et al* 2002, Persson *et al* 2003, Buhlin *et al* 2003, Spahr *et al* 2006). Genco *et al* (2002) showed that periodontal infection is a risk factor of heart diseases (Syafri 2004).

These results are similar to the study by Persson *et al* (2003), in which it was stated that there was a relationship between alveolar bone damage and heart infarctions. In this study alveolar bone damage was detected by periodontal pocket depth and loss of attachment.

Fisher Exact Test

The results in Table 2 demonstrate that

there was no significant difference in Plaque Index between periodontitis patients with CHD and Non CHD ($p=0.065$) however most of the subjects had a Plaque Index Score >2 , in both periodontitis patients with CHD 42.86 % and non CHD 24.49%. This recent study is contradictory with another study in which poor oral health was associated with CHD (Montebugnoli *et al* 2004). This may suggest that the socio-economic status and education of the subjects were almost similar between CHD and Non CHD patients. Age, which varied among the subjects, is also an important variable on periodontal condition and CHD relationship (Matilla *et al* 2000, DeStefano *et al* 1993). The number of the subjects also has an impact in the results obtained.

There was no significant difference of PBI between periodontitis patients with CHD and non CHD ($p=0.448$). The score of PBI in both CHD and non-CHD patients approximately ≤ 1 . This may suggest that most cases of chronic periodontitis are do not always have increased papillary bleeding, and this condition probably reflects a long standing or low grade of inflammation and fibrosis of the marginal tissues (Novak and Novak 2006). Other reasons for the inconsistency of findings might related to differences in age, sex,

	CHD	Non-CHD	Total	P
Plaque Index				0.065
≤2.00	5 (10.2%)	11 (22.45%)	16 (32.65%)	
>2.00	21 (42.86%)	12 (24.49%)	33 (67.35%)	
Total	26 (53.06%)	23 (46.94%)	49 (100%)	
Calculus Index				0.033
≤2.00	1 (2.04%)	3 (6.12%)	4 (8.16%)	
>2.00	25 (51.02%)	20 (40.82%)	45 (91.84%)	
Total	26 (53.06%)	23 (46.94%)	49 (100%)	
Papillary Bleeding Index				0.448
≤1.00	23 (46.94%)	18 (36.74%)	41 (83.67%)	
>1.00	3 (6.12%)	5 (10.20%)	8 (16.33%)	
Total	26 (53.06%)	23 (46.94%)	49 (100%)	

Table 2. The difference of the relationship of Plaque Index, Calculus Index and Papillary Bleeding Index in periodontitis patients with CHD and non-CHD

variation of periodontal parameter, oral status, and CHD condition of subjects (Genco *et al* 2002).

A significant difference in Calculus Index was noted between periodontitis patients with CHD patients and non CHD ($p=0.033$). This result is similar to a previous study that showed that Calculus Index in Diabetic Mellitus Type 2 with CHD is higher than Non-CHD, and this probably correlated with coronary artery calcification in CHD and dental calculus accumulation (Kemal *et al* 2000).

As presented in Table 3 no significant

difference of total cholesterol ($p=0.572$) and LDL ($p=0.448$) was noted between periodontitis patients with CHD and Non-CHD. However, there was significant difference in triglyceride levels between periodontitis patients with CHD and non-CHD ($p=0.039$). Some of the CHD subjects were using medication to control their blood lipids, as noted in the questionnaire. However, triglyceride levels are difficult to decrease without an exercise or diet programme. Other studies have reported that total cholesterol, LDL and triglyceride in periodontal disease patients show higher levels of lipids than in

	Periodontitis with CHD	Periodontitis and Non-CHD	Total	P
Total Cholesterol				0.572*
≤200 mg/dl	16 (32.7%)	12 (24.5%)	28 (57.1%)	
>200 mg/dl	10 (20.4%)	11 (22.4%)	21 (42.9%)	
Total	26 (53.06%)	23 (46.94%)	49 (100%)	
Low-Density Lipoprotein				0.448**
≤160 mg/dl	23 (46.9%)	18 (36.7%)	41 (83.7%)	
>160 mg/dl	3 (6.1%)	5 (10.2%)	8 (16.3%)	
Total	26 (53.06%)	23 (46.94%)	49 (100%)	
Triglyceride				0.039**
≤160 mg/dl	14 (28.6%)	19 (38.8%)	33 (67.3%)	
>160 mg/dl	12 (24.5%)	4 (8.2%)	16 (32.7%)	
Total	26 (53.06%)	23 (46.94%)	49 (100%)	

Table 3. The difference of the relationship of total cholesterol, low-density lipoprotein and triglyceride in periodontitis patients with CHD and non-CHD (* Pearson Chi-Square, ** Fisher Exact Test)

healthy individual (Cutler *et al* 1999, Losche *et al* 2000, Posch Machado *et al* 2005). According to the Third National Health and Nutrition Examination Survey (NHANES III) the correlation between periodontal condition and total cholesterol is weak (Wu *et al* 2000). However high triglyceride, low high-density lipoprotein (HDL) will increase the risk factor for CHD (Cynthia 2006).

As presented in Table 4 in severe chronic periodontitis, triglyceride levels ranged between 179-642 (mean ± sd: 365 ± 244.547) and the range of the level of total cholesterol

was from 172-283 (mean ± sd : 213 ± 60.918). These levels were higher than the range of these lipids in mild and moderate periodontitis. These results are similar to Moenintaghavi *et al* (2005) which found that there was a relationship between the level of cholesterol in blood and periodontitis, but it is not yet definitively known whether periodontitis increases the level of lipid serum as a risk factor for CHD. Further study is needed to determine the relation between CHD and periodontitis in different criteria and in larger number of subjects.

Chronic Periodontitis	Total Triglyceride	Min-Max (Mean \pm SD) Low Density Lipoprotein	Total Cholesterol
Mild	56-309 (130.04 \pm 66.039)	50-214 (131.08 \pm 37.814)	96-303 (200.56 \pm 41.898)
Moderate	45-279 (150.38 \pm 70.861)	59-175 (116 \pm 39.290)	116-300 (190.71 \pm 39.29)
Severe	179-642 (365 \pm 244.547)	34-131 (73 \pm 51.215)	172-283 (213 \pm 60.918)

Table 4. Mean values, standard deviation of total cholesterol, LDL and triglyceride in chronic periodontitis with CHD and non-CHD patients

Conclusion

In this study there was a possible relationship between the severity of periodontitis and CHD. There was a significant difference in the Calculus Index between periodontitis patients with CHD and non-CHD, however there were no significant differences both in Plaque Index and Papilla Bleeding Index between periodontitis patients with CHD and those in the non-CHD group.

There was a significant difference in the level of triglycerides between periodontitis patients with CHD and non-CHD, however there were no significant difference in both total cholesterol and LDL level between periodontitis with CHD and non-CHD patients. Further study is needed with different criteria, in larger number of subjects and more control of confounding factors.

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