

Study on Prevalence of Hypertension and Periodontal Disease as Classified by Salivary Occult Blood Test in Japanese Factory Workers

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Summary

In the previous, we report examined the link between degree of periodontal disease and hypertensive/blood pressure using the CPI value as the measure of the disease, as employed in the work of Ainamo, et al. While the CPI value has frequently been used in dental epidemiological studies, several questions remain unanswered as to its accuracy, reproducibility, and objectivity. Given the foregoing, the current study adopted the occult blood test, an objective screening test for periodontal disease, as the measure for evaluating the relation between periodontal disease and hypertension.

As the result of logistic regression analysis, relationships between presence/absence of hypertension and periodontal disease, as determined by the occult blood test, were statistically significant. In comparison to the healthy group, the probability of the periodontal disease group to contain hypertensive persons was higher by 2.60 times. The findings of the current study using the occult blood test as the index, which suggested a relationship between periodontal disease and hypertension, reinforces the link between the incidence of ischemic heart disease and periodontal disease.

I . Introduction

Periodontal disease is the main cause of tooth loss among post- middle-aged persons. Periodontal disease starts as an infection, caused by Periodontopathic bacteria in dental plaque, such as *Porphyromonas gingivalis* and *Bacteroides forsythus* that lead to destruction of periodontium and eventually tooth loss ¹⁾. Periodontal disease has hitherto been regarded as a disease limited to the interior of the oral cavity. However, with advances in recent studies regarding the relationship between periodontal and systemic

diseases, research on derivative diseases that originate in the oral cavity is rapidly progressing. Such studies increasingly elucidate the fact that periodontal disease is not only affected by systemic diseases, but itself exerts effects on ischemic heart disease (IHD), diabetes, and low weight in newborn babies.

According to the review articles of periodontal disease and the circulatory system by Beck, et al. ²⁾ and Loesche, et al.³⁾, the high incidence of cardiac diseases, especially IHD among those whose oral cavities are in poor condition, has been confirmed by

Table 1 Morbidity of Hypertension, Diabetes Mellitus and Hyperlipidemia by Age

Age(years)	Hypertension(%)	Diabetes Mellitus(%)	Hyperlipidemia(%)
20-29	0.00	0.00	0.00
30-39	0.38	0.38	0.75
40-49	1.49	1.49	0.21
50-59	8.40	0.80	0.40

many studies. Strong involvement of hyperlipidemia, hypertension, smoking and diabetes in IHD incidence has been recognized. Hypertensive involvement has especially been examined from a variety of angles. However, relations between periodontal disease and hypertension/blood pressure have not been fully analyzed.

In this environment, the authors in the previous report⁴⁾ examined the link between degree of periodontal disease and hypertensive/blood pressure using the CPI value as the measure of the disease, as employed in the work of Ainamo, et al.⁵⁾ While the CPI value has frequently been used in dental epidemiological studies, several questions remain unanswered as to its accuracy, reproducibility, and objectivity. Given the foregoing, the current study adopted the occult blood test⁶⁾, an objective screening test for periodontal disease, as the measure for evaluating the relation between periodontal disease and hypertension.

II . Subjects and Method

The current study examined the relationship between periodontal disease and hypertension in 2,000 employees of a large business establishment. In addition, a correlation analysis of periodontal disease and blood pressure was performed on employees with normal blood pressure as measured at the time of a health examination.

1. Evaluation of periodontal disease using occult blood test

Test strip was immersed for 2-3 seconds in sample saliva collected in a paper container, then evaluated after 30 seconds by comparing it to a standard colorimetric table. The quantity of occult blood was classed in six categories, ranging from 0 to 5; higher

values indicating more progressed stages of periodontal disease.

2. Measurement of blood pressure

After a rest period, blood pressure was measured at the upper right arm in a sitting position. An automatic blood pressure monitor (HEM-706 Fuzzy, OMRON) was used.

3. Definition of hypertension

Employees diagnosed as hypertensive by physicians at the business establishment, or by physicians at other medical institutions, were defined as hypertensive for the purpose of the study.

4. Measurement of serum lipid

Five ml of blood drawn from a right elbow vein was centrifugally separated to obtain serum. Serum lipid was measured using enzymatic method.

5. Smoking survey

A self-report survey was used for determining the presence/absence of any smoking habit (1 smoke, 2 do not smoke at present, and 3 do not smoke)

6. Statistical analysis

The relationship between degree of periodontal disease and hypertension was analyzed using logistic regression. Correlation analysis was performed to evaluate the correlation between evaluated degree of periodontal disease and blood pressure among male employees with systolic pressure of less than 140 mmHg and diastolic pressure of less than 90 mmHg, excluding those with a diagnosis of hypertension.

III . Results

Table 1 shows the morbidity of hypertension,

Table 2 Blood pressure, serum lipid of study population by age

Age(years)	Systolic blood pressure(mm/Hg) (Mean \pm S.D.)	Diastolic blood pressure(mm/Hg) (Mean \pm S.D.)	Total cholesterol(mg/dl) (Mean \pm S.D.)	Triglyceride(mg/dl) (Mean \pm S.D.)	HDL-cholesterol(mg/dl) (Mean \pm S.D.)
20-29	126 \pm 14	70 \pm 11	181.3 \pm 29.1	109.4 \pm 55.2	54.9 \pm 11.9
30-39	125 \pm 13	77 \pm 9	197.1 \pm 30.5	125.1 \pm 54.8	55.3 \pm 12.2
40-49	129 \pm 17	80 \pm 11	205.4 \pm 29.6	135.1 \pm 58.7	56.0 \pm 13.5
50-59	135 \pm 19	83 \pm 11	207.3 \pm 30.3	134.5 \pm 55.5	55.2 \pm 13.9
Total	128 \pm 16	77 \pm 12	197.6 \pm 31.6	126.1 \pm 57.4	55.4 \pm 12.9

Table 3 Percentage of Salivary occult blood code in subjects by age

Age(years)	20-29	30-39	40-49	50-59	Total
Salivary occult blood Code					
Code 0	1.39%	0.75%	0.42%	0.40%	0.74%
Code 1	13.30%	9.40%	6.37%	4.80%	8.53%
Code 2	51.52%	56.39%	49.05%	42.80%	50.00%
Code 3	24.93%	22.18%	32.06%	32.80%	28.34%
Code 4	4.43%	6.02%	5.94%	10.00%	6.31%
Code 5	4.43%	5.26%	6.16%	9.20%	6.08%

Table 4 Results of logistic regression analysis for incidence of hypertension and progression of Salivary occult blood

Variables	Logistics coefficient	Standard error	Odds ratios
Healthy group			1.00
Periodontal disease group	0.955**	0.359	2.60(1.29-5.26)
Odds ratios adjusted for age and smoking habit		*:p < 0.05	** : p < 0.01

diabetes mellitus, hyperlipidemia classed according to age. The prevalence of hypertension in subjects of age 40s and older was higher than that of diabetes and hyperlipidemia: the rate for 50-59 years old was 8.4%. **Table 2** shows subjects' blood pressure by age, serum lipid by age. Five items that included systolic and diastolic pressure, total serum cholesterol all showed a tendency to increase with age. **Table 3**, Salivary occult blood code 3-5 shows a tendency to increase with age, while Salivary occult blood code 0-2, on the contrary, decreased with age.

As the result of logistic regression analysis, relationships between presence/absence of hypertension and periodontal disease, as determined by the occult blood test, were statistically significant. In comparison to the healthy group, the probability of the

periodontal disease group to contain hypertensive persons was higher by 2.60 times (**Table 4**).

Table 5 shows the correlation between blood pressure and amount of occult blood in the group of persons with the standard-range blood pressure, classed according to their smoking habits. With non-smokers, statistically significant correlations were found between occult blood in saliva and systolic/diastolic blood pressure as well as serum triglyceride. With smokers, no statistically significant correlation was found with any of above items.

IV . Discussion

Tooth loss interferes with chewing or eating. Consequent adverse effects on health are obvious. Lowering of physical, mental, and social activities are

Table 5 Person's correlation coefficients for Salivary occult blood and blood pressure, serum lipid by smoking habit status

Variables	Current smokers (n = 747)		Nonsmokers (n=444)	
	Correlation coefficient	p value	Correlation coefficient	p value
Systolic blood pressure(mm/Hg)	2.609	0.905	0.007	< 0.01
Diastolic blood pressure(mm/Hg)	- 0.005	0.136	0.009	< 0.05
Total cholesterol(mg/dl)	0.001	0.309	- 0.001	0.385
Triglyceride(mg/dl)	1.399	0.817	0.002	< 0.05
HDL-cholesterol(mg/dl)	- 0.001	0.648	- 0.002	0.463

n : Number of subjects Ajusted for age

reported as indirect influences of tooth loss in daily life.

At the same time, direct involvement of dental disease, especially periodontal disease, with incidence of cardiovascular diseases has become clear in recent research. Syrjanen, et al.⁷⁾ compared conditions of oral cavity in two groups matching in gender and age, a group of 50 brain-infarct patients over the age of 50 and a control group of 50 subjects. Oral cavities of male brain-infarct patients have been reported to be in worse condition than the control group. The cross-sectional study of Paunio, et al.⁸⁾ demonstrated a significant correlation between tooth loss and IHD among 1,384 male subjects, age 45-64, when their age, hypertension, educational level, smoking habit, etc. were matched.

Mattila, et al.⁹⁾ compared 100 acute cardiac-infarct patients to control subjects, who were matched as to their age, social class, smoking habit, the level of serum lipid, etc. Patients' conditions of oral cavity were inferior to those of controls. Their further 14 years of follow-up survey of 9,760 persons revealed higher incidences of IHD among those with deteriorating periodontal compared to healthy subjects.

A large scale cohort study by Joshipura, et al.¹⁰⁾, in which 44,119 health care workers participated, reported a high rate of IHD occurrence in a group with many cases of periodontal disease related tooth loss. As seen above, a number of reports connecting incidence of IHD and periodontal disease appeared in recent years. These reports were summed up in a review article by Beck, et al. Loesche, et al.³⁾ also recognizes periodontal disease as a risk factor for cardiac diseases.

However, few reports exist that have investigated the link between hypertension and periodontal disease. A report by Muratsu, et al.¹¹⁾, in which the relationship between blood pressure and number of missing teeth was explored among 86 healthy persons aged 65-79 was one of them. Report by Wakai, et al.¹²⁾, in which the connection between systolic blood pressure and the CPI value among 497 persons who went through a thorough medical checkup, was another one. While Muratsu, et al.¹¹⁾ found a statistically significant relationship, the results of Wakai, et al.¹²⁾ produced only a statistically non-significant trend. Thus, sufficient evidence for linkage between blood pressure and periodontal disease was not currently available.

In our previous report, the authors examined link between periodontal disease and incidences of hypertension/blood pressure⁴⁾. The indicator of degree of periodontal disease here was the CPI value as used in the study of Ainamo, et al.⁵⁾ The result was a statistically significant difference as measured using the CPI value, an index of degree of periodontal disease. Another finding was that nonsmokers younger than 50 with higher systolic pressure tended to develop more advanced periodontal disease. While the CPI value in the previous study has frequently been employed in many dental epidemiological studies, several questions remain unanswered as to its accuracy, reproducibility, and objectivity.

For this reason, in this study the analysis of the relationship between periodontal disease and hypertension was performed using the occult blood test as measure, an objective screening test for periodontal disease. Similar results as in the previous report were

obtained. The findings of the current study using the occult blood test as the index, which suggested a relationship between periodontal disease and hypertension, reinforces the link between the incidence of ischemic heart disease and periodontal disease.

Reports on the mechanism that underlies periodontal disease explain that the disease is caused by gram-negative bacterial infections. Endotoxins (lipopolysaccharide) and inflammatory cytokines (TXA₂, IL-1 β , PGE₂, TNF- α) from those bacteria damage blood vessels, the facilitating cause of arterial sclerosis and thrombosis. Further, reportedly another possible cause for cardiovascular disease is a chronic infection that progresses to low-level bacteremia, which increases leukocytes¹³⁾ and fibrinogen, important risk factors for IHD³⁾. While no direct explanatory factor is proposed to explain the results of the present study, it is assumed that such a mechanism as described above might be the underlying reason. As this was a cross-sectional study involving patients and control subjects, the timing of the beginning of hypertension as well as that of dental disease remain unknown. Therefore, the relationship found in this study could not prove the right temporal association. Elucidation of the cause-and-effect relations between blood pressure and dental disease using a variety of methods, including cohort studies, remains as our future task.

V . Reference

- 1) Yoshida Y, Takahashi S : Mutual relationship between periodontal disease and systemic disease. Bull Osaka Pre College Health Science, 8:1-9 (2002)
- 2) Beck JD, Pankow J, Tyroler HA, Offenbacher S: Dental infections and atherosclerosis. Am. Heart J, 138, 5528-5533 (1999)
- 3) Loesche, W.J. : Periodontal disease as a risk factor for heart disease. Compendium Conitin Education Dent, 15, 976-991 (1994)
- 4) Ogawa Y, Imaki M, Yoshida Y, Matsumoto M, Tanada S : Epidemiological study on the relationship between hypertension and dental disease in Japanese factory workers. San Ei Shi, 40, 235-240 (1998)
- 5) Ainamo J, Barmes D, Beagrie G, Cutress T, Martin J, Sardo-Infirri J : Development of the World Health Organization (WHO) Community Periodontal Index of Treatment Needs (CPITN). Int Dent J, 32, 281-291(1982)
- 6) Ichikawa Y : The effect of smoking on periodontal health and occult blood in saliva. Nihon Univ Dent J, 76, 333-341 (2002)
- 7) Syrjanen J, Peltola J and Valtonen, V : Dental infections in association with cerebral infarction in young and middle-age men. J Intern Med, 225,179-184 (1989)
- 8) Paunio K, Impivaara O, Tiekso J, Maki, J. : Missing teeth and ischaemic heart disease in men aged 45-64 years. Eur Heart J, 14, 54-56 (1993).
- 9) Mattila K, Valtonen V, Nieminen M, Huttunen J : Dental infection and the risk of new coronary events: Prospective study of patients with documented coronary artery disease. Clin Infect Dis, 20, 588-592 (1995)
- 10) Joshipura K, Rimm E, Douglass C, Trichopoulos D, Ascherio A, Willett W: Poor oral health and coronary heart disease. J Dent Res, 75,1631-1636 (1996)
- 11) Muratsu K, Fujino T, Yanagawa R : Effects of blood pressure on Tooth loss. Koku eisei, 40, 414-415 (1990)
- 12) Wakai K, Kawamura T, Umemura O et al. : Associations of medical status and physical fitness with periodontal disease. J Clin Periodontol, 26, 664-672 (1999)
- 13) Imaki M, Ogawa Y, Yoshida Y, Uchida M, Tanada S : Cohort study of the total leukocyte count and periodontal disease among company employees. Environ Health Prev Med, 4, 54-57 (1999)

大規模事業所従業員における唾液潜血試験を指標とした歯周病と 高血圧症に関する研究

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歯周病の評価について、CPI 値は歯科関連の疫学研究で多数用いられているが、精度、再現性、客観性などいくつかの問題点も残されている。そのため、本研究においては、歯周病の客観的なスクリーニングテストとして用いられている唾液潜血反応試験を評価の指標として、大規模事業所従業員男性 1,145 名を対象に歯周病と高血圧に関する解析を行った。高血圧症の有無と歯周病に関するロジスティック回帰分析の結果、統計的に有意な関連性は認められた。歯周病群は、健康者群に比較して 2.60 倍の確率で高血圧症に罹患することが認められた。また、非喫煙者において収縮期・拡張期血圧値および血清トリグリセライドと唾液潜血量との間に統計的に有意な相関関係が認められた。

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