Tooth Loss Is Associated With an Increased Risk of Hypertension in Postmenopausal Women

Akira Taguchi, Mitsuhiro Sanada, Yoshikazu Suei, Masahiko Ohtsuka, Kaoru Lee, Keiji Tanimoto, Mikio Tsuda, Koso Ohama, Masao Yoshizumi, Yukihiito Higashi

Abstract—Tooth loss has been associated with an increased risk of vascular diseases such as coronary heart disease and cerebrovascular disease. Little is known whether hypertension is an important risk factor linking 2 phenomena in postmenopausal women. We compared an incidence of hypertension and traditional risk factors for vascular diseases between 2 age-matched groups: 67 postmenopausal women with missing teeth and 31 without missing teeth. In addition to blood pressure, serum concentration of total cholesterol, high- and low-density lipoprotein cholesterol and triglycerides, plasma angiotensin-converting enzyme activity, plasma angiotensin II concentration, plasma renin activity, and resting heart rate were measured as traditional risk factors for vascular diseases. Subjects without missing teeth had significantly lower diastolic blood pressure than did subjects with missing teeth (P=0.021). The former tended to have lower systolic blood pressure than did the latter (P=0.058). There were no significant differences in other variables between subjects with and without missing teeth. The odds ratio of having hypertension in subjects with missing teeth was 3.59 (95% confidence interval, 1.10 to 11.7) after adjustment of obesity, hypercholesterolemia, and hypertriglyceridemia. Our results suggest that hypertension may be an important factor linking tooth loss and an increased risk of vascular diseases in postmenopausal women. 

Key Words: vascular diseases ■ hypertension ■ women

Vascular diseases such as coronary heart disease and cerebrovascular diseases are important causes of death in elderly women in Japan as well as in the United States. Premenopausal women are relatively at low risk for vascular diseases compared with men, but this risk increases with advancing age and with the onset of menopause. Risk factors for vascular diseases include menopause, smoking, diabetes mellitus, obesity, hypercholesterolemia, hypertriglyceridemia, and hypertension in women.

Tooth loss has been associated with an increased risk of vascular diseases such as coronary heart disease, cerebrovascular disease, and peripheral arterial disease. One potential pathway linking tooth loss and vascular disease risk is oral infection-inflammation related to periodontal disease. Periodontal disease, a local chronic bacterial infection in the oral cavity, may contribute to endothelial dysfunction, or deterioration of the atherogenic potency of HDL. A second pathway is that tooth loss may affect dietary quality and nutrient intake, leading to an increased risk of vascular diseases. A third is confounding variables such as smoking or diabetes mellitus that largely affect both tooth loss and vascular diseases may produce spurious association between 2 phenomena.

Tooth loss might lead to dietary pattern change, resulting in an increased risk of hypertension because the change of dietary pattern may be associated with hypertension. Systolic and diastolic blood pressure are important predictors for cardiovascular disease and stroke in the United States and Europe as well as in eastern Asia. Hypertension might be an important risk factor linking tooth loss and vascular disease risk in postmenopausal women. An analysis of postmenopausal, nonsmoking women without diabetes mellitus and clinical manifestations of atherosclerosis would be of interest to explore this hypothesis. The purpose of this study was to investigate whether tooth loss is associated with an increased risk of hypertension in postmenopausal women.

Methods

Subjects

We evaluated 2 age-matched groups: 67 postmenopausal women with missing teeth (mean age ±SD 54.8±4.4 years, range 44 to 68 years) and 31 postmenopausal women without missing teeth (mean age 53.4±4 years, range 46 to 64 years). Because third molars tend to be impacted completely or missed congenitally, these were
TABLE 1. Differences in Characteristics Between Subjects With and Without Missing Teeth*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Missing Teeth (n=67)</th>
<th>No Missing Teeth (n=31)</th>
<th>P Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of teeth remaining</td>
<td>22.2±0.7</td>
<td>28.0±0.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Years since menopause</td>
<td>5.6±0.7</td>
<td>5.2±1.0</td>
<td>0.632</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>154.0±0.6</td>
<td>154.4±1.0</td>
<td>0.752</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>53.6±0.9</td>
<td>51.8±1.0</td>
<td>0.250</td>
</tr>
<tr>
<td>Total cholesterol (mg/dL)</td>
<td>228.7±4.0</td>
<td>240.3±8.9</td>
<td>0.246</td>
</tr>
<tr>
<td>HDL cholesterol (mg/dL)</td>
<td>71.7±1.8</td>
<td>73.8±3.0</td>
<td>0.534</td>
</tr>
<tr>
<td>TGs (mg/dL)</td>
<td>119.3±10.1</td>
<td>96.2±7.7</td>
<td>0.147</td>
</tr>
<tr>
<td>LDL cholesterol (mg/dL)</td>
<td>142.5±4.2</td>
<td>151.5±8.4</td>
<td>0.289</td>
</tr>
<tr>
<td>Systolic blood pressure (mm Hg)</td>
<td>129.1±2.3</td>
<td>121.6±2.9</td>
<td>0.058</td>
</tr>
<tr>
<td>Diastolic blood pressure (mm Hg)</td>
<td>78.9±1.5</td>
<td>73.1±1.7</td>
<td>0.021</td>
</tr>
<tr>
<td>Heart rate (bpm)</td>
<td>65.4±1.1</td>
<td>65.4±0.9</td>
<td>0.997</td>
</tr>
<tr>
<td>Plasma ACE activity (IU/L at 37°C)</td>
<td>12.2±0.5</td>
<td>12.4±0.7</td>
<td>0.813</td>
</tr>
<tr>
<td>Plasma renin activity (ng/mL per hour)</td>
<td>1.13±0.10</td>
<td>1.18±0.14</td>
<td>0.793</td>
</tr>
<tr>
<td>Plasma angiotensin II (pg/mL)</td>
<td>7.22±0.6</td>
<td>7.74±1.0</td>
<td>0.656</td>
</tr>
<tr>
<td>No. (%) with hysterectomy</td>
<td>19 (28.4%)</td>
<td>11 (35.5%)</td>
<td>0.477</td>
</tr>
<tr>
<td>No. (%) with unilateral oophorectomy</td>
<td>6 (9.0%)</td>
<td>4 (12.9%)</td>
<td>0.721</td>
</tr>
<tr>
<td>No. (%) with bilateral oophorectomy</td>
<td>9 (13.4%)</td>
<td>5 (16.1%)</td>
<td>0.723</td>
</tr>
</tbody>
</table>

*The results were shown as mean±SEM or No. (%).
†P value was calculated from unpaired t test, χ² test, or Fisher exact test.

Analytical Methods

Hypertension was defined as systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg measured in a sitting position on at least 3 different occasions in the outpatient clinic of Hiroshima University School of Medicine. Normal blood pressure was defined as a systolic blood pressure <130 mm Hg and a diastolic blood pressure <80 mm Hg.

Routine chemical methods were used to determine the serum concentration of total cholesterol, HDL cholesterol, and triglycerides (TGs). The serum concentration of LDL cholesterol was determined by the Friedewald method. Plasma angiotensin-converting enzyme (ACE) activity was measured with ACE color (Fujirebio Co., Ltd). Plasma renin activity and plasma concentration of angiotensin II were determined by radioimmunoassay. Resting heart rate, height, and weight were measured at sampling venous blood. Body mass index (BMI) was calculated as weight divided by the square of height (kilograms per meter squared).

Statistical Analysis

All characteristics were compared between subjects with and without missing teeth by unpaired t test, χ² test, or Fisher exact test.

Discussion

Tooth loss was significantly associated with an increased risk of hypertension in this study; however, there were no significant associations among other traditional risk factors for hypertension in this study; however, there were no significant differences in other characteristics between the 2 groups (Table 1).
TABLE 2. Comparison of Risk Factors for Vascular Diseases Between Subjects With and Without Missing Teeth*

<table>
<thead>
<tr>
<th>Risk Factor for Vascular Diseases</th>
<th>Missing Teeth (n=67)</th>
<th>No Missing Teeth (n=31)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI</strong></td>
<td></td>
<td></td>
<td>0.363</td>
</tr>
<tr>
<td>Low BMI</td>
<td>3 (4.5%)</td>
<td>4 (12.9%)</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>50 (74.6%)</td>
<td>21 (67.7%)</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>12 (17.9%)</td>
<td>6 (19.4%)</td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>2 (3.0%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Total cholesterol &gt;220 mg/dL</strong></td>
<td>39 (58.2%)</td>
<td>20 (64.5%)</td>
<td>0.553</td>
</tr>
<tr>
<td>HDL cholesterol &lt;40 mg/dL</td>
<td>1 (1.5%)</td>
<td>0 (0%)</td>
<td>1.000</td>
</tr>
<tr>
<td>TGs &gt;150 mg/dL</td>
<td>11 (16.4%)</td>
<td>3 (9.7%)</td>
<td>0.375</td>
</tr>
<tr>
<td>LDL cholesterol &gt;140 mg/dL</td>
<td>35 (52.2%)</td>
<td>18 (58.1%)</td>
<td>0.590</td>
</tr>
<tr>
<td>Hypertension</td>
<td>24 (35.8%)</td>
<td>4 (12.9%)</td>
<td>0.029</td>
</tr>
</tbody>
</table>

*The results were shown as No. (%).
†P value was calculated from χ² test or Fisher exact test.

vascular diseases and tooth loss. This is the first demonstration that refers to an association between hypertension and tooth loss in postmenopausal women. The Eastern Stroke and Coronary Heart Disease Collaborative Research Group demonstrated that blood pressure is an important determinant of stroke risk in eastern Asian populations, whereas cholesterol concentration is less important, affecting the proportions of stroke subtypes more than overall stroke numbers. Franklin et al reported that diastolic blood pressure was the strongest predictor of coronary heart disease in patients younger than 50 years of age, whereas systolic blood pressure, diastolic blood pressure, and pulse pressure were comparable predictors in patients aged 50 to 59 years in different age groups of the Framingham Heart Study participants. Franklin et al reported that diastolic blood pressure was the strongest predictor of coronary heart disease in patients younger than 50 years of age, whereas systolic blood pressure, diastolic blood pressure, and pulse pressure were comparable predictors in patients aged 50 to 59 years in different age groups of the Framingham Heart Study participants. Diastolic blood pressure was significantly associated with tooth loss in our subjects who were relatively younger postmenopausal women. Our results suggest that postmenopausal women with missing teeth may have a higher risk of hypertension and subsequent vascular diseases than do those without missing teeth.

On the basis of causal relationship, some hypotheses might be considered potential mechanisms linking tooth loss and an increased risk of hypertension. Intake of some nutrient-rich foods and beta carotene, folate, and vitamin C serum levels were significantly lower in denture wearers in the US civilian, noninstitutionalized population. The decrease of serum antioxidant vitamins such as vitamin C in postmenopausal women with missing teeth in this study might contribute to an increased risk of hypertension.

Subjects with missing teeth might have been at greater risk of periodontal disease than those without missing teeth, resulting in endothelial dysfunction through the oral infection-inflammation pathway and subsequent increased risk of hypertension. However, because Saito et al reported significant association between obesity and periodontitis in Japanese men and women, there is less possibility that subjects with missing teeth had risk of periodontal disease than those without missing teeth at the time of examination in this study because there was no significant difference in obesity between subjects with and without missing teeth. Further, relatively younger women lost their teeth more likely by caries than by periodontal disease.

Tooth loss might be a reflection of previously continuous pain and mental stress that may contribute to an increased risk of hypertension. However, there was no previous study that can support such a hypothesis in postmenopausal women. There were no significant differences in plasma ACE activity, plasma renin activity, or plasma angiotensin II concentration between subjects with and without missing teeth. These findings suggest that unknown mechanisms linking tooth loss and an increased risk of hypertension are at least not related to renin-angiotensin system.

On the basis of noncausal relationship, healthy bias might be considered 1 of confounding variables linking tooth loss and hypertension in this study. Postmenopausal women without missing teeth might have both good general and oral health consciousness compared with those with missing teeth, resulting in spurious association between tooth loss and hypertension. However, there were no significant differences in other risk factors for vascular diseases as well as basic characteristics between subjects with and without missing teeth. These suggest that tooth loss—hypertension association in this study may not be a spurious finding because of healthy bias.

The number of years of education was a significant independent predictor of the number of teeth remaining in white postmenopausal women. Al-Mahroos et al reported that educational status may be associated with hypertension in a cross-sectional survey of 2120 Bahrainis aged 40 to 69 years. Mizuno et al reported that Japanese postmenopausal women who graduated only from primary school tended to have lost more teeth than those who graduated from primary school or more. Because all subjects in this study had at least graduated from a junior high school, it is unlikely that educational status may be the confounding variable linking tooth loss and hypertension in this study.

This study has some design limitations. First, our subjects are not representative of Japanese postmenopausal women. Our findings are limited to relatively healthy postmenopausal women because of restrictive exclusion criteria. A small number of subjects also may limit the interpretation of our findings. Second, we did not clarify the difference in the dietary patterns between subjects with and without missing teeth. Third, we did not measure endothelial function in this study. The estimation of dietary patterns and the measurement of endothelial function would be necessary to clarify as to which mechanisms contribute to an association between tooth loss and an increased risk of hypertension in postmenopausal women.

In conclusion, there was significant association between tooth loss and an increased risk of hypertension in postmenopausal women, although there were no significant associations among tooth loss and other traditional risk factors for vascular diseases. Our results suggest that hypertension may be an important factor linking tooth loss and vascular disease risk in postmenopausal women.

Perspectives

Tooth loss was associated with an increased risk of hypertension in postmenopausal women. However, it was still unknown whether there was causal link between 2 phenomena because this study was cross-sectional. Some unknown confounding variables related to socioeconomic status, nutritional features,
psychosocial factors, or lifestyle might contribute to noncausal association. At the point of causal relationship, hypertension also might facilitate tooth loss. The strategy for tooth retention might play an important role in preventing hypertension and subsequent vascular diseases after menopause in women. Conversely, treating hypertension at an earlier age might promote tooth retention. Prospective longitudinal study including possible confounding variables would clarify the causal or noncausal relationship between tooth loss and hypertension in postmenopausal women.

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References
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