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, Yukihiro 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 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. (Hypertension. 2004;43:1297-1300.)

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.1 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,2–4 cerebrovascular disease,5,6 and peripheral arterial disease.7 One potential pathway linking tooth loss and vascular disease risk is oral infection-inflammation related to periodontal disease.6–18 Periodontal disease, a local chronic bacterial infection in the oral cavity, may contribute to endothelial dysfunction,12 carotid artery plaque formation,11,13,15,17 or deterioration of the antiatherogenic potency of HDL.18 A second pathway is that tooth loss may affect dietary quality and nutrient intake, leading to an increased risk of vascular diseases.19–21 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.22–25

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.26 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.27–30 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 ± 5.4 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.

Results

There were significant differences in the number of remaining teeth (P<0.001) and diastolic blood pressure (P=0.021) between subjects with and without missing teeth. Subjects without missing teeth tended to have lower systolic blood pressure than did subjects with missing teeth (P=0.058); however, there were no significant differences in other characteristics between the 2 groups (Table 1).

There was significant association between an incidence of hypertension and tooth loss (P=0.029); however, there were no significant associations among other traditional risk categories for vascular diseases and tooth loss (Table 2). After adjustment of other risk categories, the odds ratio of having hypertension in subjects with missing teeth was 3.59 (95% CI, 1.10 to 11.7).

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
Tooth loss might be a reflection of previously continuous pain and mental stress that may contribute to an increased risk of hypertension.\textsuperscript{35,36} 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.\textsuperscript{37} 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.\textsuperscript{38} 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.\textsuperscript{39} 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.

Acknowledgments
This study was supported by grants-in-aid for scientific research from the Japan Society for the Promotion of Science (14571786, 1559075100, KOSE151201).

References
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 and Yukihito Higashi

*Hypertension*. 2004;43:1297-1300; originally published online April 26, 2004; doi: 10.1161/01.HYP.0000128335.45571.ce

*Hypertension* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2004 American Heart Association, Inc. All rights reserved.
Print ISSN: 0194-911X. Online ISSN: 1524-4563

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://hyper.ahajournals.org/content/43/6/1297