The Cardio-Ankle Vascular Index and Carotid Ultrasound Data Reflect Different Concepts of Vascular Damage

Suzuki et al. recently reported the effects of conventional cardiovascular risk factors on the arterial stiffness and carotid atherosclerosis in young patients1). The authors selected the cardio-ankle vascular index (CAVI) and carotid ultrasound data as markers of arterial stiffness and carotid atherosclerosis, and concluded that there was a positive relationship between conventional cardiovascular risk factors and physiological arteriosclerosis markers. We fundamentally agree with their analytical procedure, but the arterial stiffness and carotid atherosclerosis are different concepts2), and carotid plaques and the intima-media thickness (IMT) also represent different aspects of vascular damage3).

The arterial stiffness is a fundamental pathological change in cardiovascular disease (CVD), and is an important risk factor for the development of CVD4, 5). The pulse wave velocity (PWV) has been measured to estimate the severity of atherosclerosis6), and the CAVI was developed by improving on the PWV method for assessing the arterial stiffness7). Kangas et al. reported the advantages of measuring the PWV in patients with metabolic syndrome, even in the absence of hypertension8), and the CAVI has been applied clinically for monitoring the severity of atherosclerosis9).

We herein present findings demonstrating the ability of an increased CAVI value to predict the changes in the carotid plaque size or carotid IMT.

A total of 134 men, aged 31 to 86 years old (mean ± standard deviation, 64.1 ± 10.8), underwent intensive health checkups between April 2013 and March 2014. The subjects receiving treatment for hypertension, diabetes mellitus and/or dyslipidemia were included in this study. Informed consent was obtained from all of the participants. This study was conducted with the approval of the Institutional Review Board of Sano City Hospital, Tochigi Prefecture, Japan (November 21, 2013).

After each subject had rested in the sitting position for at least 5 min, the brachial systolic and diastolic blood pressures were measured using an automated blood pressure measurement device (UM-101; A & D Company, Ltd., Tokyo). The body mass index (BMI) was calculated as the weight (in kilograms) divided by height (in meters) squared. The waist circumference (WC) was measured midway between the iliac crest and the 12th rib.

Carotid ultrasound detection was performed with a color Doppler ultrasound diagnostic apparatus (Aplio SSA-700A, Toshiba Corporation, Tokyo) by a trained technician. The maximal IMT was adopted for the analysis. The carotid artery plaque size was also determined, and the total plaque score was calculated.

The CAVI, an index of arterial stiffness, was measured non-invasively (VaSera VS-1500AE, Fukuda Denshi, Japan). The mean CAVI values obtained on the right and left sides for each participant were used for the analysis.

All tests were two-sided, and \( p < 0.05 \) was set as the statistical significance level. All analyses were performed using the SPSS 21 statistical software package (SPSS Inc. Japan). The results are expressed as the

Table 1. The characteristics of the subjects (mean and standard deviation) stratified by the presence/absence of plaque and an intima-media thickness of \( \geq 1 \) mm

<table>
<thead>
<tr>
<th>Variables</th>
<th>Plaque</th>
<th>IMT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+ n=101</td>
<td>- n=33</td>
</tr>
<tr>
<td>Age</td>
<td>65.8, 10.1**</td>
<td>58.7, 11.3</td>
</tr>
<tr>
<td>BMI</td>
<td>23.9, 2.7</td>
<td>24.3, 3.7</td>
</tr>
<tr>
<td>WC</td>
<td>85.3, 7.6</td>
<td>84.3, 9.0</td>
</tr>
<tr>
<td>SBP</td>
<td>124.4, 13.9*</td>
<td>118.2, 13.5</td>
</tr>
<tr>
<td>DBP</td>
<td>74.2, 9.7</td>
<td>73.7, 8.8</td>
</tr>
<tr>
<td>CAVI</td>
<td>8.6, 1.1***</td>
<td>7.7, 0.96</td>
</tr>
</tbody>
</table>

SD: Standard deviation, BMI: Body mass index, WC: waist circumference, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, CAVI: Cardio-ankle vascular index

Student’s \( t \)-test was used for the analysis. \(* p<0.05\), \(** p<0.01\), \(*** p<0.001\)
We declare that there are no conflicts of interest associated with this study.

References
8) Kangas P, Tikkakoski AJ, Tahvanainen AM, Leskinen MH, Viitala JM, Kähönen M, Kääb T, Niemelä OJ, Mustonen JT, Pörsti IH: Metabolic syndrome may be associated with increased arterial stiffness even in the

**Table 2.** The results of a multiple logistic regression analysis performed to identify the predictors of the total plaque score (a) or an IMT ≥ 1 mm (b) with adjustments for the age, body mass index, systolic blood pressure and CAVI

<table>
<thead>
<tr>
<th>Variables</th>
<th>OR of (a) (95% CI)</th>
<th>OR of (b) (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (one unit increase)</td>
<td>1.02 (0.97-1.08)</td>
<td>1.1 (1.06-1.2)***</td>
</tr>
<tr>
<td>BMI (one unit increase)</td>
<td>1.03 (0.88-1.2)</td>
<td>1.2 (1.01-1.4)*</td>
</tr>
<tr>
<td>SBP (one unit increase)</td>
<td>1.01 (0.97-1.05)</td>
<td>1.01 (0.98-1.05)</td>
</tr>
<tr>
<td>CAVI (one unit increase)</td>
<td>1.9 (1.01-3.4)*</td>
<td>1.4 (0.84-2.2)</td>
</tr>
</tbody>
</table>

Abbreviations: OR; odds ratio, CI; confidence interval
All other abbreviations are listed in Table 1.
*p < 0.05, ***p < 0.001

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**COI**

We declare that there are no conflicts of interest associated with this study.
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