



Cardio-ankle vascular index in the management of hypertension

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Keywords Arterial stiffness · Hypertension · Blood pressure

Received: 2 September 2022 / Accepted: 9 September 2022 / Published online: 14 October 2022
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Arterial stiffness is a marker to predict future cardiovascular (CV) events, and its increase is affected by various CV risk factors, including blood pressure, age, glucose/lipid metabolism, smoking, and so on [1, 2]. In particular, blood pressure is a major factor affecting arterial stiffness. High office blood pressure is associated with an increased risk of CV disease. The present study conducted by Kawabata et al. shows that the cardio-ankle vascular index (CAVI) is significantly higher in cases of poor office blood pressure control, with or without antihypertensive medication [3]. These findings suggest that increased arterial stiffness, as reflected by CAVI, is also relevant as one of the mechanisms by which elevated office blood pressure acts as a risk factor for the development of CV events.

Elevated blood pressure increases intraluminal pressure in vessels and increases vascular tonus via endothelial dysfunction, and these abnormalities lead to functional arterial stiffness [1, 2]. Furthermore, elevated blood pressure causes vascular smooth muscle hypertrophy and proliferation and degeneration of vascular connective tissues, and these abnormalities lead to structural arterial stiffness [1, 2]. The hemodynamic abnormalities resulting from increased arterial stiffness are an important mechanism by which arterial stiffness is associated with the development of CV events and is thought to act via increased cardiac afterload, impaired coronary blood flow supply, microvascular damages and arterial wall damage, leading to the development or exacerbation of CV diseases [1, 2]. Pulse wave velocity (PWV) is a marker that reflects both the combined functional and structural stiffness of arteries, and both influence the increased risk for CV events. Therefore,

PWV makes it difficult to estimate the degree of structural vascular damage as organ damage in cases with poorly controlled office blood pressure (Fig. 1). On the other hand, CAVI is a marker of arterial stiffness that attempts to reduce the influence of blood pressure [4]. Thus, the present results are considered to suggest that poor office blood pressure control also structurally stiffens the arteries (Fig. 1). However, recent studies have reported that the white coat phenomenon also increases CAVI, and the blood pressure at the measurement of CAVI may also affect CAVI value [5]. Therefore, further studies are needed to assess the extent to which an increase in CAVI in cases of poor office control of blood pressure reflects the extent of structural vascular damage [6].

Office blood pressure is a common marker in the control of blood pressure levels. However, the fluctuation of blood pressure is well noted, and thus, the management of blood pressure only by office blood pressure is not sufficient. Therefore, the measurement of home blood pressure is recommended [7], and furthermore, its importance as a marker for organ damage assessment, such as left ventricular hypertrophy assessed by electrocardiogram or echocardiogram and proteinuria, has been presented [8]. Similarly, arterial stiffness assessed by PWV is thought to be in this category. The recent SPERTA study used PWV as a surrogate marker for the management of hypertension, while the SPARTE study was a multicenter, prospective and intervention study contrasting the efficacy of PWV-based antihypertensive treatment, in which PWV was controlled to a target value, in preventing the development of CV events with conventional antihypertensive treatment using blood pressure levels as the index [9]. It was a 4-year observational study with ~250 participants on both sides, but no significant differences were found in the main CV outcomes. However, office blood pressure was significantly lower with PWV-base treatment, and the increase in PWV over the study period was significantly smaller than with blood pressure-base treatment. While the benefit of PWV-

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The findings of Kawabata's study
 In case of poor control of office blood pressure

High value of pulse wave velocity (PWV) : office blood pressure affects PWV value
 → hard to distinguish functional/structural arterial stiffness

High value of cardio-ankle vascular index (CAVI): office blood pressure may less affect CAVI value as compared to PWV
 → possibly structural arterial stiffness is dominant



Next step: How to apply PWV/CAVI as a surrogate marker in the management of hypertension?

PWV-based management of hypertension may be useful for the cardiovascular risk assessment and patient education

While CAVI-based management of hypertension may be useful for the cardiovascular risk assessment, the establishment of own strategy is needed

Fig. 1 The clinical implications of cardio-ankle vascular index and pulse wave velocity for the management of hypertension

based treatment is not well established in this SPARTE study, Laurent et al., the lead authors of the SPARTE study, suggest that PWV could be used as a patient education indicator in the longitudinal treatment of hypertension [9]. The current study by Kawabata et al. found a large difference of 25 mmHg in systolic blood pressure (i.e., 126/73 mmHg in the good blood pressure control group vs. 151/84 mmHg in the poor control group) but no significant difference in CAVI values between the two groups [3]. These results may suggest that the use of CAVI as a surrogate marker in the management of hypertension requires the creation of a different strategy for PWV (Fig. 1).

Compliance with ethical standards

Conflict of interest Hirofumi Tomiyama received funds from Omron Health Care company, Asahi Calpis Wellness company, and Teijin Pharma company.

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