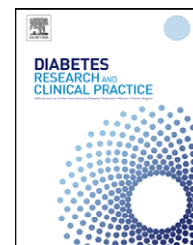




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Usefulness of brachial-ankle pulse wave velocity as a predictive marker of multiple coronary artery occlusive disease in Korean type 2 diabetes patients

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ABSTRACT

Multiple coronary artery occlusive disease (multiple CAOD) is the most fatal and frequently observed coronary artery disease in type 2 diabetes patients, but no simple, non-invasive screening tool is available yet. The aim of this study is to evaluate the arterial stiffness in type 2 diabetes patients using brachial-ankle pulse wave velocity (baPWV), to demonstrate the correlation between arterial stiffness and multiple CAOD, and to suggest the cutoff point of baPWV for predicting multiple CAOD in Korean type 2 diabetes patients. One hundred and eighty-one diabetes and 262 non-diabetes patients were enrolled in the study. Routine anthropometric and serologic data were collected. baPWV was measured the day before coronary angiography, and the severity of CAOD was assessed with Gensini score after angiography. baPWV and Gensini score were significantly increased in diabetes patients and Gensini score had a positive correlation with baPWV. Subjects in the highest tertile of baPWV showed odds ratio of 3.06 for multiple CAOD compared to the lowest tertile. In ROC curve, baPWV at 1635 cm/s showed 73% sensitivity and 75% specificity with AUC 0.76 in diabetes patients in detecting multiple CAOD. Therefore, baPWV may be utilized a screening tool for predicting multiple CAOD, especially in type 2 diabetes patients.

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1. Introduction

Coronary artery occlusive disease (CAOD) is the leading cause of death in type 2 diabetes patients, and multiple CAOD occurs at a higher incidence in this group compared to the normal population. For this reason, a simple and non-invasive tool for predicting multiple CAOD in type 2 diabetes patients is needed. The arterial stiffness and CAOD have been shown to be closely related [1–4], but the data on the correlation between multiple CAOD and arterial stiffness,

especially in type 2 diabetes patients, is lacking. Recently, several tools have been introduced to assess the arterial stiffness, and pulse wave velocity is recognized as a good marker of arterial distensibility and stiffness that reflects a vascular damage [1]. Brachial-ankle pulse wave velocity (baPWV) is not merely a simple marker of arterial stiffness, but it has also been shown to be associated with CAOD [2]. The aim of this study is to evaluate the usefulness of baPWV as a predictor of multiple CAOD in Korean type 2 diabetes patients.

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2. Materials and methods

2.1. Subjects

We enrolled 181 type 2 diabetes and 262 age-matched non-diabetes subjects. All the subjects had been admitted to our hospital and had undergone elective coronary angiography for a suspected coronary artery disease by cardiologists between September 2003 and May 2004. Brachial-ankle PWV (baPWV) was measured using the oscillometric method 1 day before the procedure and routine anthropometric and laboratory data were collected. Patients who were in conditions of severe nephropathy (serum creatinine > 133 μ mol/L), vascular obstruction, limb amputation, acute illnesses, obesity, or underweight were excluded from the study. Also, subjects with atrial fibrillation, valvular heart disease, low left ventricular ejection fraction (<40%), or a permanent pacemaker implant were excluded for factors known to influence the PWV. All patients gave informed consents before entering the study and the protocol was approved by the Local Ethics Committee.

2.2. Blood sampling

Before the cardiac catheterization, fasting blood samples were collected in the morning to investigate the following parameters: total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, LDL particle size, glucose and others as shown in Table 1. The subjects were divided into two groups according to the

presence of diabetes based on the definition of American Diabetes Association [5].

2.3. Methods

After the subject had rested in a supine position for more than 5 min, baPWV was measured using form ABI/PWV (Colin Co., Ltd., Komaki, Japan). Form ABI/PWV is a device with four cuffs that can simultaneously measure blood pressure in both arms and legs and automatically calculate the ankle brachial pressure index. This device can also record pulse wave by sensors in the cuffs, store data on the start point of each pulse wave in the right arm and both legs in memory, record the time difference between the transmission time to arm and to ankle, calculate the transmission distance from the right arm to each ankle according to body height, and automatically compute and output the baPWV values by transmission time and distance. After the hospitalization, all subjects underwent coronary angiography the day after pulse wave analysis. The extent of CAD was defined as 0-, 1-, 2-, 3-vessel disease according to the number of coronary vessels with >50% luminal narrowing by gross measurement, and its severity was reassessed by Gensini score [6]. Moreover, when there was a >50% luminal narrowing in the left main coronary artery or in more than three sites of coronary arteries, the patient was defined as having a multiple CAOD. All coronary angiograms were assessed blindly by two cardiologists, and when there was a discrepancy in the interpretation between the cardiologists, it was settled by an opinion from a third cardiologist.

Table 1 – Basal characteristics of patients (n = 443).

	Non-diabetes (n = 262)	Diabetes (n = 181)	p
Age (yr)	58.8 $\pm$ 11.02	58.9 $\pm$ 10.91	NS
Gender (M:F)	1.1:1	1.2:1	NS
AI (%)	16.78 $\pm$ 25.45	16.0 $\pm$ 24.87	NS
Mean ABI	1.13 $\pm$ 0.09	1.11 $\pm$ 0.13	NS
Mean baPWV (cm/s)	1542 $\pm$ 336	1734 $\pm$ 427	0.00**
Gensini score	9.4 $\pm$ 19.23	17.2 $\pm$ 26.17	0.00**
Weight (kg)	67.9 $\pm$ 12.79	67.0 $\pm$ 10.75	NS
Height (cm)	163.5 $\pm$ 8.36	163.6 $\pm$ 8.41	NS
BMI (kg/m ²)	25.0 $\pm$ 2.8	24.8 $\pm$ 30.06	NS
Systolic BP (mmHg)	126.9 $\pm$ 19.13	130.8 $\pm$ 22.19	NS
Diastolic BP (mmHg)	76.0 $\pm$ 12.27	75.1 $\pm$ 12.66	NS
Pulse pressure (mmHg)	66.5 $\pm$ 11.55	70.6 $\pm$ 14.22	0.00**
Pulse rate (bpm)	70.8 $\pm$ 13	74.9 $\pm$ 12	0.00**
Total cholesterol (mmol/L)	4.44 $\pm$ 0.89	4.39 $\pm$ 1.31	NS
HDL cholesterol (mmol/L)	1.10 $\pm$ 1.93	1.04 $\pm$ 0.31	NS
LDL cholesterol (mmol/L)	2.66 $\pm$ 0.84	2.69 $\pm$ 0.82	NS
Triglycerides (mmol/L)	3.37 $\pm$ 0.34	3.30 $\pm$ 0.28	NS
Mean LDL size (nm)	26.43 $\pm$ 0.85	26.32 $\pm$ 0.84	NS
Homocysteine (μ mol/L)	11.15 $\pm$ 12.09	11.21 $\pm$ 6.05	NS
BNP (ng/L)	69.56 $\pm$ 165.38	127.59 $\pm$ 241.58	0.01*
CRP (mg/L)	1.02 $\pm$ 8.41	1.13 $\pm$ 10.06	0.02*
Fasting glucose (mmol/L)	5.51 $\pm$ 1.24	7.7 $\pm$ 3.69	0.00**

Data are expressed by mean $\pm$ S.D., except for frequency data. Abbreviations: AI, augmentation index; ABI, ankle brachial pressure index; baPWV, brachial-ankle pulse wave velocity; BMI, body mass index; BP, blood pressure; HDL, high density lipoprotein; LDL, low density lipoprotein; BNP, B type natriuretic peptide; CRP, c-reactive protein; CAOD, coronary artery occlusive disease; Y, yes; N, no; NS, not significant.

* p < 0.05.

** p < 0.01.

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