Reduction in Arterial Stiffness after Percutaneous Coronary Intervention in Patients with Coronary Artery Disease

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Background and objectives: Coronary artery disease (CAD) is a worldwide major cause of mortality and morbidity. Arterial stiffness plays a significant role in the pathogenesis of CAD and its complications. Arterial function may change over time following treatment, but the prognostic value of these changes has not been investigated, especially in Thai population with CAD. The present study was aimed to assess whether the arterial stiffness of patients with CAD is improved after percutaneous coronary intervention (PCI).

Methods: A total of 17 CAD patients (12 males and 5 females, mean age 63±8 years) were studied. All patients were underwent PCI. Aortic-femoral pulse wave velocity (afPWV), brachial-ankle pulse wave velocity (baPWV), and aortic-ankle pulse wave velocity (aaPWV) were measured at baseline before underwent coronary angiography and after treatments for 1-3 years. Blood samples were collected for biochemical assays.

Results: During follow-up, we noticed that afPWV was significantly improved after treatments ($p<0.05$), whereas baPWV and aaPWV remained unchanged. There were no differences in medication treatments before and after PCI. Interestingly, plasma MDA concentration was significantly reduced after PCI ($p<0.05$).

Conclusion: Our findings suggest that a reduction in rigidity of large arteries may have a prognostic predictive value for assessment of therapeutic efficacy in CAD patients with a long treatment background.

Key words: coronary artery disease, arterial stiffness, percutaneous coronary intervention, pulse wave velocity

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Proceeding

Introduction

Coronary artery disease (CAD) is one of the major leading causes of death among Thai populations with a high clinical, social and economic burden. Elevated arterial stiffness has been associated with progression of cardiovascular morbidity and mortality[1]. It has been demonstrated that decreasing arterial rigidity may lead directly to a decreased risk of major adverse cardiac events in patients with CAD[2]. Pulse wave velocity (PWV) is a good marker for evaluating arterial stiffness[3]. Although arterial elasticity is reportedly associated with CAD, there are limited evidences demonstrating changes of arterial stiffness in Thai CAD patients, especially during the follow-up periods. Therefore, the aim of this study is to evaluate the arterial stiffness before and after treatments in Thai patients with CAD.

Methods

Study design and study population

The study population consisted of 17 participants (12 males and 5 females, mean age 63ฑ8 years). All study subjects were diagnosed as having CAD (presence of equal or more than 50% stenosis in any of main vessels). A stent implantation was performed in all patients with the standard interventional techniques by cardiologist at the Cardiac Catheterization Unit, Queen Sirikit Heart Center of Northeast, Faculty of Medicine, Khon Kaen University.

PWV, plasma MDA and blood biochemistry and anthropometric parameters were assessed before and after performing PCI. The follow-up period was 1-3 years (mean 1.83 $\pm$ 0.8 years). Exclusion criteria included unstable angina, recent myocardial infarction, recent coronary angioplasty, valvular heart disease, heart failure, end stage renal disease, inflammatory diseases, malignancy and hsCRP greater than 10 mg/L.

Each subject was recruited by a complete history, physical examination, and laboratory analysis. No caffeine intake or smoking was allowed before the study. The study was approved by the Ethics Committee for Human Research, Khon Kaen University. All participants received an explanation regarding the proposed study and provided written informed consent.

The measurement of pulse wave velocity

After resting in the supine position for 10 min in a quiet and temperature-controlled (25^0C) room, PWV was measured according to a previously described method[4] using a custom-built data acquisition system (Arterial Compliance Monitor, Barts and The London's School of Medicine and Dentistry, UK), compatible with commercial continuous wave Doppler probes (Dopplex

Table 1 The characteristics of all study subjects.

	Before (n = 17)	After (n = 17)
Systolic blood pressure (mmHg)	128 $\pm$ 17.77	130 + 16.0
Diastolic blood pressure (mmHg)	71.9 $\pm$ 10.7	71.3 $\pm$ 10.0
Pulse pressure (mmHg)	55.9 $\pm$ 12.9	58.8 $\pm$ 12.7
Heart rate (beats/min)	62.2 $\pm$ 7.1	65.6 $\pm$ 10.7
Waist circumference (cm)	90.2 $\pm$ 7.6	89.1 $\pm$ 8.8
Body mass index (kg/m^2)	25.2 $\pm$ 2.1	25.2 $\pm$ 3.3
Total cholesterol (mg/dL)	178 $\pm$ 38.9	177 $\pm$ 35.4
Triglyceride (mg/dL)	211 $\pm$ 98.0	183 $\pm$ 95.8
HDL-cholesterol (mg/dL)	37.7 $\pm$ 8.8	43.7 $\pm$ 11.5*
LDL-cholesterol (mg/dL)	101 $\pm$ 31.5	97.2 $\pm$ 31.0
Fasting glucose (mg/dL)	117 $\pm$ 45.7	119 $\pm$ 32.0
Insulin (ตIU/mL)	19.5 $\pm$ 10.4	19.5 $\pm$ 7.2
HOMA-IR	5.81 $\pm$ 3.9	6.11 $\pm$ 3.7
hsCRP (mg/L)	3.73 $\pm$ 6.6	4.02 $\pm$ 5.6

All data are expressed as mean ฑ SD. HDL: high density lipoprotein; LDL: low density lipoprotein; HOMA-IR: homeostatic model assessment-insulin resistance; hsCRP: high sensitivity C reactive peptide; * p <0.05 *vs*. before treatments.

MDII, Huntleigh Healthcare, Cardiff, UK) and custom-made reflectance photoplethysmography (PPG) probes. PWV was measured by placing two pulse sensing probes at either end of arterial segment under study. The afPWV, baPWV, and aaPWV were measured by placing either two PPGs or PPG with Doppler probe (4-MHz) at each arterial segment. Data were analysed offline by custom-written software to detect the feet of the proximal and distal pulse waves and to measure the time delay between them. Knowing the distance between the proximal and distal sites and the propagation time delay between the artery waveforms, PWV was calculated and expressed as m/s.

Malondialdehyde assay

Venous blood samples were collected after an overnight fasting. Plasma MDA was assessed as thiobarbituric acid reactive substances followed a previous described method[5].

Statistical analysis:

Data were expressed as mean ± S.D. Comparison between two groups were used Student's *t*-test. *P*-value less than 0.05 was considered significant. All statistical analyses were performed using Stata version 11 (Stata Corp., College Station, TX, USA).

Results

The characteristics of the study populations are summarized in Table 1. There were no difference in systolic blood pressure, diastolic blood pressure, pulse pressure, heart rate, waist circumference, body mass index, total cholesterol, triglyceride, LDL-cholesterol, fasting glucose, insulin, HOMA-IR, and hsCRP between before and after PCI, whereas HDL-cholesterol was significantly increased after treatments.

All patients were treated with medications, including aspirin, statin, ARB/ACE inhibitors, beta-blocker, diuretic, clopidogrel and anti-diabetic drugs as shown in Table 2. There were no differences in medication treatments before and after PCI.

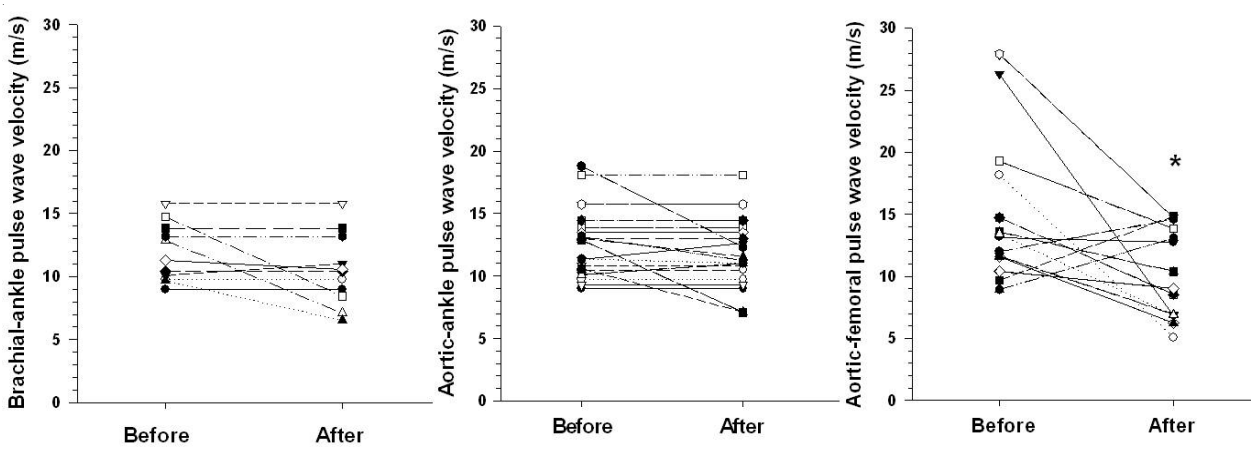

Figure 1 Brachial-ankle, aortic-ankle and aortic-femoral pulse wave velocities in coronary artery disease patients before and after treatments. *p<0.05 *vs.* before treatments.

Table 2 The medication treatments in patients with coronary artery disease before and after percutaneous coronary intervention.

Medications	Before (n=17)	After(n = 17)
Aspirin (%)	94	94
ARB/ACE inhibitors (%)	41	35
b- blockers (%)	41	41
Calcium antagonists (%)	0	17
Diuretics (%)	12	6
Clopidogrel (%)	35	71
Anti-diabetic drugs (%)	35	29
Statin (%)	88	94

The baPWV and aaPWV did not change before and after treatments, whereas afPWV, a marker of central arterial stiffness, was significantly reduced ($p<0.05$; Figure 1). The oxidative stress as assessed by plasma MDA, was significantly decreased in CAD patients after treatments ($p<0.05$; Figure 2). These data suggest that reduction in arterial stiffness and oxidative stress were found in CAD patients after PCI.

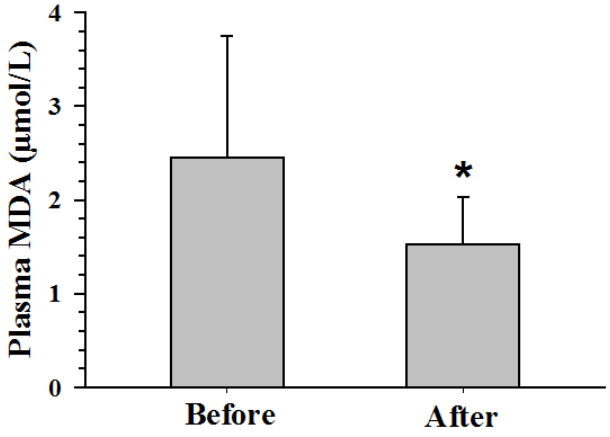

Figure 2 The levels of plasma malondialdehyde in coronary artery disease patients at before and after treatments. *$p<0.05$ *vs*. before treatments.

Conclusion

Our results showed that central arterial stiffness and oxidative stress were alleviated in CAD patients after PCI. Oxidative stress status and arterial elasticity property might be used as prognostic markers for assessment of therapeutic efficacy in CAD patients with a long treatment background.

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