



# Judgment value of brachial-ankle pulse wave velocity for lesion severity in hypertension patients with coronary arteriosclerosis

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## ABSTRACT

**Objective:** To analyze the judgment value of brachial-ankle pulse wave velocity for lesion severity in hypertension patients with coronary arteriosclerosis. **Methods:** A total of 100 cases of hypertension patients with coronary arteriosclerosis who received physical examination in Physical Examination Centre of our hospital were collected as research subjects of observation group, 100 cases patients with primary hypertension alone who received treatment in our hospital during the same period were selected as control group, brachial-ankle pulse wave velocity and ultrasound coronary area were detected, serum was collected to detect the levels of coronary arteriosclerosis illness-related indicators in it, and the judgment value of brachial-ankle pulse wave velocity for coronary arteriosclerosis severity was further analyzed. **Results:** PWV value of observation group was higher than that of control group while ABI value was lower than that of control group; intravascular ultrasound inspection showed that blood vessel volume, lumen volume and plaque volume of observation group were larger than those of control group; serum Hcy, Ox-LDL and ApoB/ApoA1 values of observation group were higher than those of control group while APN value was lower than that of control group; serum Lp-PLA2, sTWEAK, CML and bFGF values of observation group were higher than those of control group while secKlotho, Chrelin and MPO values were lower than those of control group; PWV and ABI values were directly correlated with disease severity-related factors. **Conclusions:** Brachial-ankle pulse wave velocity can effectively judge the lesion severity of hypertension patients with coronary arteriosclerosis, can be used as one of the accurate indicators to guide treatment and judge prognosis in clinical practice, and has important clinical value.

## 1. Introduction

Hypertension with coronary atherosclerosis is not uncommon in clinical practice, arterial endothelial dysfunction injury combined with lipid, etc. can all aggravate atherosclerosis process and lead to vascular stiffness and worsened elasticity, and there may even be acute coronary thrombosis and serious cardiovascular events in those with atherosclerotic plaque rupture[1]. In view of the disease severity in hypertension patients with coronary atherosclerosis, any

changes must be closely monitored in the process of treatment. Coronary angiography is the most direct and accurate way to judge coronary lesions, but because of its lag, high cost and other characteristics, its clinical application is limited. Basic screening and condition judgment by noninvasive technology is a hotspot of current clinical research, and the classical indexes that reflect arterial elasticity, pulse wave velocity (PWV) and ankle brachial index (ABI), are the effective noninvasive indexes to judge the severity of coronary artery lesions, are with simple operation and good repeatability, and are expected to become the alternative coronary angiography examination methods[2,3]. In the research, the judgment value of brachial-ankle pulse wave velocity for lesion severity in hypertension patients with coronary arteriosclerosis was mainly analyzed, hereby reported as follows.

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## 2. Materials and methods

### 2.1. Case selection

A total of 100 cases of hypertension patients with coronary arteriosclerosis who received physical examination in Physical Examination Centre of our hospital were collected as research subjects of observation group, 56 cases were male and 44 cases were female, they were 42-70 years old and the average was (57.28±6.11) years; 100 cases patients with primary hypertension alone who received treatment in our hospital during the same period were selected as control group, 54 cases were male and 46 cases were female, they were 40-71 years old and the average was (56.77±8.05) years. Differences in baseline information were not statistically significant between two groups ( $P>0.05$ ).

### 2.2. Observation indicators

Automatic arteriosclerosis instrument was used to detect pulse wave velocity (PWV) and ankle brachial index (ABI).

Intravascular ultrasound indexes: the radial artery path was adopted, ultrasound examination was only conducted in blood vessels with diameter 3.0 mm, 200  $\mu$ g nitroglycerin was injected in coronary artery before inspection, intravascular ultrasound probe was guided by coronary guidewire, sent into the distal target lesion and automatically withdrawn to the proximal lesion at the rate of 0.5 mm/s, and gray-scale intravascular ultrasound images were synchronously recorded during the period. Image analysis software was used to measure blood vessel volume, lumen volume and plaque volume with 1 mm distance.

Enzyme-linked immunosorbent assay was used to detect serum lipid and cysteine levels, including homocysteine (Hcy), adiponectin (APN), oxidized low density lipoprotein (Ox-LDL) and apolipoprotein B/apolipoprotein A1 (ApoB/ApoA1).

Serum phospholipase (Lp-PL)A2, soluble tumor necrosis factor-like weak inducer of apoptosis (sTWEAK), N carboxymethyl lysine (CML), secretory Klotho protein (secKlotho), Chrelin, peroxidase (MPO) and basic fiber growth factor (bFGF) levels of two groups were detected.

### 2.3. Statistical methods

Data obtained in the research was analyzed by SPSS 23.0 software, measurement data was in terms of Mean  $\pm$  SD, comparison between two groups was performed by t test, correlation analysis by unary linear regression and  $P<0.05$  was set as the standard of statistical significant differences.

## 3. Results

### 3.1. PWV and ABI values

Detection of PWV and ABI values of two groups by automatic arteriosclerosis instrument showed that PWV value of observation group was (1 683.29±137.96) cm/s and ABI value was (0.98±0.08); PWV value of control group was (1 314.29±115.78) cm/s and ABI value was (1.18±0.13). PWV value of observation group was higher than that of control group while ABI value was lower than that of control group ( $P<0.05$ ).

### 3.2. Intravascular ultrasound indicators

Intravascular ultrasound inspection showed that blood vessel volume, lumen volume and plaque volume of observation group were larger than those of control group ( $P<0.05$ ), shown in Table 1.

**Table 1**

Comparison of intravascular ultrasound indicator values between two groups (mm<sup>3</sup>).

Groups	Blood vessel volume	Lumen volume	Plaque volume
Observation	141.28±10.32	60.72±5.38	81.28±7.32
Control	134.07±12.08	53.38±4.97	60.17±5.89
<i>t</i>	6.392	7.182	9.834
<i>P</i>	<0.05	<0.05	<0.05

### 3.3. Lipid and cysteine levels

Serum Hcy, Ox-LDL and ApoB/ApoA1 values of observation group were higher than those of control group while APN value was lower than that of control group ( $P<0.05$ ), shown in Table 2.

**Table 2**

Comparison of serum lipid and cysteine levels between two groups.

Groups	Hcy ( $\mu$ mol/L)	APN (mg/L)	Ox-LDL ( $\mu$ mol/L)	ApoB/ApoA1
Observation	22.85±2.06	8.27±0.76	2.67±0.23	0.95±0.08
Control	14.37±1.29	14.27±1.35	1.34±0.12	0.72±0.06
<i>t</i>	8.394	6.483	5.332	5.093
<i>P</i>	<0.05	<0.05	<0.05	<0.05

### 3.4. Serum lesion severity-related factors

It showed that serum Lp-PLA2, sTWEAK, CML and bFGF values of observation group were higher than those of control group while secKlotho, Chrelin and MPO values were lower than those of control group ( $P<0.05$ ), shown in Table 3.

### 3.5. Correlation of PWV and ABI values with disease severity

PWV value was directly proportional to the values of blood vessel volume, lumen volume and plaque volume as well as the levels of Hcy, Ox-LDL, ApoB/ApoA1, Lp-PLA2, sTWEAK, CML and bFGF,

**Table 3**

Comparison of serum lesion severity-related factor levels between two groups.

Groups	Lp-PLA2 (μg/L)	sTWEAK (pg/mL)	CML (mg/L)	secKlotho (pg/mL)	Chrelin (μg/L)	MPO (U/mL)	bFGF (pg/mL)
Observation	386.72±35.96	1142.76±109.85	0.59±0.05	315.66±30.85	2.02±0.18	3.12±0.28	24.59±2.33
Control	147.82±11.95	812.83±76.95	0.23±0.02	453.82±49.83	3.15±0.32	4.57±0.43	18.36±1.76
<i>t</i>	9.384	12.371	5.382	8.934	5.723	6.124	7.293
<i>P</i>	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

and inversely proportional to APN, secKlotho, Chrelin and MPO levels ( $P<0.05$ ). ABI value was inversely proportional to the values of blood vessel volume, lumen volume and plaque volume as well as the levels of Hcy, Ox-LDL, ApoB/ApoA1, Lp-PLA2, sTWEAK, CML and bFGF, and directly proportional to APN, secKlotho, Chrelin and MPO levels ( $P<0.05$ ).

#### 4. Discussion

Atherosclerosis is the pathophysiological basis of many kinds of cardiovascular and cerebrovascular diseases, and early screening and detecting atherosclerotic lesions will help to move forward the front of cerebrovascular disease prevention and treatment. PWV refers to the distance that pulse wave conducts along the arterial wall in a period of time, it can reflect large artery stiffness, and PWV value will certainly increase in artery with increased stiffness[4]. Hence PWV is currently regarded as an indicator to early reflect large artery stiffness, and is an important parameter of propagation characteristics in human pulse system. ABI refers to the ratio of the peak values of ankle systolic blood pressure and bilateral brachial systolic blood pressure, the sensitivity and specificity of ABI diagnosis of lower-limb peripheral vascular disease are above 95%, and it is a reliable index to determine the lower-limb vascular lesion. Atherosclerosis can involve several blood vessels of the body, symptomatic lower-extremity peripheral arterial disease is window sign of atherosclerosis, so the ABI values is also one of the objective and noninvasive indicators that reflect the degree of atherosclerosis[5,6]. The above two noninvasive arteriosclerosis detection technology have been able to accurately assess the structure and function of blood vessels, but it is an urgent problem whether they guide diagnosis and treatment and reduce the incidence of atherosclerosis and ischemic events. In this study, the method of prospective study was intended to be used, cases of primary hypertension with coronary atherosclerosis were collected, PWV and ABI values were early detected and the traditional indicators related with atherosclerosis severity were further detected to judge the roles of PWV and ABI in predicting disease severity and guiding clinical treatment.

In above research, PWV and ABI values of two groups were detected at first, and results showed that PWV value of observation group was higher while ABI value was lower, which met with the characteristics of increased stiffness and weakened vascular elasticity after arteriosclerosis, and were the specific indicator values of coronary arteriosclerosis[7]. Intravascular ultrasound is a traditional noninvasive method to detect vascular inner and outer diameters,

and can provide high-resolution images of cross-sectional area of coronary lumen and plaque, thus measuring vascular cross-sectional area, plaque area and the degree of stenosis. Intravascular ultrasound inspection showed that both blood vessel volume and lumen volume of observation group increased, and the area of plaque with serious lipid accumulation was larger and could cause luminal stenosis, which indicated that atherosclerosis led to coronary artery wall stiffness, vasomotor change decreased with arteriopalmus, eventually causing increased lumen pathology and decreased degree of variation.

Coronary atherosclerosis process is accompanied with the change of levels of lipid and other microcirculation factors, which has played an important role in the development of disease, and can also be used as the objective index to judge the severity of disease[8]. Hcy is sulfur-containing amino acid composed of non-protein, and the intermediate product of methionine metabolism, and its content is very low in the body under normal condition. Hcy is an important potential risk factor for atherosclerosis, and as Hcy levels rise, the risk of atherosclerosis increases. APN is the only cytokine with decreased expression in obesity patients, and is the most closely related to atherosclerosis, and along with lipid accumulation and atherosclerosis formation, APN levels decline gradually, and is an independent risk factor for disease. Ox-LDL is a key factor to coronary atherosclerosis, is the product after oxygen free radicals oxidize and modify LDL, and can accelerate the body oxidation and promote atherosclerosis[9,10]. ApoB/ApoA1 is a clinical common risk stratification indicator of coronary heart disease, increased ApoB level indicates the increased risk of coronary heart disease, ApoA1 is HDL structural protein that can promote the reverse cholesterol transport. ApoB/ApoA1 value objectively reflects the body's atherosclerosis and anti-atherosclerosis balance, and decreased ApoB/ApoA1 value indicates that patient get better[11]. The research results showed that serum Hcy, Ox-LDL and ApoB/ApoA1 values of observation group were higher while APN value was lower, indicating that the changed levels of above factors were directly involved in the occurrence and development of coronary arteriosclerosis.

Lp-PL A2 has the effect of resisting and promoting arteriosclerosis at the same time, increased plasma level of Lp-PLA2 is the independent risk factor of coronary heart disease, and it can degrade oxidized phospholipids in low density lipoprotein, lead to enhanced local inflammation, and cause oxidative stress injury and vascular endothelial function damage[12]. sTWEAK can cooperate with the Ox-LDL to promote vascular smooth muscle inflammation and participate in the process of arteriosclerosis. CML is one of the molecular structures of the advanced glycosylation end products,

research shows that CML may play an important role in the process of coronary atherosclerotic plaque formation, and it also confirms the CML content in serum in patients with coronary heart disease is higher than that in normal people. secKlotho is a peptide hormone that participates in the regulation of a variety of functions and strengthens the body's anti-oxidative stress ability. A study shows that serum secKlotho concentration is lower in patients with coronary heart disease, indicating that the weakened protective effect of secKlotho on blood vessels is one of the important links that cause the occurrence of coronary atherosclerosis[13]. Chrelin is derived from the gastric X/A-like cells, its natural receptors are located in the aorta and coronary artery, Chrelin expression is raised several times in coronary atherosclerotic individuals, and it participates in the process of arteriosclerosis. MPO is polymorphonuclear neutrophil antioxidant that can clear ROS and maintain REDOX state of cells. Decreased MPO expression can lead to the accumulation of reactive oxygen species, start and participate in the occurrence and development of coronary atherosclerosis. bFGF is thought to be closely associated with coronary atherosclerosis, and study shows that serum concentration of bFGF rises sharply in patients with coronary heart disease[14]. The research results showed that serum Lp-PLA2, sTWEAK, CML and bFGF values of observation group were higher while secKlotho, Chrelin and MPO values were lower, indicating that above factors were directly involved in the occurrence and development of coronary arteriosclerosis, and their levels could be used as the objective indicators to judge disease severity.

Given that there are numerous coronary atherosclerosis-related factors, the estimating accuracy of single factor detection is limited, combined detection of a variety of factors increases sensitivity and specificity, but the detection amount is huge, the time required for the obtaining results is long, so it is not suitable for repeated clinical detection and condition monitoring[15]. In the research, the correlation of PWV and ABI values with the levels of disease-related factors was analyzed, and results showed that the values of PWV and ABI were directly correlated with disease-related factor values, and the detection of PWV and ABI is noninvasive and convenient, making clinical brachial-ankle pulse wave velocity inspection become the ideal means to monitor disease progress and guide clinical treatment.

To sum up, it is concluded as follows: brachial-ankle pulse wave velocity can effectively judge the lesion severity of hypertension patients with coronary arteriosclerosis, can be used as one of the accurate indicators to guide treatment and judge prognosis in clinical practice, and is worth popularization and application in clinical practice in the future.

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