Arterial Stiffness as a Marker of Cardiovascular Diseases

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Abstract: The current cardiovascular risk estimation scales (Framingham, SCORE, PROCAM, etc.) not fully predict it. In this regard, the search for new, more objective markers of risk, one of which is arterial stiffness is conducted.

The estimation of major risk factors impact on vascular stiffness in 48 patients (30 men and 18 women) aged 28–49 years (mean age 33,1±14,3 years) not suffering from hypertension and coronary heart disease. All patients were scored «low-risk»on the SCORE scale. It is found that in young and middle age patients with normal blood pressure (BP) gender, smoking, and abdominal obesity impact on the vascular stiffness parameters (pulse wave propagation time, the maximum rate of rise in blood pressure, arterial stiffness index, augmentation index, outpa tient index of stiffness). Tainted hereditary and moderate hypercholesterolemia do not have a significant effect.

Keywords: hypertension, risk factors, vascular wall stiffness.

It is known that existing scales for the assessment of cardiovascular risk (Framingham, SCORE, PROCAM, etc.) do not accurately predict it. In this regard, the search for new, objective risk markers continues, one of which is arterial stiffness [1].

Generally, the prognosis of patients with arterial hypertension (AH) is determined by the overall risk, of which high blood pressure (BP) is the most important, but not the only, component [2].

Achieving target blood pressure in the largest number of patients with hypertension partially solves the problem of effective treatment of hypertension and prevention of its complications [16]. For the effectiveness of treatment and prevention of hypertension, it is very important to influence not only the level of high blood pressure, but also other prognostic risk factors (RF) - dyslipidemia, smoking, increased arterial stiffness, etc. [4].

Increased arterial stiffness is an important independent risk factor for cardiovascular risk in hypertensive patients in whom target blood pressure levels have been achieved. Normalization of arterial stiffness in hypertensive patients is an additional important criterion of therapy effectiveness [15]. Today, one of the promising areas of scientific research is to study the possibility of correcting arterial stiffness in people without hypertension, but at high risk of developing it [21].

At the same time, as a rule, recommendations on the need to assess the condition of target organs apply to patients with hypertension, and in some cases, patients with diabetes mellitus. At the same time, pulse wave propagation speed and other indicators reflecting the state of the vascular wall, left ventricular hypertrophy and microalbuminuria are common in the general population, especially in people with other risk factors. smoking, dyslipidemia, and significantly age.

At the same time, the contribution of individual risk factors to the structure of such lesions in patients with a higher than normal level has not been sufficiently studied [6]. One of the promising areas of scientific research is the study of vascular stiffness in people with undiagnosed hypertension, but at high risk of developing it [21].

The purpose of the study: to evaluate the effect of risk factors (smoking, obesity, family history, hypercholesterolemia - hypercholesterolemia on the stiffness of blood vessel walls in individuals without hypertension.

Materials and methods

48 abnormal patients (30 men and 18 women) aged 28-49 years (average age 33.1±14.3 years) were examined. All patients were classified as low risk according to the SCORE scale.

All patients were evaluated for RF by history, examination, laboratory tests (lipid spectrum indicators, glucose level), 24-hour blood pressure monitoring (BPlab MnSDP-3 device,) and echocardiography (EchoKG). Obesity was diagnosed with a waist circumference greater than 80 cm in women and 94 cm in men and/or a body mass index greater than 29 kg m2.

If the glucose level is more than 5.6 mmol / L, fasting hyperglycemia is diagnosed. Using a 24-hour blood pressure monitoring device, in addition to its profile, the following parameters were evaluated: Pulse transit time (PTT) - pulse wave propagation time, dp / dt max - the maximum rate of increase in blood pressure, arterial stiffness Index (ASI) - arterial stiffness index, Augmentation index (AIx), AASI - ambulatory stiffness index.

PTT is the time from the opening of the aortic valve to the beginning of the pulse wave front in a certain part of the artery. AIx is the pulse wave growth index, which describes the ratio of the amplitudes of the direct and reflected pulse wave components from the aortic bifurcation and is measured as a percentage.

Usually, AIx is negative for pulsations detected in the brachial artery. In the case of high stiffness and/or increased amplitude of the reflected wave, the value of AIx will be positive. AASI was calculated based on the linear correlation coefficient between diastolic and systolic blood pressure (DBP and SBP) values during 24-hour monitoring. According to recent studies, it has been shown that an increase in AASI value of more than 0.5 should be considered as an additional risk factor for cardiovascular complications [5].

The maximum rate of rise in blood pressure (dP/dt) was measured in max mmHg. Art. per second. It was defined as the maximum derivative of arterial pressure with respect to time (at the leading edge of the pulse wave). This indicator indirectly reflects the myocardial contractility, the general stiffness of the main arteries, as well as the "dynamic" load on the vessel walls during the passage of the pulse wave. Individuals with relevant clinical conditions (myocardial infarction, stroke or transient ischemic attack, chronic heart and kidney failure, clinically significant rhythm disturbances), severe concomitant diseases (oncological, liver and kidney, etc.) were not included in the study.

EchoKG was performed on a Siemens device with a 3.25 MHz sensor in M-modal and two-dimensional modes in standard echocardiographic positions. The thickness of the walls of the left ventricle and the dimensions of the cavities were determined from the parasternal position of the long axis of the left ventricle. Measurements were made in M-mode with the ultrasound beam parallel to the short axis of the CHQ. Myocardial mass was calculated based on its length and short axis thickness

From parasternal access according to the formula of R. Devereux and N. Reichek (1977, 1985). The study did not include patients with segmental contractility disorders. Left ventricular myocardial mass index (LVMI) was calculated as the ratio LVMM / BSA, where BSA is the body surface area determined by the formula of D. Dubois (1975). LVH was defined as LVMI values greater than 115 g/m2 in men and 96 g/m2 in women according to the latest ASE recommendations in 2005 [13]. Contractile function (ejection fraction - EF) was estimated using the Teicholz formula

Statistical processing of results was performed using Student's t test using Biostat software, results were considered statistically significant at $p<0.05$;

The work was carried out within the framework of the research project "New technologies in 24-hour blood pressure monitoring (BPM)".

Results

We analyzed the relationship of vascular wall stiffness index to some risk factors for cardiovascular diseases (CVD) (smoking, family history, obesity, gender, hypercholesterolemia). The data is presented in the table.

Based on smoking adherence, patients were divided into 2 groups: current smokers and never smokers. Smoking patients (n=28) had significantly higher RTT scores than non-smoking patients (n=20), 154.1±23.3 and 137.6±31.5, respectively; arterial stiffness index (142.7±24.3 and 127.6±29.6, respectively) and ambulatory stiffness index

(0.28±0.02 and 0.23±0.04, respectively). Other indicators worsened in the smoking group, but the differences were not significant (p>0.05).

According to the results of BMI evaluation, 2 subgroups of patients were identified: those suffering from abdominal obesity (23 people) and patients with normal body weight (25 people). In the subgroup of patients with obesity, the values of the reproductive index were significantly different, in patients without abdominal obesity (-61.7) ± 12.3% compared to (-53.6) ± 13.7% (differences are significant, p < 0.05). .

PTT was higher in obese patients (163.6 ± 11.6) compared to non-obese patients (147.6 ± 25.1) (differences were significant, p < 0.05). Also, the index of arterial stiffness in obesity (143.7±31.5 and 129.8±27.8, respectively, p<0.05) and the index describing the maximum rate of increase in blood pressure (572.4±62 .5 and 541.9±45.4 respectively, p) was significantly higher. <0.05). Ambulatory stiffness index did not differ between subgroups based on weight.

We evaluated the parameters of the lipid spectrum in the examined patients. Total cholesterol level (TC) was considered higher than 5.5 mmol/l. Two subgroups of patients were identified: n=19 with hypercholesterolemia (mean total cholesterol 6.3±0.2) and patients with normal total cholesterol, n=29. In patients with hypercholesterolemia and in patients with normal lipid spectrum indicators, there are no significant differences in the estimated indicators of vascular wall stiffness (see table). This may be related to the average level of HSH in the studied group of patients.

There were 21 patients with heart attacks in the family. We found no significant effect of family history on vascular wall stiffness indicators (see table).

Significant differences were found between indicators describing persistence in subgroups depending on gender. Among the 18 women and 30 men we examined, all the identified parameters were higher in men, which reflects the stiffness of the blood vessel wall. Thus, growth index scores were significantly different, -39.1±12.6% in males versus -47.4±13.8% in females (significant differences, p<0.05) .

PTT was higher in males, 134.7 ± 21.6 vs. 146.9 ± 15.7 in females (significant differences, p<0.05). Arterial stiffness index was also significantly higher in men (133.1±28.8 and 116.4±27.9, respectively, p<0.05) and the index describing the maximum rate of increase in blood pressure (519 ,3±69.5 and 478.6±72.9, p<). 0.05). Ambulatory persistence index was also higher in the male group and was 0.28±0.02 compared to the female group, 0.12±0.01, p>0.05.

We analyzed the relationship of blood vessel stiffness indicators with age, but no differences were found between patients of different ages. This is probably due to the young age of the subjects (the oldest subject was 49 years old).

Discussion

Unlike circulating (high-sensitivity C-reactive protein, homocysteine), tissue biomarkers or markers of target organ damage can be used in combination with and independently of traditional risk factors, which is preferable and helps identify patients. will help. the risk of heart attack is high [3].

Vascular wall stiffness has certain characteristics as a risk factor. On the one hand, the relationship between the increased pulse wave velocity (PWV) in the aorta and the risk of heart and brain complications is well proven [7, 19,22]. In addition, recent data from the Framingham study suggest that adding PWV assessment to standard risk scales increases their informativeness [17]. On the other hand, there is a certain discrepancy between the expected relationship of vascular stiffness indicators with RF and the actual data of epidemiological studies. Thus, according to S. Laurent, the hardness of the vessel wall it increases with age, in the presence of arterial hypertension, diabetes and hypercholesterolemia [14].

A group of researchers M. Cecelja et al. [9] analyzed all publications on the association of PWV with risk factors and found that only age and blood pressure level were significant predictors of PWV, while the contribution of other factors was small. Even the presence of diabetes influenced the increase in blood vessel stiffness in only half of the study

In this case, the severity of the effect was small. Most studies have found no association between PWV and cholesterol levels, gender, or even obesity. At the same time, a clear relationship between vascular stiffness and damage to other organs, in particular, LV hypertrophy and thickening of the intima-media complex during ultrasound examination of blood vessels [8, 10, 11]. Many researchers explain this relationship with the independent contribution of vascular stiffness to cardiac remodeling and accelerated atherogenesis, which leads to increased risk. In addition, several data strongly suggest that vascular fibrosis is combined with myocardial fibrosis [12].

Our study revealed the relationship between parameters describing the stiffness of the vascular wall in young and middle-aged people with normal blood pressure, gender, obesity and smoking.

There was no association between vascular wall stiffness scores and family history of CVD and hypercholesterolemia.

Summary

In young and middle-aged people with normal blood pressure, a significant association was found between blood vessel stiffness scores and risk factors such as smoking, male gender, and abdominal obesity.

Disrupted heredity and moderate hypercholesterolemia did not significantly affect the parameters of the stiffness of the vascular walls.

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