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ARTERIAL WALL RIGIDITY IN PATIENTS WITH CHRONIC HEART FAILURE WITH PRESERVED SYSTOLIC FUNCTION OF THE LEFT VENTRICULAR

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Abstract:

In recent years, the number of patients with chronic heart failure with preserved ejection fraction (CHFsEF) of the left ventricle has sharply increased. It was found that the rigidity of the main arteries in patients with CHF-eFV of ischemic genesis is increased. An increase in central aortic pressure and augmentation index was also revealed. It was noted that the severity of CHF depends on the increase in the parameters of central hemodynamics. The relationship between increased rigidity of great vessels and NT-proBNP levels in patients with CHF-eFV was revealed.

Keywords: Chronic Heart Failure, Arterial Stiffness, Central Hemodynamic Parameters, Natriuretic Peptide.

INTRODUCTION.

Chronic heart failure (CHF) is a syndrome that develops as a result of impaired filling and/or emptying ability of the heart, proceeding in conditions of disturbed balance of vasoconstrictor and vasodilator factors of neurohumoral system, with inadequate perfusion of organs and body tissues.

One of the key parameters of hemodynamics in CHF is ejection fraction (EF), which determines systolic function of left ventricle (LV). In recent years, major clinical studies have shown that systolic dysfunction is no longer a prerequisite for CHF and there are more and more patients with symptoms and signs of CHF when LV systolic function is normal. The pathophysiological basis in most patients with preserved LVEF is diastolic LV dysfunction (LVDD) .

Increased arterial stiffness is increasingly recognized as a surrogate endpoint in cardiovascular disease (CVD). A number of studies consider arterial stiffness as a predictor of future major adverse cardiovascular events - ACS, myocardial infarction, stroke, revascularization and mortality of patients. One of the new directions of studying CHF is the determination of vascular wall stiffness in the pathogenesis of CHF with preserved ejection fraction (CHFsEF).

The aim of the study was to investigate the parameters of arterial stiffness, central aortic pressure (CAD) and echo wave parameters in CHF patients with preserved LV systolic function.

MATERIAL AND METHODS

The study enrolled 40 patients with signs and clinical symptoms of CHF of ischemic genesis and LVEF of 50% and more (CHFsFV). The mean age of the patients was 64.2±6.1 years, 28 of them were men (70%) and 12 women (30%). The study included clinical examination of the patients, ECG registration, EchoCG on ultrasound system SONO-SCAPE-5000 (China). To determine the functional class (FC) of CHF, all the patients underwent 6-minute walking test.

To estimate structural-functional state of large vessels wall and central hemodynamic parameters we used photo-plethysmography method using "Angioscan-01" hardware-software system (Russia). Automatic contour analysis of pulse wave assessed the following parameters: assessment of vascular stiffness - by reflection index (RI) and stiffness index (SI); assessment of central hemodynamic parameters - by central aortic pressure, augmentation index(AIx) and systolic pressure value in proximal aorta (SPa).

The level of brain natriuretic peptide precursor NT-proBNP was also determined by enzyme immunoassay.

Statistical processing was performed using the STATISTIKA-6 software package. Significance of differences in the mean values was assessed using parametric Student's test for dependent and independent samples in the case of their normal distribution, otherwise nonparametric Wilcoxon's test. Significance of differences was assessed at $p<0.05$. Correlation single-factor and multifactor analysis of

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variance and regression were used to determine the strength of the relationship between the parameters.

RESULTS OF THE STUDY

The leading symptom of CHF was dyspnea, and echocardiography showed cardiomegaly. Edema was detected in 30% of patients, and cardiac asthma attacks at night were detected in 60% of patients (Table 1). The symptoms of fluid retention were more pronounced in CCFIII patients, more often they had various clinically pronounced heart rhythm disorders (20%) - atrial fibrillation, extrasystole.

The state of arterial wall stiffness was characterized by the following parameters. Thus, increased stiffness led to increased vascular stiffness and central hemodynamic parameters - central aortic pressure and augmentation index, though no differences were found in other hemodynamic parameters. In patients with signs of CHF FK II and CHF FK III, vascular stiffness was significantly elevated: thus, RI index increased by 22.1% in CHF FK II and by 35.1% in CHF FK III; SI index increased by 33.3% and 49.3%, respectively. Parameters of central hemodynamics increased: AIx index - by 65% and 80% respectively (Table 1**)**

Table 1
Arterial stiffness and central hemodynamic parameters in CHF patients

Indicators	**CHF patients** (**P** =4)	**CHF FK I** (**P** =8)	**CHF FK II** (**P** =20)	**CHF FK III** (**P** =12)	**P**
AIx, %	18,4±14,6	14,8±11,4	18,5±15,1	21,8±17,4	< 0,05
Spa, мм рт.ст.	152,0±28,2	140,2±26,8	150,8±28,1	165,1±29,6	< 0,05
SI,м/с	10,2±3,5	9,5±3,1	10,0±3,4	11,2±3,9	< 0,05
RI, %	97,2±32,3	88,9±29,2	97,7±31,4	108,1±36,2	< 0,05

Changes in the content of natriuretic hormone (NT-proBNP) were observed in patients with CHF (Fig.1). The increase of NT-proBNP level depending on functional class of CHF was revealed (Table 2)

Таблица 2
NT-proBNP levels in patients with CHF with preserved EF

Indicators	**CHF FK I** (**P** =8)	**CHF FK II** (**P** =20)	**CHF FK III** (**P** =12)	**P 1-2**	**P** 1-3	**P** 2-3
NT-proBNP, пг/мл	186,1±4,3	290,5±4,3	368,7±3,5	< 0,001	< 0,001	< 0,001

NT-proBNP level was statistically significantly increased, although it was not significantly elevated, as is typical for CHF patients with LV systolic dysfunction (Fig.1).

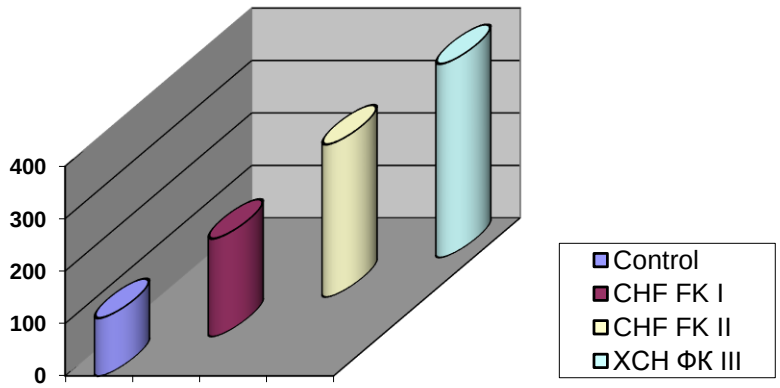

Figure 1. NT-proBNP levels as a function of CCNSFV severity

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The severity of CHF was correlated with NT-proBNP levels (r0.65; p0.0001). There was a direct correlation between AIx and NT-proBNP(r0.61; p0.0001); SI and NT-proBNP(r0.75; p0.0001). Also, increased vascular wall stiffness correlated with patient age (r0.68; p0.0001).

DISCUSSION

The results of the study showed that CHF develops in patients with CHD despite the preservation of LV systolic function. These disorders are also confirmed by laboratory - instrumental parameters - the increase of biochemical markers of CHF.

It is known that in the long-term course of CHD and especially after MI, most patients have LV systole and diastole disturbances, but systolic CHF does not develop in all patients. The results of our study showed that in patients with different functional classes of CHF, all other conditions being equal, the parameters of LV systolic and diastolic dysfunction were generally comparable.

Increased stiffness of the main vessels in CHF patients was established. Moreover, the degree of increased stiffness depended on the severity degree and functional class of CHF syndrome. This is confirmed by positive correlations between the values of natriuretic peptide and the stiffness index of the vascular wall. Also in CHF patients with increased arterial wall stiffness, we found an increase in the parameters of central hemodynamics - augmentation index and systolic pressure value in the proximal aorta. Apparently, increased vascular stiffness led to pathological overload of the heart due to increased pulse volume and worsened ventricular relaxation. As a consequence of the pathological impact of impaired cardiovascular interaction, there is relative coronary insufficiency due to decreased coronary perfusion pressure during diastole in patients with stiff arteries. This is also confirmed by clinical data, i.e., the frequency of angina in CHF patients with various functional classes.It can be assumed that exactly the combination of impaired LV diastole, moderate decrease in LV systolic function and increased arterial stiffness are those important components, leading to the development of CHF with preserved LV ejection fraction.

Thus, aggravation of intravascular hemodynamics due to LV-vessel interaction disorder as a result of pulse volume change is one of the reasons of insufficient treatment effect in patients with CHF of ischemic genesis.

CONCLUSIONS

In CHF patients with preserved LVEF of ischemic genesis, the stiffness of the vascular wall is increased.

Increased central aortic pressure and augmentation index in CHF patients with preserved LVEF and increased arterial stiffness were revealed.

Positive correlations between central aortic pressure, augmentation index and natriuretic hormone values were found in CHF patients with preserved VEF.

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