ORIGINAL ARTICLE

STRUCTURAL AND FUCNTIONAL PARAMETERS OF THE CARDIOVASCULAR SYSTEM DURING ATRIAL FIBRILLATION IN PATIENTS AFTER STROKE

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ABSTRACT

The aim: To evaluate the structural and functional parameters of the cardiovascular system during atrial fibrillation (AF) in patients after a stroke.

Materials and methods: In the main group, we selected 28 patients with non-valvular AF who had previously suffered an ischemic stroke (IS). The comparison group (30 people) included patients with AF without a stroke, comparable in age and gender.

Results: As a result of the study, we discovered an increase in the risk of stroke with an increase in the thickness of the intima-media complex>0.9mm. The thickness of the interventricular septum was 1.19 (1.1; 1.25) in the group of patients with IS, and in the group of patients without IS – 1.09 (1.0; 1.19) cm (p = 0.019), the thickness of the LV posterior wall is greater in the main group 1.14 (1.05; 1.24) and 1.09 (1.01; 1.18) cm in the comparison group (p = 0.038). The myocardial mass index is 123.3 in the main group and 107.4 g/m2 in the comparison group (p = 0.41), which indicates left ventricle (LV) hypertrophy in the main group.

Conclusions: thus, during AF in stroke patients, changes in the following structural and functional parameters of the cardiovascular system were discovered: an increase in the thickness of the interventricular septum, thickness of the posterior wall of the LV, and in the thickness of the intima-media complex.

KEY WORDS: ischemic stroke, non-valvular atrial fibrillation, echocardiography, heart

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INTRODUCTION

Atrial fibrillation (AF) is an important medical problem due to its widespread and increased mortality rate, increasing the risk of stroke by 5 times and increasing the risk of general mortality by 40 – 90% [1].

According to Hannon N. et al, with the development of stroke in a patient, a fatal situation arises not only for the brain, but for the whole body, which leads to a deterioration in the general somatic status [2].

One of the risk factors for ischemic stroke (IS) is a decrease in the peak blood flow velocity in the left atrial appendage (LAA) according to echocardiography (EchoCG). In this case, it is believed that the indicator is associated with a risk of atrial thrombosis, regardless of the form and duration of AF [3].

According to Golukhova E.Z. when conducting transesophageal echocardiography in patients with AF, it was found that the parameters of the hemodynamics of the heart, in particular: a decrease in blood flow velocity in the LAA less than 30 cm/s and the morphological type of LAA are predictors of intracardiac thrombogenesis [4].

There is evidence that a decrease in the ejection fraction of the left ventricle (LVEF) <50% and an increase in LA over 42mm increases the risk of LAA thrombosis in AF [5].

Basically, retrospective studies are conducted to study clinical or laboratory risk factors for thrombosis in AF patients who have had a cardioembolic stroke (CES). The anatomy and morphology of LAA describes the relationship between the formation of a thrombus in the LAA and complications of AF.

However, in recent years, many studies have proven that the most accurate criterion for the remodeling of the LA should be the volume index of the LA (index. LAV) [6]. It was proven that the volume of the LA correlates with the degree of atrial fibrosis [7]. There are data on the assessment of LV diastolic function (DF) in patients with AF as a predictor of recurrence of arrhythmia [8], however, there are still no accurate echocardiography parameters for stroke prediction. There are studies on the dysfunction of the LA (stanning), as a predictor of recurrence of arrhythmia and possible CES [6, 8]. «This phenomenon is based on several mechanisms: an excess of calcium in the cytoplasm of myofibrils, hibernation of the atrial myocardium due to tachycardia, as well as atrial fibrosis» [9].

In AF, diastolic dysfunction (DD) is difficult to assess with echocardiography due to the absence of atrial contraction (peak A), it is impossible to identify the type of left ventricular diastolic dysfunction LVDD. Also, there is a constant variation of indicators with each reduction, which makes repeated measurements necessary in order to obtain the average value and identify LVDF [1, 10, 11].

There is the possibility of assessing DD using tissue dopplerography (TD): the speed of movement of the

fibrous ring of the mitral valve (MV) is measured in the early filling phase of the left ventricle (E') and is an active component of diastole [12]. The ratio of the E' to the peak E of the transmitral blood flow (E / E' – i.e. the ratio of the rates of the early diastolic flow and the early diastolic movement of the myocardium) allows you to indirectly evaluate the pressure in the cavity of the LV. The ratio (E / E' > 15) which reflects the increase in pressure in the LV and the increase in the pressure of filling the LV, is one of the key parameters for assessing LVDF in patients with AF [13]. This indicator correlates with the «tau» coefficient, which reflects a decrease in LV pressure during the relaxation period.

Caputo M. et al. believe that the measurement of E / E', as a criterion for assessing LVDD, should be mandatory for the echocardiography protocol in individuals with AF, and treatment tactics for patients with LVDD and AF should include longer anticoagulant therapy [8]. However, till date, there are many questions regarding the accuracy of different methods for assessing LVDF in patients with AF.

Analyzing recent studies in patients with AF on echocardiography, it was revealed that the only risk factor for ischemic stroke (IS) is the presence of LV systolic dysfunction (LVSD) corresponding to LVEF <40%. When studying the data of trans esophageal echocardiography in ischemic stroke, evidence such as the presence of blood clots in the LAA, decrease in blood flow in the appendage less than 20 cm/s, the presence of spontaneous contrast, as well as atherosclerotic lesions of the aorta attest. [9].

It was found that in people with AF up to 60 years without structural heart disease, the risk of IS and systemic thromboembolic complications (TEC) is 1.3% over 15 years. Unlike patients older than 75 years, who, on the contrary, had a very high risk of stroke [14].

Thus, it seems important to us to evaluate the structural and functional parameters of the cardiovascular system for atrial fibrillation in stroke patients in order to identify echocardiography parameters that increase the risk of stroke and resulting from a stroke.

THE AIM

The purpose of our research was to evaluate the structural and functional parameters of the cardiovascular system during atrial fibrillation in patients after stroke.

MATERIALS AND METHODS

In connection with the aim, we selected 28 patients with non-valvular atrial fibrillation who had previously suffered an ischemic stroke, of which 18 (64.3%) were men and 10 (35.7%) were women, the average age of the patients was 69.6 (62; 74), body mass index (BMI) – 29.20 (24.6; 33.2) kg / m2. The selection was conducted at the «City Hospital No. 2 of Belgorod City State Budgetary Healthcare Institution» (from January 2018 to December 2019).

Written informed consent was obtained from patients to participate in the study, permission was also received from the Ethics Committee of the Belgorod State National Research University to conduct the study.

The comparison group (30 people) included patients with non-valvular AF without stroke and transient ischemic attacks (TIA), a history of comparable age: 19 (63.3%) men and 11 (36.7%) women. Inclusion criteria: presence of non-valvular AF; the presence of 2 points when calculating the risk of feasibility study on the scale of CHA2DS2-VASc in men and 3 in women. Patients with valvular AF (moderate to severe and severe mitral stenosis or mechanical prosthesis of heart valves), thyrotoxicosis, and a history of cancer were excluded from the study.

All the patients underwent laboratory diagnostics, electrocardiographic (ECG), echocardiographic (Echo) studies, ultrasound duplex scanning of the arteries of the brachiocephalic zone (ultrasound of the BCA), and also filled out an individual questionnaire, which indicated anamnesis with the date of onset of atrial fibrillation, accompanying stroke pathology and all medications that the patient was on.

Structural and functional parameters of the heart were evaluated on a GE VIVID 7 Vantage (Expert Class Digital Ultrasound System) ultrasound apparatus, a multi-frequency sensor 2.5-4 for cardiac research. Echocardiography was performed according to the standard technique in M and B modes and tissue dopplerography. Determination of LV ejection fraction (EF) using the Simpson method.

The assessment of the intima-media complex (IMC) and the percentage of stenosis of the carotid arteries (CA) was performed on the device in accordance with the Russian national recommendations for cardiovascular prophylaxis of 2017 [15]. The thickness of IMC CA (mm) was determined at three standard points. The increase was considered the thickness of the IMC > 0.9 < 1.3mm. Local thickenings of more than 1.3 were considered evidence of the presence of atherosclerotic plaque (ASP). The degree of stenosis of the carotid arteries was assessed using the criteria of the ECST method (European Carotid Surgery Method), in which the degree of stenosis of the bifurcation of the common carotid artery is calculated as the ratio of the difference between the maximum and free lumen of the vessel to the maximum diameter of the vessel, expressed in percentage [16].

Statistical processing of the material was carried out using the program "Statistica 6.0". The methods of descriptive statistics were used with the determination of the median (Me), and the interquartile range with the lower and upper quartiles (Q1 – Q3). Quality indicators were expressed in percentage. All indicators are given in the SI system. To assess the significance of differences between groups in quantitative terms, the nonparametric Mann-Whitney test was used. The analysis of differences in qualitative characteristics in two independent groups was carried out by constructing contingency tables with the subsequent calculation of the χ^2 Pearson's criterion and the Odd ratio, with the calculation of 95% CI. The normality of the distribution was checked using the Shapiro-Wilk test; an abnormal distribution was detected. Significant changes in the indicators were considered at which $p < 0.05$.

Table 1. The dynamics of the structural and functional parameters of the cardiovascular system during atrial fibrillation in patients after stroke.

Index	Main group (n = 28)	Comparison group (n = 30)	p
Thickness IVS, cm	1.19 (1.1; 1.25)	1.09 (1.0; 1.19)	0.019
Thickness LVPWd, cm	1.14 (1.05; 1.24)	1.09 (1.01; 1.18)	0.038
LVMI, g/m2	123.3 (117.1; 129.4)	107.4 (101.6; 115.4)	0.041
LVEDD, cm	4.81 (4.21; 5.48)	4.76 (4.1; 5.38)	0.28
LVESD, cm	3.42 (2.67; 4.12)	3.39 (2.62; 4.1)	0.19
LVEF Simpson, %	53.4 (44.8; 61.5)	55.12 (45.9; 63.4)	0.24
Width LAA, cm	4.26 (3.65; 4.81)	4.23 (3.69; 4.76)	0.31
Length LAA, cm	6.02 (5.08; 6.9)	5.86 (5.03; 6.61)	0.12
Volume LAA, ml	73.71 (49.6; 87.2)	71.2 (48.1; 86.3)	0.26
Volume index LAA, ml/m2	39.9 (34.8; 44.7)	37.6 (31.4; 43.5)	0.11
E/E', unit	14.6 (11.2; 17.4)	13.8 (10.1; 16.2)	0.14
IMC CA, mm	1.03 (0.97; 1.1)	0.91 (0.84; 1.05)	0.021

Table 2. Ratio of odds to stroke risk

Factor	OR	95 %CI
LVMI according to Echo	2.596	1.253 – 5.712
IM thickness CA	5.534	2.629 – 11.612

RESULTS

Among the examined patients, a history of concomitant diseases were identified: Hypertension (HTN), coronary heart disease (CHD), and chronic heart failure (CHF). The average duration of AF disease was 4.7 (2.6; 6.4) years in the study group and 3.8 (2.0; 5.1) years in the comparison group (p = 0.07). A stroke was suffered in the range of 4 to 19 months ago.

In the main group there were 9 (32.13%) patients with paroxysmal AF, 10 (35.7%) with persistent atrial fibrillation.

We identified a lack of commitment to taking anticoagulants. Only 12 (42.87%) patients took direct oral anticoagulants (DOAC), 5 (17.86%) took warfarin and 10 (35.7%) – indicated only the intake of acetylsalicylic acid (ASA) and / or clopidogrel. 1(3.57%) patient did not take antithrombotic drugs at all. In this case, the question about whether anticoagulants were prescribed, almost all patients (92.8%) answered positively, the remaining 2 could not remember the purpose of these drugs.

In the study of previous antithrombotic therapy, the following indicators were in the comparison group: ASA and / or clopidogrel were received by 15 (50%) people, warfarin – 8 (26.7%), novel oral anticoagulants (NOAC) – 7 (23.3%).

In patients in the main group, the average score on the CHA2DS2-VASc scale was 4.5 (3: 5) and in the comparison group 2.75 (2; 4) p = 0.068.

Currently, there is no single accurate echocardiographic parameter that is used to diagnose LV diastolic dysfunction in patients with AF.

It is recommended to use echocardiographic examinations, including a comprehensive analysis of two-dimensional echocardiography, Doppler echocardiography, as well as color tissue Doppler ultrasound. [10, 17].

From table 1, it shows that when comparing the main group and the comparison group, statistically significant differences were found in the following indicators: thickness of the interventricular septum (IVS) -1.19 (1.1; 1.25) in the group of patients with stroke, and not IS – 1.09 (1.0; 1.19) cm (p = 0.019), the thickness of the posterior wall of the left ventricle (LVPWd) is greater in the main group 1.14 (1.05; 1.24) compared to 1.09 (1.01; 1.18) cm in the comparison group (p = 0.038). The myocardial mass index (LVMI) is 123.3 (117.1; 129.4) g/m2 in the main group and 107.4 (101.6; 115.4) g/m2 in the comparison group (p = 0.041). This indicates LV hypertrophy in the main group.

LV sizes did not significantly differ: the end diastolic dimension of the left ventricle (LVEDD), the end systolic dimension of the left ventricle (LVESD). The ejection fraction of the left ventricle also did not have significant differences; in the group of patients with stroke, it was 53.4 (44.8; 61.5) % and 55.12 (45.9; 63.4) % in the group of patients without stroke (p = 0.24).

The width of the LV in the first group was 4.26 (3.65; 4.81) cm, and in the second group – 4.23 (3.69; 4.76) cm; without statistically significant differences. Similar results were obtained for the volume of the LV – 73.71 (49.6; 87.2) ml in the main group and 71.2 (48.1; 86.3) in the control group (p = 0.26).

The LV volume index was above norm in both groups, which indicates the presence of LV DD in both groups, (39.9 (34.8; 44.7) ml / m2 in the main group and 37.6 (31.4; 43.5) ml /m2 in the control group (p = 0.11)).

The ratio of the rates of early diastolic flow and early diastolic movement of the myocardium E / E' in the main group 14.6 (11.2; 17.4) units and in the control group 13.8 (10.1; 16.2) units did not differ significantly.

The thickness of the intima-media in the main group was statistically significantly different – 1.03 (0.97; 1.1) mm and 0.91 (0.84; 1.05) mm in the comparison group (p = 0.021), which indicates an increased thickness of the arterial walls in patients and in our opinion is not as a result of a stroke, but on the contrary, a stroke could be a result of the thickening of the intima-media of the arteries of the brachiocephalic zone. In the group of patients with IS, the thickness of the intima-media exceeded the norm in the carotid arteries more than 0.9 mm. In the main group, such patients were 19 (67.8%), and in the comparison group only 7 patients (23.3%); p = 0.01.

Analyzing the ECG data, it was found that signs of LV hypertrophy were observed in 16 patients (57.1%) in the main group and 12 patients (40%) in the comparison group, p = 0.043.

We evaluated the association of indicators with the risk of stroke. The results of calculating the odds ratio, when conducting a one-factor analysis are presented in table 2.

Table 2 shows that a significant association with the risk of stroke was identified by LVMI with echocardiography (evidence of left ventricular hypertrophy) and by the thickness of the intima-media of the CA.

DISCUSSION

We identified a lack of commitment to taking anticoagulants, despite the high risk of developing complications. The recommendation for the management of patients with atrial fibrillation and especially after ischemic stroke, the need for constant administration of anticoagulant therapy is clearly stated [1, 15].

Our data of previous antithrombotic therapy are comparable with the results of the study by A. Karpov, where ASA was received by 50.6% patients, 23.1% received warfarin, 8.3% – dabigatran, 19.4% rivaroxaban, and 4.3% received apixaban. [18].

The average score on the CHA2DS2-VASc obtained in our study is comparable with the data of other studies. There is a study of 281 patients with AF from Krasnoyarsk [19]. According to their register, in patients, the average score on the CHA2DS2-VASc scale was 3.6 (2.0 – 5.0), which is also comparable to the data obtained from the international registry GARFIELD, in which the average score is 3.2, and European (PREFER in AF) – 3.4 points [20, 21].

The LV volume index was above norm in both groups, which indicates the presence of LV DD in both groups. A study by Gupta S. et al. proved that the most accurate criterion for the remodeling of LV should be considered the index of LA volume [6]. It was also proven that the volume of the LA correlates with the degree of atrial fibrosis [7], however, there are still no exact echocardiography parameters for predicting stroke.

The ratio of the rates of early diastolic flow and early diastolic movement of the myocardium E / E' in the main group and in the control group did not differ significantly. In the presence of AF, LVDF certainly suffers, but its assessment during arrhythmia is difficult [21, 22].

Association with the risk of stroke was identified by LVMI with echocardiography (evidence of left ventricular hypertrophy) and by the thickness of the intima-media of the CA. Our data are consistent with the results of a study by Nikolin D.U. et al. In their opinion, left ventricular hypertrophy according to echocardiography is associated with an increased risk of ischemic stroke [23].

We realized statistically significant differences between the groups using the following echocardiographic parameters: thickness of the interventricular septum, thickness of the posterior wall of the left ventricle and the left ventricular myocardial mass index in patients who have had ischemic stroke. When studying the sources, we did not find such results.

In our study, a significantly higher frequency of occurrence was found in patients whose intima-media thickness exceeded the norm in the group with ischemic stroke. A number of studies have shown that an increase in the risk of stroke was shown with an increase in the thickness of the intima-media complex of the carotid arteries of more than 0.9 mm [24, 25].

The left atrial volume index was above norm in both groups in both groups, which indicates the presence of diastolic dysfunction of the left ventricle with atrial fibrillation. After all, it is the volume of the left atrium that correlates with the degree of atrial fibrosis and atrial fibrillation [6-8]. But, we were not able to determine the statistically significant differences in the left atrial volume index in patients with and without atrial fibrillation.

CONCLUSIONS

Thus, as a result of the study, we realized statistically significant differences between the groups using the following echocardiographic parameters: thickness of the interventricular septum, thickness of the posterior wall of the left ventricle and the left ventricular myocardial mass index in patients who have had ischemic stroke.

An increase in the risk of stroke was shown with an increase in the thickness of the intima-media complex of the carotid arteries of more than 0.9 mm and an increase in the left ventricular myocardial mass index. In our study, a significantly higher frequency of occurrence was found in patients whose intima-media thickness exceeded the norm in the group with ischemic stroke 67.8% and only 23.3 % in the comparison group.

The left atrial volume index is higher than normal in both groups, 39.9 (34.8; 44.7) ml / m2 in the main group and 37.6 (31.4; 43.5) in the control group), which indicates the presence of diastolic dysfunction of the left ventricle with atrial fibrillation. However, we were not able to determine the statistically significant differences in the left atrial volume index in patients with and without atrial fibrillation.

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Conflict of interest
The Authors declare no conflict of interest

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