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Studying Signs of Diastolic Dysfunction of the Right Ventricle in Patients with Hypertonic Disease

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Abstract- Hypertension is currently one of the most pressing medical problems. This is largely due to the fact that arterial hypertension, which is largely responsible for high cardiovascular morbidity, disability and mortality, and is also characterized by a wide prevalence. Early diagnosis of changes in the heart in patients with essential hypertension is of great practical interest, which allows timely preventive measures and treatment. As a rule, with arterial hypertension, the left ventricle is primarily and to a greater extent affected, since the main load falls on it from the very beginning of the disease. The analysis of parameters of diastolic function of the right ventricle was carried out depending on the level of rise in diastolic blood pressure between patients with mild and high arterial hypertension. At the same time, significant differences were revealed that related to the ratio of the maximum filling rate to the maximum expulsion rate.

Keywords: essential hypertension, arterial hypertension, diastolic dysfunction, right ventricle, echocardiography, maximum filling rate, maximum expulsion rate.

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Studying Signs of Diastolic Dysfunction of the Right Ventricle in Patients with Hypertonic Disease

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Abstract- **Hypertension is currently one of the most pressing medical problems. This is largely due to the fact that arterial hypertension, which is largely responsible for high cardiovascular morbidity, disability and mortality, and is also characterized by a wide prevalence. Early diagnosis of changes in the heart in patients with essential hypertension is of great practical interest, which allows timely preventive measures and treatment. As a rule, with arterial hypertension, the left ventricle is primarily and to a greater extent affected, since the main load falls on it from the very beginning of the disease. The analysis of parameters of diastolic function of the right ventricle was carried out depending on the level of rise in diastolic blood pressure between patients with mild and high arterial hypertension. At the same time, significant differences were revealed that related to the ratio of the maximum filling rate to the maximum expulsion rate. There was a tendency to an increase in the time of the fast filling phase of the contribution of the fast filling phase to the right ventricular diastole, which is due to the initial signs of diastolic dysfunction of the right ventricle with a decrease in the maximum filling rate and a moderate increase in the contribution of right atrial systole to right ventricular filling.**

Keywords: essential hypertension, arterial hypertension, diastolic dysfunction, right ventricle, echocardiography, maximum filling rate, maximum expulsion rate.

I. Introduction

Hypertension is currently one of the most pressing medical problems. This is largely due to the fact that arterial hypertension, which largely determines high cardiovascular morbidity, disability and mortality, and is also characterized by a wide prevalence. [1, 2]

Myocardial remodeling remains a significant factor worsening the course and prognosis of hypertension. While the remodeling of the left ventricle in hypertension has been studied rather well, the state of the right ventricle has received much less attention. Violations of the diastolic function of the right ventricle in patients with heart failure are an independent prognostic factor for survival, and the use of tissue Doppler ultrasonography reveals new informative parameters of diastolic dysfunction, as well as to prove its relationship with the development of pulmonary hypertension [1, 2, 4].

Despite the proven opinion about an increase in the risk of death from cardiovascular diseases with a combination of heart failure and arterial hypertension, myocardial remodeling in hypertensive disease against the background of concomitant heart failure is also insufficiently studied. Adaptive processes in the heart during the development of heart failure against the background of long-term arterial hypertension have their own characteristics, manifested in impaired diastolic function of the right ventricle. [5, 6, 7] preventive measures and treatment. As a rule, in this disease, the left ventricle is primarily and to a greater extent affected, and the main load falls on it from the very beginning of the disease [8, 9, 10]. It should be noted that the diastolic function, being a complex process consisting of numerous interrelated factors, depends on such indicators as: age, gender, body surface area, breathing phase, ventricular myocardial mass, heart rate, - and after load. [11, 12] With the help of various research methods, it has been established that the pancreas with hypertrophy also undergoes hypertrophy, impairments of its contractility and clinically expressed insufficiency develop. [12]

Purpose of the study: To study the diastolic function of the right ventricle in patients with different stages of hypertension and with concomitant heart failure of II-III functional classes.

II. Materials and Methods

We examined 71 patients with essential hypertension. All examined were subjected to a comprehensive examination in order to exclude symptomatic hypertension and other diseases. The diagnosis of hypertension was made on the basis of the criteria proposed by the WHO expert committee. The study included patients with stage II-III hypertension - 31 women (43.66%) and 40 men (56.3%) (aged 25 to 63). The average age in the group was 50.3 ± 4.6 years. For men, the average age was 43.4 ± 4.9 years and for women, 52.7 ± 4.9 years. The antihypertensive drugs were discontinued 24 hours before the start of the study.

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Electro - ocardiographic examination was carried out in 12 conventional leads at a speed of 50 mm / sec.

Blood pressure was measured after at least 5 minutes of patient rest. Blood pressure was measured on the right brachial artery using the Korotkov method. The diagnosis of stage II hypertension was established in 46 patients. The average age of the patients was 42.3 ± 4.2 years. Of these, 21 women (average age 44.7 ± 4.7 years) and 25 men (average age 37.4 ± 4.7 years). The study excluded patients with diseases that significantly affect the systolic and diastolic function of the right ventricle, such as diabetes mellitus, obesity, chronic nonspecific lung diseases, tricuspid regurgitation more than grade II, tachycardia with heart rate more than 100 beats per minute and atrial fibrillation.

III. Results and Discussion

All patients showed signs of left ventricular hypertrophy on the ECG and the presence of hypertensive retinal angioretinopathy. Stage III hypertension was diagnosed in 25 patients with lesions of target organs. The average age of the patients was 57.1 ± 4.3 years. Of these, 10 women (average age 55.9 ± 4.6 years) and 15 men (average age 62.4 ± 4.5 years). Of these, 7 patients (2 women and 5 men, average age 63.3 ± 4.7 years) had a history of transient cerebrovascular accidents, the remaining 18 (6 women and 12 men, average age 56.2 ± 5 , 3 years) - documented coronary heart disease. The groups of patients with stage II and III hypertension did not differ significantly in terms of sex and age. The combination of hypertension and coronary heart disease and 8 men, mean age 54.3 ± 2.6 years) and in 15 patients with hypertension stage III (60%) (7 women and 8 men, mean age 61.2 ± 7.3 years the diagnosis of ischemic heart disease in hypertensive patients was made according to the criteria recommended by the WHO [2]. In the group of patients included in the study, the duration of hypertension was 13.4 ± 3.2 years, the duration of a stable increase in blood pressure was - 9.7 ± 3.8 years. 38 examined patients (53.5%) complained of headaches, 21 patients complained of dizziness, 29.5%), pain in the left side of the chest was observed in 30 patients (42.2%). The severity of heart failure in patients with various stages of hypertension is shown in Table 1.

Table 1: The severity of heart failure in hypertensive patients

	Heart failure Functional class I	Heart failure Functional class II	Heart failure Functional class III	Heart failure Functional class IV
Hypertonicdisease Stage II	20	24	2	-
Hypertonicdisease Stage III	2	13	10	-

The distribution of patients by age and severity of heart failure is shown in Table 2.

Table 2: Distribution of patients by age and severity of heart failure

Patientage	Less than 39	40-49	50-59	60-69	Total
Numberofpatients	10	33	18	10	71
Heart failure Functional class I	8	10	2	2	22
Heart failure Functional class II	2	22	4	1	37
Heart failure Functional class III	-	1	-	7	12
Heart failure Functional class IV	-		-	-	0

Among the examined patients included in the study, the labile course of the disease was noted in 7 (9.8%), stable blood pressure values - in 64 (90.1%) patients.

According to the "Recommendations of the WHO Committee of Experts" [1,2], the examination included patients with mild, moderate and high arterial hypertension. Patients with a mild form of increased blood pressure were 25 (35.2%), with a moderate form - 37 (52.1%) and high arterial hypertension - 9 patients (12.7%).

An objective clinical study in 26 patients (36.6%) revealed an expansion of the boundaries of the relative dullness of the heart to the left. And in almost all examined patients during auscultation, an accent of the II tone was heard by the aorta; in patients with

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hypertension stage III, a tendency toward a decrease in the fraction of the right ventricle was determined. The rest of the clinical indicators between the subgroups practically did not differ. Comparative clinical characteristics of patients depending on the degree of rise in diastolic blood pressure are shown in Table 3. Indicators of systolic function of the right ventricle did not differ significantly between the subgroups.

Table 3: Clinical characteristics of patients with varying degrees of rise in diastolic blood pressure

	Mild (n = 25)	Moderate (n = 37)	High(n = 9)
Patientage	63,3± 5,3	65,3± 12,3	68,4± 13,7
Durationofillness	13,8+6,5	14,7 ±3,6	15,8±7,8
Duration of a stable flow	9,7±4,5	9,9±5,6	10,2±4,6
Systolic blood pressure	153,5±8,7	168,6±9,7	195,6±9,4
Diastolicbloodpressure	98,6+7,8	110,8±4,7	195,8±4,8
Heartfailurefunctionalclass	1,9±0,3	1,8±0,3	2,0±0,4
Rightventricularejectionfraction,%	55,4±8,7	66,7±10,8	58,5±7,7
Stroke volume of the right ventricle, ml	62,1±5,3	57,6±4,7	53,3±5,6

The analysis of the parameters of the diastolic function of the right ventricle was carried out depending on the level of rise in diastolic blood pressure between patients with mild and high arterial hypertension. At the same time, significant differences were revealed that related to the ratio of the maximum filling rate to the maximum expulsion rate with a tendency to an increase in the time of the fast filling phase, the contribution of the fast filling phase to the diastole of the right ventricle, which was due to the initial signs of diastolic dysfunction of the right ventricle with a decrease in the maximum speed filling and a moderate increase in the contribution of the right atrial systole to the filling of the right ventricle.

The indices of relaxation and filling of the right ventricle between patients with mild and moderate increases in blood pressure did not differ significantly, except for patients with a moderate increase in diastolic blood pressure. When analyzing the diastolic function of the right ventricle, depending on the stage of hypertension, the following indicators were revealed (Table 4). Significant differences between the subgroups of patients with essential hypertension concerned only the ratio of the maximum filling rate to the maximum expulsion rate, which significantly decreased in stage II hypertension.

Table 4: Indicators of diastolic function of the right ventricle in patients with varying degrees of rise in diastolic blood pressure

	Mild (n = 25)	Moderate (n = 37)	High(n = 9)
Maximum filling speed, ml / sec	280,8±12,7	300,6+15,8	299,7±17,6
Maximum expulsion rate, ml / sec	300,5±13,6	301,4±13,7	298,6±10,7
Time to reach the maximum filling rate, msec	334,3+35,8	320,7±36,9	321,9±34,9
Time to reach the speed of maximum expulsion, msec	140,4±18,9	144,7±11,6	140,8+18,8
Time to reach the speed of maximum filling, correlated to the duration of the cardiac cycle,%	34,4±14,8	37,7±11,9	36,8±15,7
Time to reach the speed of maximum filling, correlated to the duration of diastole,%	35,3±15,5	35,6±12,6	35,5±14,6
The ratio of the maximum filling rate to the maximum expulsion rate, units	0,84±0,08	0,96±0,08	0,95±0,06
Contribution of the first third of diastole to filling the right ventricle,%	15,3±8,6	15,6±6,6	16,6±9,6
Fastfillingphasecontribution,%	42,5±6,9	32,7±6,8	35,6±7,5
Contribution of right atrial systole to right ventricular filling,%	15,9±5,8	14,8±6,6	14,7±4,8
End-diastolic volume of the right ventricle, ml	125,5±9,7	127,9±8,9	135,8±8,8

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Table 5 Indicators of diastolic function of the right ventricle at different stages of hypertension

	Hypertension II stage (n=46)	Hypertension IIIstage(n=25)	Control
Maximum filling speed, ml / sec	300,3+14,6	340,7± 15,8	302,4±15,8
Maximum expulsion rate, ml / sec	314,7±135	300,5+11,2	302,5±14,2
Time to reach the maximum filling rate, msec	330,3±42,6	189,9±36,8	320,5±15,6
Time to reach the speed of maximum expulsion, msec	314,7±13,5	143,5±13,7	147,7±8,6
Time to reach the speed of maximum filling, correlated to the duration of the cardiac cycle,%	330,3±42,7	42,7±11,8	20,8±16,7
Time to reach the maximum filling rate in relation to the duration of diastole,%	138,5±14,7	41,4±12,3	25,5+15,6
The ratio of the maximum filling rate to the maximum expulsion rate, units	24,3±13,8	1,04+0,04	0,93+0,03
Contribution of right atrial systole to right ventricular filling,%	24,3±147	23,7±8,4	18,6+10,6
Fastfillingphasecontribution,%	0,88±0,08	40,6±6,4	40,6±64
Contribution of right atrial systole to filling of the right ventricle,%	15,3±8,6	14,7±6,7	12,7±3,7
End-diastolic volume of the right ventricle, ml	37,5±8,7	135,8±9,9	125,6±5,8
Stroke volume of the right ventricle, ml	13,5±7,8	46,7±5,7	52,3±4,7

Further study of the diastolic function in patients with stage II hypertension revealed that 31 patients (40.8%) had a "pseudo-normal" type of diastolic disorders, which consists in approaching the normative indicators of the maximum filling rate, as well as in normalizing the contribution of the system atrial tolas (Table 8).

Table 6: Indicators of diastolic function of the right ventricle in patients with hypertension stage II, depending on the type of diastole disorders

Indicator	Moderate Relaxation Disorders (n = 15)	Pseudo-normaltype (n=31)	Control
Maximum expulsion rate, ml / sec	300,8+12,5	295,9±12,5	302,5+14,1
Maximum filling speed, ml / sec	190,4±13,6	300,3±12,3	302,4±15,8
Time to reach maximum expulsion speed, msec	145,7±6,9	144,6+4,9	147,7±8,9
Time to reach the maximum filling rate, msec	323,4±12,6	317,3±13,7	320,5+15,6
Time to reach the maximum filling rate in relation to the duration of diastole,%	24,5±14,5	25,7±14,6	25,5±15,6
Maximum filling speed / maximum expulsion speed, units	0,73±0,06	0,94+0,06	0,93±0,03
Contribution of the first third of diastole to the filling of the right ventricle,%	16,8±9,8	8,3±4,4	18,3±6,2
Contribution of fast filling to filling of the right ventricle,%	41,5±4,5	42,6±7,3	40,6+6,5
Contribution of right atrial systoles to filling of the right ventricle,%	14,4±5,8	11,3± 4,9	12,7±3,8
End-diastolic volume of the right ventricle, ml	128,7±9,8	124,8±8,8	125,6±5,8
End-diastolicvolume, ml	55,6±6,4	53,6±5,4	52,3+4,7

Thus, the diastolic function of the left ventricle depends on the level of blood pressure and / or the presence of myocardial hypertrophy, but also on the neurohumoral changes that are characteristic of the

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initial stages of hypertension. The revealed data show the processes of myocardial hypertrophy not only of the left, but also of the right ventricle. The development of diastolic disorders on the part of the right ventricle begins with a decrease in the maximum filling rate and a compensatory increase in pressure in the right atrium. These disorders are significant in comparison with the pseudo-normal type of diastolic dysfunction. The significant nature of these changes and the relatively high number of patients with this type of diastolic disorders among patients with stage II essential hypertension cause a tendency towards a decrease in the maximum filling rate in stage II hypertension, which led to a significant decrease in the index of maximum filling rate / maximum expulsion rate in these data. sick.

The pseudonormal type of right ventricular dysfunction is associated with an increase in maximum filling rate. The increase in the maximum filling speed is of a compensatory nature, allowing to overcome the rigidity of the right ventricle. In addition, this type of diastolic dysfunction was associated with a shortening of the time of isovolumic relaxation. With the development of stage III HD, there is a significant predominance of patients with a restrictive type of diastole disorder (Table 9). At the same time, there was an increase in the maximum rate of filling and a decrease in the parameters of the contractile ability of the right ventricle. The index of the ratio of the maximum filling rate to the maximum expulsion rate significantly increased. In patients with stage III hypertension, the formation of a restrictive type of diastolic disorders also influenced the temporal indices of diastolic disease. For example, there was a tendency to an increase in the time of the rate of maximum filling and expulsion.

Table 7: Indicators of diastolic function of the right ventricle in patients with hypertension stage III, depending on the type of diastole disorders

	Pseudo-normaltype (n = 4)	Restrictivetype (n = 21)	Control
Maximum expulsion rate, ml / sec	296,8+13,5	167,5+13,5	302,5+14,1
Maximum filling speed, ml / sec	302,4±19,3	335,3±15,2	302,4+15,8
Time to reach the speed of maximum filling, correlated to the duration of the cardiac cycle,%	19,6±13,3	24,6+14,8	20,8±16,7
Time to reach the speed of maximum maximum expulsion, msec	144,6+7,9	154,4±8,4	147,7+8,9
Time to reach the speed of maximum maximum filling, msec	318,4±13,6	330,5±14,8	320,5±15,5
Time to reach the maximum filling rate in relation to the duration of diastole,%	25,6±17,7	30,9+13,8	25,5±15,6
Maximum filling speed / maximum expulsion speed, units	0,96±0,08	1,13±0,05	0,93±0,03
Contribution of the first third of diastole to filling the right ventricle / 3,%	8,5±4,6	19,8±8,7	18,6+6,3
Contribution of the fast filling phase to filling the right ventricle,%	41,5±8,4	41,7+5,4	40,6±6,7
Contribution of right atrial systole to right ventricular filling,%	12,5+ 9,8	16,8±7,8	12,7±3,8
End-diastolic volume of the right ventricle, ml	124,8±8,9	121,8+7,8	125,6±5,8
Stroke volume of the right ventricle, ml	54,6+5,7	46,3±6,8	52,3±4,7

The indicator of the ratio of the maximum filling rate to the maximum expulsion rate is an indicator of diastolic dysfunction of the right ventricle, depending on the stage of hypertension. The predominance among patients with stage III hypertension of patients with restrictive type of diastole disorders led to a significant increase in the index of the ratio of the maximum filling rate to the maximum expulsion rate, while in patients with stage II hypertension, its decrease was noted.

For patients with stage II hypertension, it was 1.54 ± 0.5, and for patients with stage III hypertension - 2.6 ± 0.4. There were no significant differences in the stage of insufficiency of the maximum rate of expulsion of blood circulation between the groups, however, in order to minimize the effect of developing heart failure on the considered indicators, in the future, the analysis of diastolic disorders will be carried out in each subgroup separately.

IV. Conclusion

Thus, with the addition of cardiac insufficiency, patients at various stages of hypertension develop more severe diastolic dysfunction of the right ventricle, in some cases, the character of a restrictive nature. In patients with severe heart failure, a decrease in the contractility of the right ventricle is revealed, which consisted in a reliable, decrease, a tendency to a

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decrease in the stroke volume and an increase in the bed-diastolic volume of the right ventricle.

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