

Dynamics of cardiovascular parameters in combined aortic malformations under the influence of a physical therapy program during the rehabilitation process

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Purpose: to study hemodynamic parameters and the reaction of the cardiovascular system to the dosed physical load of patients combined aortic defect with heart failure of the I degree under the influence of the complex physical therapy program developed by us during the rehabilitation process.

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Material & Methods: the study involved 26 middle-aged men with a diagnosis: combined aortic valve disease, HF I dg.

Results: dynamics of functional parameters of the cardiovascular system of patients under the influence of the physical therapy program is analyzed.

Conclusion: the combination of morning hygienic gymnastics, therapeutic gymnastics, independent activities and dosed walking with a therapeutic massage contributes to the normalization of vascular tone, motor-vascular reflexes and blood pressure, increasing the tolerance of the cardiovascular system to physical activity.

Keywords: physical therapy combined aortic malformation, functional parameters of the cardiovascular system.

Introduction

The first descriptions of the aortic valve defects date back to the 17th century. For a long time these diseases were considered rare and benign. However, studies conducted in recent years have shown that aortic valve pathology occurs in 30–35% of patients with heart valve defects, and the aortic valve ranks second in rheumatic fever after mitral valve. In developed countries, calcified aortic malformation is the third most common nosological form after arterial hypertension and ischemic heart disease [5; 11].

Isolated aortic stenosis is more common in men (2.4:1), whereas a combination of this defect with aortic valve deficiency or mitral valve defects is observed equally often in both men and women. The average age of patients at the time of death is 47,2 years. Aortic stenosis is poorly recognized when combined with aortic valve insufficiency or mitral malformation. All these data gave grounds to V. Kh. Vasilenko (1983) to assert that "stenosis of the aortic aorta is not so rare that it is rarely recognized". Stenosis of the aortic estuary can occur in isolated form, but most often it is combined with aortic valve insufficiency, expressed in varying degrees. In cases of poorly expressed deficiency of aortic valves, hemodynamic disorders will be determined mainly by the presence of stenosis [1; 5].

The life expectancy of patients, even with severe aortic insufficiency, is usually more than 5 years from the date of diagnosis, and in half of cases - even more than 10 years. The prognosis worsens with the addition of coronary insufficiency (angina attacks) and heart failure. Medication in these cases is usually ineffective. The life expectancy of patients after the onset of heart failure is about 2 years. Timely surgical treatment significantly improves life expectancy [18; 19].

Conservative methods of treatment are aimed primarily at the prevention of rheumatism and infective endocarditis (as possible etiological factors of aortic malformation), as well as to reduce the manifestations of cardiovascular insufficiency. It is generally accepted that the use of forms and means of physical therapy, along with medication to achieve these goals, enhances the therapeutic effect [12; 13].

Physical therapy, including restorative therapy in conditions of medical and preventive institutions, has an arsenal of means of active influence on the functional systems of the body, such as therapeutic physical culture, phytotherapy. Timely measures of adequate activation of patients with the help of metered training regimens that directly and indirectly affect the cardiovascular, respiratory and other systems contribute to increasing exercise tolerance and improve the overall functional state of the whole organism [4; 10; 13].

With combined aortic valve defects, a three-stage rehabilitation system is used: I – hospital; II – sanatorium (local rehabilitation center) III – polyclinic. At the polyclinic stage of rehabilitation of patients with aortic malformation, three motor regimens are applied: gentle, gentle-training and training regimens [15]. But the existing physical rehabilitation programs for combined aortic defects do not take into account the degree of heart failure, which necessitates the development of a new program of physical rehabilitation, taking into account the characteristics of the course of the underlying disease.

Relationship of research with scientific programs, plans, themes. The work was carried out in accordance with the priority of the thematic area 76.35. "Medico-biological substantiation of remediation and purpose of physical rehabilitation of young people of different levels of fitness". Number of state registration – 0116U004081.

The purpose of the research: to study hemodynamic parameters and the reaction of the cardiovascular system to the dosed physical load of patients combined aortic defect with heart failure of the I degree under the influence of the complex physical therapy program developed by us during the rehabilitation process.

Material and Methods of the research

Studies were conducted on the basis of the city polyclinic No. 6 in the Moscow region. Kharkiv. Under our supervision, there were 26 middle-aged men diagnosed with a combined aortic valve defect, CH I dg., which were arbitrarily divided into two groups: the main (13 patients) and the control (13 patients). The mean age of the patients of the main group was $41,2 \pm 0,24$ years, the control age was $41,6 \pm 0,28$ years. By the number of patients, age, the presence of concomitant pathology, the main and control groups were homogeneous. Patients of the main group were rehabilitated according to the author's program of physical therapy, the patients of the control group were engaged in a physical therapy program with S. M. Popov [14; 15].

Methods of research: analysis of scientific and scientific-methodical literature; medical and biological methods and medical and pedagogical observations; determination of the heart rate (HR), conduct and analysis of arterial tonometry, hemodynamic indicators and functional tests and tests; methods of mathematical statistics [1; 7].

Determination of the heart rate was carried out by palpation of the pulse on the radial artery at rest, at the beginning, in the middle and at the end of exercise therapy according to the generally accepted method. Arterial tonometry was performed using a membrane tonometer BP AGI-80 (manufacturer – Microlife, Switzerland, serial number 86517325). In order to more fully obtain information on the functional state of the cardiovascular system in patients on combined aortic defect, and also to determine the amount of physical activity in the preparation of an individualized physical rehabilitation program, we determined and analyzed the following haemodynamic parameters: systolic (SBP), diastolic (DBP) and pulse (PP) pressure, stroke volume (SV) and minute (MBV) blood volume, cardiac (CI) and shock (SI) indices, Skibinsky index. Determination and evaluation of the type of reaction of the cardiovascular system to the dosed physical load, we conducted according to the results of the Martine-Kushelevsky test – 20 sit-ups for 30 s. The results of the functional test were evaluated according to the following indices: the rate of pulse increase (%), changes in systolic and diastolic pressure, recovery time of heart rate and blood pressure after exercise. The indicator of the quality of the reaction (IQR) was determined, which was calculated by the formula of Kushelevsky and Ziskin [1; 2; 7; 17].

Results of the research and their discussion

A primary study was conducted before the start of the course of physical therapy. The duration of the disease in the main and control groups was 3–5 years, patients complained of periodic headaches in the parieto-occipital region, dizziness with a rapid change in body position, aching pain in the heart, poor sleep, general weakness, rapid fatigue, dyspnea fast walking and ascent to the 2nd-3rd floor, confirming the presence of a combined aortic defect with a predominance of aortic valve

insufficiency with the presence of a heart failure syndrome of the 1st century. in the examined patients of both groups. The main etiological factor in the development of combined aortic malformation in patients of both groups was atherosclerosis of the aorta in combination with hypertensive disease [18].

Hemodynamic parameters obtained during the initial study testify to the lack of economization of the cardiovascular system, confirm the presence of the concomitant aortic defect of hypertensive disease of I dg. [6; 8; 9; 16]. The prevalence of aortic valve insufficiency and a slight constriction of the aorta in the examined patients led to an increase in the pulse pressure in the main and control groups to $72,15 \pm 3,32$ MmHg and $74,62 \pm 2,91$ MmHg respectively, and heart rate acceleration in the main group to $89,85 \pm 1,61$ beats min^{-1} , in the control – to $92,00 \pm 1,41$ beats min^{-1} ($p > 0,05$).

Shock volume was recorded at the lower limit of the norm in the main and control groups $64,26 \pm 2,42$ ml and $59,75 \pm 2,19$ ml, respectively. MBV and SI in both groups were determined within the limits of normal values ($p > 0,05$). The primary values of SI obtained were $33,93 \pm 1,48$ ml m^{-2} in MG and $30,68 \pm 1,26$ ml m^{-2} in CG indicating a predominance of the hypokinetic type of hemodynamics ($p > 0,05$). Evaluation of the Skibinsky index in the initial study indicates a "satisfactory" state of the cardio-respiratory system in patients of the main and control groups: $1596,77 \pm 78,23$ c. u. and $1553,08 \pm 56,39$ c. u. respectively ($p > 0,05$) [2; 17].

The primary study of the response of the cardiovascular system to physical activity was assessed by the results of a Martyn-Kushelevsky test [6]. In the initial study, we found a decrease in IQR in both groups, which indicates an unsatisfactory response of the cardiovascular system to the dosed physical load. In determining the type of response to physical load stress after Karpman in the main and control group, we found the prevalence of an urgent hypertensive reaction to physical activity. Persons with physiological adequate or physiological inadequate reaction types were not found in the primary study.

With the purpose of stimulation of auxiliary circulatory factors, tissue respiration, external breathing apparatus training, reduction of the degree of cardiovascular insufficiency in the main group of patients in the polyclinic stage of restorative treatment in a complex of rehabilitation measures, we applied therapeutic exercises and therapeutic massage. TE was held in the form of morning hygienic gymnastics, therapeutic gymnastics, self-study, dosed walking and walking on the stairs. The basis of the complexes of therapeutic gymnastics and self-study were general developing physical exercises for medium and large muscle groups of the limbs (predominantly lower – when performing physical exercises for the upper limbs, there is a greater increase in blood pressure compared to exercises for the muscles of the lower extremities) and the trunk; exercises in throwing and transferring balls and gymnastic objects in alternation with relaxation of muscle groups of hands and feet and breathing dynamic exercises performed in the preparatory position (p. p.) "standing" and "walking", at a calm pace, with a large amplitude of movements in the joints.

Patients began to engage in therapeutic physical culture according to the sparing program (1–2 weeks), then sparing-training (3–4 weeks) and training (4–6 weeks) regime. Criteria

for transferring patients from one regime to another were: improvement of the general condition, reduction of complaints, normalization of blood pressure, and increased tolerance of the cardiovascular system to dosed physical activity.

In order to adapt the cardiovascular system to physical activity and decrease the degree of heart failure in the main group of patients in a complex of rehabilitation measures at a sparing motor regime, occupations of TG in the exercise room alternated with training walking on the stairs 1–3 times in walking, and on sparing-training and training – with dosed training walking.

Training walking on the ladder for patients with sparing regimen was carried out at a rate of 1 step per 1 s to 3–4 floors 1–3 times a day (depending on the general condition of the patient). Walking at a gentle pace was applied at a rate of up to 60–80 steps per minute for a distance of 2–3 km 1 time per day. Dosed walking at a sparing-training regime was carried out once a day at a rate of 60–80–100 steps per minute for a distance of 3–4 km per day. On the training schedule, the dosed walking was carried out at a rate of 80–90–120 steps per minute for a distance of 4–5 km 1–2 times a day.

At the polyclinic stage for patients of the main group, we applied therapeutic massage by the method of V. M. Kozakova, V. M. Sokrut, A. S. Povazhnoy (2003) [3].

Patients of the control group were rehabilitated according to the physical rehabilitation program for patients with combined aortic defect and cardiac insufficiency of the 1st degree for S. M. Popov (2005, 2008) [14; 15].

After three months of using rehab programs, we found some changes in the re-examination. The study of functional parameters of the cardiovascular system indicated an improvement in the functional state (Table 1).

So, in the main group there was a decrease in the heart rate by 15,6%, in the control group – by 8,9%, which indicates an increase in the physiological reserves of the cardiovascular system. In both groups there was a decrease in blood pressure. However, in the MG, the SBP figures reached their normal values and amounted to 133,15±2,68 MmHg ($p<0,05$), and in the control group – occurred hypertension: SBP – 144,69±1,83 MmHg DBP decreased in both groups, but in CG reduction in DBP was not statistically significant. In the main group of patients, a statistically significant decrease in the pulse pressure up to 63,15±2,11 MmHg. The shock volume in the main group was within the normal range and amounted to 69,06±1,17 ml, which indicates the normalization of the contractile function of the myocardium in the control group SV decreased to 59,60±2,30 ml, which may indicate a reduced contractility myocardium and worsening of the functional state of the cardiovascular system.

We observed a decrease in MBV in the main group from 5852,00±161,00 to 5017,69±148,59 ml min⁻¹ due to a decrease in HR ($p<0,05$). In the CG, MBV also decreased from 5712,71±189,96 to 5247,23±203,55 ml min⁻¹ due to a decrease in heart rate and SV, but its changes were statistically insignificant. CI has decreased in the MG to 2,73±0,10 l·min⁻¹·m⁻² and in CG – to 2,75±0,15 l·min⁻¹·m⁻² by reducing the MBV, but was within the normal range. In patients in MG, there was an increase in SI to 31,19±1,52 ml m⁻², indicating the hemodynamic type approach to the most optimal, eukinetic ($p<0,05$). In the CG, SI changes were statistically insignificant.

In determining the type of response to physical activity in the main group, we found 8 (61,5%) patients with a physiological adequate type, 2 (15,4%) with a physiological inadequate type, 2 (15,4%) with an urgent hypertensive type, 1 (7,7%) with a retarded hypertensive type of reaction.

In the control group, urgent hypertensive – 5 (38,5%) and

Table 1
Dynamics of functional parameters of the cardio-respiratory system in patients of the main and control groups in primary and secondary studies (M±m)

Indicators	Norm	Periods of study		t	p
		Primary research	Secondary research		
Main group (n=13)					
HR, beats·min ⁻¹	60–84	89,85±1,61	75,85±1,27	6,83	<0,001
SBP, MmHg.	100–139	147,23±3,05	133,15±2,68	3,51	<0,05
DBP, MmHg.	60–89	75,08±1,95	70,00±1,47	2,08	<0,05
PP, MmHg.	40–60	72,15±3,32	63,15±2,11	2,29	<0,05
SV, ml	60–120	64,26±2,42	69,06±1,17	1,78	<0,05
MBV, ml·min ⁻¹	3000–7000	5852,00±161,00	5017,69±148,59	3,81	<0,05
CI, l·min ⁻¹ ·m ⁻²	2,5–4,5	3,09±0,13	2,73±0,10	2,18	<0,05
SI, ml·m ⁻²	40–50	33,93±1,48	37,48±0,70	2,17	<0,05
IS c. u.	≥1100	1596,77±78,23	2816,39±116,40	8,70	<0,001
Control group (n=13)					
HR, beats·min ⁻¹	60–84	92,00±1,41	83,85±1,78	3,59	<0,05
SBP, MmHg.	100–139	152,23±2,17	144,69±1,83	2,66	<0,05
DBP, MmHg.	60–89	77,62±2,10	76,69±1,57	0,35	>0,05
PP, MmHg.	40–60	74,62±2,91	68,00±2,86	1,62	>0,05
SV, ml	60–120	59,75±2,19	59,60±2,30	0,05	>0,05
MBV, ml·min ⁻¹	3000–7000	5712,71±189,96	5247,23±203,55	1,67	>0,05
CI, l·min ⁻¹ ·m ⁻²	2,5–4,5	2,91±0,13	2,75±0,15	0,83	<0,05
SI, ml·m ⁻²	40–50	30,68±1,26	31,19±1,52	0,26	>0,05
IS c. u.	≥1100	1553,08±56,39	1972,31±57,93	5,19	<0,05

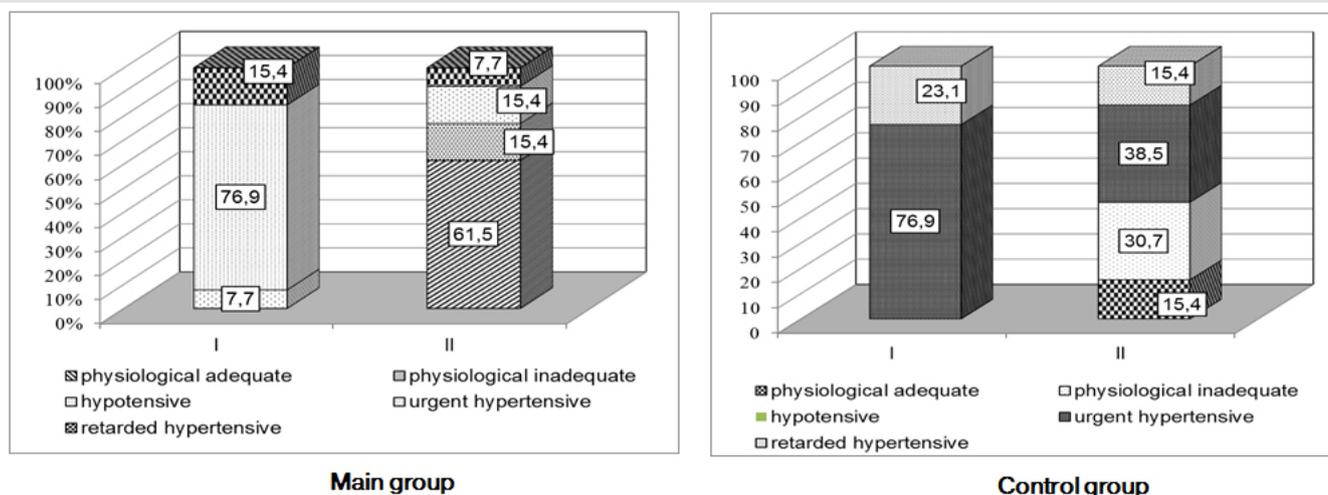


Fig. 1. Distribution of patients with MG and CG by types of reaction of the cardiovascular system to physical activity during primary (I) and secondary (II) research

Table 2
Indicators of quality response of patients in both groups in the primary and r and secondary research (M±m)

Indicators	Norm	Periods of study		t	p
		Primary research	Indicators		
IQR, c. u.	0,5–1,0	Main group (n=13)		5,40	<0,001
		0,39±0,23	0,72±0,62		
IQR, c. u.	0,5–1,0	Control group (n=13)		2,49	<0,05
		0,41±0,31	0,54±0,45		

physiological inadequate type of reaction prevailed – in 4 (30,7%) patients, the retarded hypertensive type and physiological adequate type was observed in 2 (15,4%) patients respectively (Figure 1).

In a second study, we found a statistically significant increase in IQR in both groups: in the main group $0,72 \pm 0,62$, in the control group – $0,54 \pm 0,45$ (Table 2).

When comparing repeated IQR in MG and CG, we found a statistically significant improvement in this index in the main group compared with the control group ($p < 0,05$).

Conclusions

The obtained data testify to the more effective influence of the author's program of physical therapy on the functional indices of the cardio-respiratory system and the tolerance of the cardiovascular system to the dosed physical activity, which causes a reduction in the severity of heart failure and an increase in the tolerance of the cardiovascular system to the measured physical load in combined aortic defects with syndrome heart failure degree I.

With combined aortic defects with heart failure syndrome I degree, the use of therapeutic physical training in the form of morning hygienic gymnastics, therapeutic gymnastics, self-study on the basis of general developmental exercises for medium and large muscle groups of limbs and trunk, performed at an average pace with a full amplitude, exercises with projectiles, throwing and transfer balls and gymnastic projectiles, corrective exercises for the spine, balance exercises and vestibular apparatus exercises performed in the preparatory position "standing" and "walking", in an average tempo, with a large amplitude of movements in the joints in combination with relaxation exercises and breathing exercises with an extended exhalation and varieties of walking around the gym. (walking with accelerations, attacks, squatting, on socks, heels) and jumps in place and in motion, as well as dosed walking and walking on the ladder with a load, gradually increased, in combination with a therapeutic massage by the method of V. M. Kazakov, V. M. Sokrut, A. S. Povazhnoy (2003).

Prospect of further research in this area is the study of the psychological state of patients with aortic malformations under the influence of the autogenic training program.

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