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Study of The Features of Physical Exercise in Patients with Ventricular Arrhythmias Depending on The Functional Class of Arrhythmia

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Abstract: The article studies the characteristics of exercise tolerance in patients with ventricular extrasystoles depending on the functional class of arrhythmia according to the Lown classification. The study included 63 patients with ventricular extrasystoles and 30 healthy individuals in the control group. All participants underwent 24-hour Holter ECG monitoring and a bicycle ergometry exercise test. It was found that with an increase in the class of ventricular arrhythmias, tolerance to physical activity decreases and rhythm disturbances appear earlier. Based on the obtained data, a program of dosed physical activity in the form of walking was developed for patients with ventricular rhythm disorders.

Keywords: Ventricular extrasystoles, physical activity, bicycle ergometry, exercise tolerance, Lown classification, cardiovascular diseases.

Introduction: The relevance of this work lies in the increased prevalence of cardiovascular diseases (CVD) over the past fifty years, including among young people, adolescents and children. This article will examine the importance of physical activity as a means of preventing CVD.

Cardiovascular diseases (CVD) remain the most serious health problem for many countries around the world (in 2016, 17.9 million people died from CVD, accounting for 31% of all deaths worldwide. 85% of these deaths were the result of heart attacks and strokes), including Uzbekistan, as 82% of the 17 million deaths from non-communicable diseases in people under the age of 70 occur in low- and middle-income countries, and 37% of these deaths are caused by CVD. Experts from the World Health Organisation (WHO) predict a further increase in CVD and mortality from CVD in both developed and developing countries. This is due to changes in demographic indicators (ageing population), the growth of non-communicable diseases (NCDs) and lifestyle characteristics. [1] [Global atlas on cardiovascular disease prevention and control. – Geneva: World Health Organization, 2011. – 212 p].

Accordingly, the impact of CVD on the health of the global population is forcing the entire scientific community to seek and find new ways to solve this problem. According to statistics from the National Heart, Lung, and Blood Institute, nearly 815,000 Americans die each year from CVD and 250,000 from stroke. The American Heart Association estimates that the US economy spends $420 billion annually on the treatment of these diseases. In Europe, more than 4.3 million deaths (48% of all deaths) and more than 2.0 million deaths are attributable to cardiovascular disease (CVD), which is recorded in 27 countries of the European Union (42%). This is more than 800,000 people over the age of 63 who die from CVD each year, including about 230,000 of them in developed European countries. One in five Europeans dies from CVD, with 15% of women and 16% of men dying each year [2] [https://www.who.int/ru/news-room/fact-sheets/detail/physical-activity].

Analysis shows that 53% of deaths among the population of Uzbekistan aged 30-70 are related to CVD. Over the past five years, the incidence of these diseases has increased by 20% even among young people. In total, these diseases have been diagnosed in approximately 4 million people, which is 12% of the total population

The significance of known risk factors, such as family history, age, male gender, smoking, obesity, dyslipidaemia (DLP), arterial hypertension (AH), type 2 diabetes mellitus (DM) has been conclusively proven (WHO, 2017), but even in the absence of these factors, acute myocardial infarction (AMI) and angina pectoris may occur. Therefore, in order to improve the prediction of CHD incidence and determine the indications for active primary prevention, it is necessary to study additional criteria that allow for a more accurate assessment of individual patient risk [3] [https://www.who.int/ru/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)].

The significance of physical inactivity as a health problem is constantly growing, since insufficient physical activity (PA) is a proven risk factor (RF) for the development of a number of chronic non-communicable diseases (NCDs) and their complications, including such serious ones as atherosclerosis, coronary heart disease (CHD), arterial hypertension (AH), stroke, obesity, diabetes mellitus (DM), cancer, arthritis and osteoporosis. Physically inactive people have a 35–53% higher risk of developing AH, a 30% higher risk of developing CHD, SD by 27%, and breast and colon cancer by 21–25% [4] [Amosov N. M., Bendet Ya. A. Physical activity and the heart. Kiev: Zdorovya, 1989. 230 p.].

Despite the indisputable benefits of physical activity, opportunities for a physically active lifestyle are declining, while the prevalence of a sedentary lifestyle is increasing in most countries of the world and in Uzbekistan. This leads to negative consequences for the health of citizens and a deterioration in the socio-economic situation. Thus, in Uzbekistan, from 1995 to 2011 (a period equivalent to only half a generation), the level of PA decreased by 18%, and by 2030, it is projected to decrease to 32%. About 40% of the adult population of Uzbekistan currently has low PA both at work and during leisure time [5] [Boitsov S. A. Mechanisms for reducing mortality from ischaemic heart disease in different countries of the world //Preventive Medicine. – 2013. – No. 16(5). – pp. 9-19].

According to the World Health Organisation (WHO), physical inactivity is the fourth leading cause of death worldwide: in 2008, it accounted for 5.3 million premature deaths out of 57 million deaths worldwide, i.e. 9% of the total number of deaths worldwide. People who are not physically active enough have a higher (20-30%) risk of death from all causes compared to those who engage in moderate PA for at least 30 minutes on most days of the week. Physical inactivity contributes to 9% of premature deaths among Russians (low PA is the seventh leading cause of premature death, according to World Bank data, 2005). Renowned American expert S. Blair believes that insufficient PA is "the greatest public health problem of the 21st century" (2009) [2].

Lack of PA contributes significantly to direct and indirect healthcare costs and has a negative impact on labour productivity and healthy life expectancy. If the prevalence of physical inactivity is reduced by 10%, more than 533,000 deaths per year could be prevented, and if it is reduced by 25%, 1.3 million deaths could be prevented. Eliminating low PA as a risk factor would increase the average life expectancy of the European population by almost one year [3].

Improving the PA of citizens with health limitations is not only a medical issue, but also an interdepartmental issue requiring the interaction of various structures and agencies [6] [Baevsky R. M. Forecasting conditions on the verge of normality and pathology. M.: Medicine, 1979. 298 p.].

Thus, the main direction in preventing the development of CVD and its complications is the timely detection and correction of FR, especially physical inactivity, since its high prevalence has been proven and it is a leading risk factor among controllable FR.

Research objective: By studying the initial parameters of patients with ventricular extrasystoles, to determine a physical activity programme depending on the Laune class, taking into account the period of arrhythmia.

METHODS

The clinical study included 67 individuals who voluntarily signed informed consent forms to participate in the study.

Of these, 63 patients with VES of both sexes, aged 29 to 50 years (mean 35.1±2.6), were included in the study. The group of healthy individuals consisted of 30 people aged 27 to 50 years (mean 37.6±6.7) who did not suffer from CVD.

The patients were divided into three groups: group 1 – 21 patients with class 1 PES according to the Laune classification; group 2 – 21 patients with class 2 PES according to the Laune classification; group 3 – 21 patients with class 3 PES according to the Laune classification.

The main inclusion criteria were the presence of an established diagnosis of PES in patients. To determine the functional class of PES , the classification according to B. Lown-Wolf, modified by M. Ryan (1975), was used with daily Holter ECG monitoring (Table 2.1). The diagnosis of SCD was made on the basis of complaints, clinical presentation, medical history, physical examination, laboratory tests (lipid profile, coagulogram) and instrumental methods (VEM and Holter monitoring) in accordance with the recommendations of the ESH/ESC (2019) [12, p. 425] and RKO/WHO (2017) [4, pp. 7-122].

The study did not include patients with ACS who had suffered AMI or ONMC in the previous 6 months; hypotension (BP < 100/60 mmHg); CHF stage II B-III and NYHA FC III-IV; resting heart rate before treatment <60 beats per minute; atrial fibrillation and life-threatening arrhythmias and cardiac conduction disorders, symptomatic hypertension; cardiomyopathy; heart defects; COPD; type 1 and 2 diabetes mellitus.

RESULTS

All patients underwent 24-hour Holter monitoring to confirm their diagnosis and determine their class according to the Laune classification. Table 3.5 shows that if a patient has fewer than 30 monomorphic ventricular extrasystoles per hour, they are classified as class 1 according to Laune and assigned to group 1. If patients have more than 30 monomorphic VES per hour, they are classified as class 2 according to Laune and assigned to group 2. Group 3 includes patients with polytopic or polymorphic VES according to Holter monitoring data.

In order to detect when ventricular arrhythmias occur during exercise in patients from different groups and to calculate the amount of physical activity based on their ability to perform physical activity, all patients from the three groups underwent a bicycle ergometry stress test.

Table 1

Time of onset of ventricular arrhythmia and total duration of bicycle ergometry

Indicator	Group 1	Group 2	Group 3
Time of onset of exertional dyspnoea (sec)	185.5	157.1	119.2
Time of onset of PES (W)	60.7	57.1	51.2
VEM stop time (sec)	384.3	358.1	298.7
VEM stop time (W)	95.2	88.1	81
Physical activity tolerance (high)	4	1	1
Physical exercise tolerance (average)	9	9	3
Physical exercise tolerance (low)	8	11	17

Table 1 shows that the total duration of VEM in the first group averaged 384.3 seconds (95.2 W), while ZES appeared on average at 185.5 seconds (60.7 W). In the second group, ventricular arrhythmias began to appear on average at 157.1 seconds (57.1 W), while the total duration of the exercise test was 358.1 seconds (88.1 W).

In the last group, the indicators showed a downward trend. Patients were able to complete the exercise test only for an average of 298.7 seconds (81 W), and VF began to appear much earlier than in the first and second groups, at 66.3 and 37.9 seconds, respectively (an average of 119.2 seconds-51.2 W).

Determining the pace and duration of measured walking. Paced walking is a completely safe form of physical activity in terms of cardiovascular risk and orthopaedic risk (if the route is chosen correctly). Due to the obvious simplicity of paced walking, it can be practised by most patients with cardiovascular disease, including those who have had a myocardial infarction, as well as patients with other pathologies.

Walking does not require any special skills, equipment or gear. Adherence to walking is usually high. In winter, measured walking can be practised at air temperatures down to -20°C, and in windy weather down to -15°C. The best time is from 11 a.m. to 1 p.m. and from 5 p.m. to 7 p.m. Clothing and footwear should be comfortable, loose-fitting and appropriate for the ambient temperature. When exercising in hot weather, you need to drink enough fluids, reduce the intensity of your workout, and wear as little clothing as possible. Before walking, you need to rest for 5-7 minutes to determine your baseline heart rate.

When performing physical activities, the required training load is determined by monitoring your heart rate using the following formula:

Training heart rate = resting heart rate + (maximum heart rate – resting heart rate) × X/100,

where training heart rate is the heart rate during training, max heart rate is the heart rate at the peak of the exercise test, X is the selected percentage of individual exercise capacity based on the results of the exercise test (usually within the range of 60–70%, less often 80%).

The optimal pace of dosed walking for each patient can be calculated using the formula by D.M. Aronov:

$TX = 0.042 \times M + 0.15 \times HR + 65.5$,

where TX is the desired walking pace (steps per minute), M is the maximum load during the VEM test in kgm/min (the load in W is multiplied by 6), HR is the heart rate at maximum load during the VEM test. The value of M is taken as the power of the last stage of load if the patient performed it for 3 minutes or more. If the load was stopped at the 1st or 2nd minute of this stage, then the value of the power of the previous stage of load is used as the value of M.

Given that it is difficult to accurately calculate the number of steps per minute, we used the average value as a guide. Table 3.7 shows the maximum walking speed of a patient with CHD depending on the power performed by the FN according to the VEM test data. In addition to measured walking, patients can be recommended walking in 2–3 sessions with a total duration of up to 2–2.5 hours. The walking pace should be slower than the training pace, by approximately 10 steps/min.

Table 3.7

Determination of the pace of training walking depending on the power of the exercise performed during the VEM test in patients with IHD (D.M. Aronov, 1988)

Power of exercise performed during a VEM test, W	Patient's FC	Maximum walking pace, steps per minute (or average)
50	III	99–102 (or 100)
75	II	105–108 (or 105)
100	II	111–114 (or 110) permitted short-term (2–3 minutes) brisk walking up to 120 steps/minute

125	I	118–121 (or 120) short-term (3–5 minutes) brisk walking up to 130 steps/min is allowed

Based on the data on the time of appearance of the ZES in the VEM (according to the table by D.M. Aronov, 1988), the walking pace was determined. It was established that the average speed of measured walking was 105 steps per minute for the first group of patients. For the second and third groups, the average speed was the same, 100 steps per minute.

Table 3.8

Formulation of a PA plan according to recommendations

PA intensity	Frequency per week	Duration, min	Total time, min
Moderate intensity PA	5	30	150
	10	15	150
High-intensity FA	3	25	75
Combination of medium and high intensity FA	medium 1 + high 2	30+30	30+60
	medium 1 + high 2	60+25	60

The duration and frequency of physical activity per week was determined according to the PA formation table based on the recommendations of the VEM test results, i.e. depending on physical exercise tolerance. Based on the results, the first and second groups were assigned moderate-intensity PA for 30 minutes once a day, 5 times a week (total time 150 minutes). The third group was also assigned moderate-intensity PA, but for 15 minutes twice a day, 5 times a week (total time 150 minutes).

Recommendations for physical activity for patients with ventricular arrhythmias

Group	Type of walking	Step	min	Frequency per week
Group 1	Paced walking	105 steps/min	30 min	3 to 5 days daily (can be divided into 2 parts)
Group 2	Paced walking	100 steps/min	30 min	3 to 5 days daily (can be divided into 2 parts)

Group 3	Paced walking	100 steps/min	15-30 min	3 to 5 days daily (can be divided into 2 parts)

The physical therapy prescribed to the patient should be appropriate for their functional condition and should not cause any arrhythmia, pain and/or discomfort.

CONCLUSIONS

1. The results of our study proved that all patients, regardless of their Laune class of ventricular arrhythmia, have a lower quality of life compared to the control group, and most of them have low tolerance to physical activity. This is especially noticeable in patients with class 3 ventricular arrhythmia (17 patients), which accounts for 80.9% of patients in this group. In the first and second groups, patients with low tolerance to physical activity account for half of all patients, 11 (50%) and 12 (57.1%) patients, respectively.

2. Since physical activity is not currently included in the treatment algorithm for patients with ventricular arrhythmias and there is no reliable information on the effect of dosed walking on the course of arrhythmia, the programme we have developed can serve to increase tolerance to physical activity in patients with ventricular arrhythmias, which may have a significant impact on prolonging the duration of hospitalisation, enhancing the effects of drug therapy, and, in turn, reducing overall and cardiovascular mortality.

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