

**INFLUENCE OF HEALTH-IMPROVING MOTOR ACTIVITY ON THE
VEGETATIVE BALANCE OF OLDER WOMEN**

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Purpose: based on the analysis of modern special literature to study the autonomic balance in the elderly by conducting cardiointervalography in the dynamics of physical activity.

Materials and methods: 60 elderly women were involved in the study. Women Gr.1 (n=24) are relatively healthy; women Gr. 2 (n=17) with periodic increase in blood pressure to 150/90 mm Hg; women Gr. 3 (n=19) with constant blood pressure of 150/90 - 160/100 mm Hg, but drug therapy was not taken. Cardiointervalography was recorded using the CardiolabPlus computer system.

Results: women Gr.1 had a balanced effect of sympathetic and parasympathetic divisions of the autonomic nervous system. In Gr.2 on the background of normal initial autonomic tone in orthostatic test observed hypersympathicotonic reactivity. In women, Gr.3 established the development of stress in the body of regulatory autonomic and humoral systems. A health program was developed, which was presented by the educational part, morning hygienic gymnastics and health walking. Dynamics of changes in women Gr. 2 indicated the improvement of vegetative-stabilizing properties, reducing the intensity of the

mechanisms of autonomic regulation of the ANS, due to the influence of health and motor activity. In women Gr.3 observed a positive trend. However, the initial vegetative tone fluctuated within eitonía with pronounced hypersympathicotonic reactivity. A high index of stress after orthostatic testing indicates the presence in the body of women Gr.3 voltage of regulatory autonomic and humoral systems, which is a consequence of uncontrolled increase in blood pressure.

Conclusions: the results of the study indicate the presence in older women of autonomic imbalance with a predominance of activity of the sympathetic division of the autonomic nervous system and overstrain of regulatory systems. The development of programs of health and physical activity will help to improve the state of health, prolong the active and full life of the elderly and the elderly.

Keywords: old age, cardiointervalography, heart rate variability.

Introduction

In the structure of the population of many countries, there is a tendency towards an increase in the number of the elderly population. By 2050, one in four people in Europe and North America will be 65 years of age or older. The number of people aged 80 and over is projected to triple: from 143 million in 2019 to 426 million in 2050 [2]. In this connection, there is a need to formulate the concept of active aging of the population to improve the quality of life and the involvement of a person in old age in social and professional life.

The World Health Organization (WHO) defines active aging as the process of developing and maintaining functional ability that promotes well-being in old age. The implementation of this concept presupposes, first of all, the formation of a person's sense of responsibility for the process of his own aging. Second, the ability to fulfill your potential for physical, social and psychological experiences throughout your life. Third, actively participate in community life and employment opportunities throughout life [9].

In the activity of the cardiovascular system, a significant role belongs to the autonomic nervous system (ANS), which, in turn, has two divisions: sympathetic and parasympathetic. From a physiological point of view, the ANS is a regulator of the activity of internal organs and metabolism. Several studies have confirmed that a decrease in heart rate variability (HRV) is an indicator of the risk of increased mortality from acute cardiovascular diseases. It has been proven that overall cardiovascular mortality is 5.3 times higher among people with low HRV [15]. The risk of sudden cardiac death is determined by a number of factors, one of which is an imbalance in autonomic regulation. A recognized means of assessing the peculiarities of the functioning of the nervous autonomic system is heart rate variability, which makes it possible to predict with sufficient reliability the risk of developing peculiarities of disturbances in electrophysiological processes in the myocardium. The results of studies of autonomic regulation in persons of mature age are contradictory [3,14]. At the same time, understanding the peculiarities of autonomic dysfunction in the elderly will allow for effective prevention of cardiovascular diseases through the selection of health-improving programs.

In connection with the above, society is in search of effective means that could reduce morbidity, improve the health of the elderly population, and prolong the active and fulfilling life of the elderly and the elderly. As a rule, all activities lead to the selection and use of drug therapy, sometimes causes a deterioration in health and further leads to a rejection of an active life [11, 12]. Unfortunately, society pays little attention to physical education, which is an effective and affordable means to improve all the functional capabilities of the body, especially in the elderly [1, 13]. Regular exercise not only slows down the aging process of muscle tissue, helps to maintain strength, improves posture and gait, stabilizes blood pressure, heart rate, prevents salt deposition in joints, but also helps the body cope with overstrain and stress, and also improves overall the physical state. Thus, in the process of systematic physical education, gradual changes in the body occur: the metabolism, the activity of the cardiovascular and respiratory systems improve, the level of physical fitness, vitality, working capacity and quality of life of the elderly increase [7, 8,13].

Communication of work with scientific programs, plans, themes. The work was carried out in accordance with the priority thematic area No. 76.35 "Medical and biological substantiation of the recovery measures and the appointment of physical rehabilitation means for young people of varying degrees of fitness." State registration number 0116U004081.

Purpose and objectives of the study - based on the analysis of modern special literature, to study the vegetative balance in the elderly using cardiointervalography in the dynamics of health-improving motor activity.

Material and Methods of research

As part of the implementation of state policy in the system of improving the population on the basis of the problem research laboratory of the KSAPC, the "School of Active Aging" was organized, aimed at creating conditions for improving the quality of life of women. The study involved 60 elderly women. At the first meeting, attention was drawn to the fact that all the women under study over the past 3-4 years had a decrease in physical activity, eating disorders, weight gain, spontaneously occurring headache, fluctuations in blood pressure. At the beginning of the study, the patients were divided into three groups. Gr. 1 women (n=24) are relatively healthy; women Gr. 2 (n=17) with intermittent increase in blood pressure up to 150/90 mm Hg, women Gr. 3 (n=19) with constant blood pressure values 150/90 – 160/100 mm Hg. All women involved in the study did not take drug therapy. *Cardiointervalography* is one of the methods for assessing heart rate. The method is based on a mathematical analysis of the variability of the sinus heart rate as an indicator of the adaptive-compensatory activity of the whole organism. The cardiointervalography was recorded using the CardiolabPlus computer system (produced by the Research Institute "KhAI-Medika", Kharkov). To study the statistical characteristics of the rhythm, 100 cardiocycles were analyzed. The following indicators were calculated: mode (Mo), mode amplitude (AMo), variation range (DX s), stress index (SI, expressed in%). Vegetative reactivity was assessed by the ratio SI₂/SI₁. SI in well-developed individuals ranges from 80 to 140 conditions units The results were statistically processed using the statistical software package

Statistica 6.0. All ethical principles for medical research have been followed according to the WMA declaration (Helsinki, 2013).

Results of the research

Elderly women regularly attended the "School of Active Aging" for 3 months. Before starting work on the program, all women underwent cardiointervalography. As can be seen from Table 1, healthy women (Gr. 1) are characterized by relatively high heart rate variability. This is evidenced by a sufficient difference between the maximum and minimum duration of the cardiac cycle - the variation range. At rest, they exert a balanced influence of the sympathetic and parasympathetic parts of the autonomic nervous system, as indicated by the indicator of the amplitude of the mode. Taking into account the value of the stress index, the intensity of the mechanisms of autonomic regulation of the ANS in women in this group is low. When performing the orthostatic test in women of group 1, the activation of the sympathetic part of the nervous system moderately increased, as evidenced by a decrease in the mode indicator, an increase in the amplitude of the mode and the stress index, but its activation does not bring the stress index value beyond the balance of the ANS work, as indicated by the vegetative indicator.

Table 1

Characteristics of heart rate variability in elderly women Gr. 1 (n=24), Gr. 2 (n=17) and Gr. 3 (n=19)

Indicators	Gr.1 (n=24) X±m	Gr.2 (n=17) X±m	Gr.3 (n=19) X±m	p ₁	p ₂
Mode (Moe) ₁	0,84±0,03	0,94±0,06	0,91 ± 0,12	>0,05	>0,05
Mode amplitude (Amo) ₁	18,12±1,19	19,65±1,07	26,29±2,27	>0,05	<0,05
Dx ₁	0,24±0,05	0,31±0,02	0,31±0,09	>0,05	>0,05
Stress index (SI ₁)	52,71±5,74	57,62±5,04	87,24±12,17	>0,05	<0,05
Mode (Mo ₂)	0,67±0,04	0,58±0,02	0,81±0,08	<0,05	<0,05
Mode amplitude (Amo) ₂	19,78±1,15	24,18±1,19	41,14 ± 3,27	<0,05	<0,05
Dx	0,21±0,02	0,15±0,01	0,28 ± 0,18	<0,05	<0,05
Stress index (SI ₂)	83,62±9,83	117,4±15,66	178,25±34,14	<0,05	<0,05
SI ₂ /SI ₁	1,85±0,32	2,04±0,31	2,91±0,54	<0,05	<0,05

Remark: p₁ - comparison between Gr.1 and Gr.2; p₂ - comparison between Gr. 1 and Gr. 3

According to the data of cardiointervalography of women, in comparison with the indicators of healthy women (Gr. 1), there was an insignificant increase in mode, variation range, an increase in the amplitude of the mode and the stress index, which indicates the activation of both the sympathetic part of the nervous system and

parasympathetic influences. When performing the orthostatic test in women (Gr. 2), in comparison with the indicators of women (Gr. 1), there was a significant decrease in mode and variation range; an increase in the amplitude of the mode and the stress index ($p < 0,05$), which indicates the activation of both the sympathetic and parasympathetic parts of the autonomic nervous system. These changes in women (Gr. 2) during the orthostatic test testified to sympathicotonic control of the heart rhythm, that is, there is some prevalence of the parasympathetic division of the ANS in the regulation of the heart rhythm. Indeed, based on the indicators in this group, we can talk about the negative impact of fluctuations in blood pressure on the vegetative balance.

In women of group 3 with constant high blood pressure, we found that against the background of a significant increase in the amplitude of the mode and the stress index, the mode and variation range increased, which indicates an increase in the activation of both sympathetic and parasympathetic influences. However, during the orthostatic test against the background of a decrease in the mode, an increase in the amplitude of the mode and the variation range, there was a significant increase in the stress index with significant hypersympathicotonic activity. At the same time, a high SI2 index indicates the development of tension in the regulatory autonomic and humoral systems in the body.

An important role in improving the quality of life of this category of women should be the development of health programs. The goal and objectives of the program are to maintain the vital activity of older women through an active lifestyle, psychological health, social interaction, etc. The developed wellness program was presented by talks on wellness topics, morning hygienic gymnastics and health walking. During the morning hygienic gymnastics, women performed a set of conventional physical exercises aimed at muscle relaxation, balance, coordination of movement, and training of the vestibular apparatus. The duration of the lesson is 20-30 minutes. During morning hygienic exercises, women were advised to pay more attention to breathing exercises.

Wellness walking is the most accessible type of physical activity, which does not require special training and material costs, in the process of which improves the work of all organs and systems of the body. At the beginning of the program, 3-5 women in light clothing walked for 45 minutes a day, first at a slow pace of 70-80 steps per minute for a distance of 1500 m to 2000 m. Starting from the 8th day, a route was assigned with a length of 2000 to 2500 m, the walking speed was gradually increased to 90-100 steps per minute for 60 minutes. It was recommended to monitor breathing: 2 steps - inhale, 3-4 steps - exhale [5, 10].

The educational part of the program included conversations with women on the formation of their stable beliefs in the need to change their lifestyle, correct eating behavior and fulfill the requirements of health and physical activity, the mechanism and consequences of cardiovascular diseases and their prevention. Given the prevalence of coronavirus infection, women were monitored remotely using telecommunications technology. The dynamics of changes in cardiointervalography with orthostatic test is presented in Table 2.

After repeated cardiointervalography with orthostatic test in women of group 2, regardless of the initial index, the SI1 was lower than during the initial examination. There was a decrease in the amplitude of the mode, the variation range, compared with the initial indicators, and the stress index decreased ($52,62 \pm 6,05$ versus $57,62 \pm 5,04$), that is, the stress index during the repeated study fluctuated within the limits of eutonia. When performing the orthostatic test, there was a decrease in the amplitude of the mode and the variation range, a significant decrease in the stress index ($p < 0,05$). And although the indicator of autonomic reactivity decreased ($SI2/SI1 = 1,71 \pm 0,21$ against), no statistical significance was observed ($p > 0,05$). However, the activation of autonomic reactivity in women (Gr. 2) by the value of the stress index within the balance of the ANS work, that is, the autonomic reactivity has become in the normotonic type. A decrease in the index of tension and autonomic reactivity indicates an improvement in vegetative stabilizing properties, a decrease in the tension of the mechanisms of autonomic regulation of the ANS in women (Gr. 2) due to the influence of health and motor activity.

Table 2

Dynamics of cardiointervalography indices with orthostatic test in elderly women Gr. 2 (n=17) and Gr. 3 (n=19)

Indicators	I Gr.2 (n=17) X±m	Gr.2 (n=17) X±m	Gr. 3 (n=19) X±m	Gr. 3 (n=19) X±m	p ₁	p ₂
Mo ₁	0,91±0,06	0,78±1,03	0,94 ± 0,12	0,87±0,06	<0,05	>0,05
Amo ₁	19,65±1,07	18,34±1,14	26,29±2,27	25,62±2,17	>0,05	>0,05
Dx ₁	0,31±0,02	0,27±0,07	0,31±0,09	0,28±0,02	>0,05	>0,05
SI ₁	57,62±5,04	52,62±6,05	83,62±12,17	81,92±25,71	>0,05	>0,05
Mo ₂	0,98±0,02	0,81±0,02	0,97±0,08	0,89±0,02	>0,05	>0,05
Amo ₂	24,18±1,19	21,18±1,10	29,14±3,27	28,00±1,59	>0,05	>0,05
Dx ₂	0,15±0,01	0,21±0,02	0,28 ± 0,18	0,19±0,02	>0,05	>0,05
SI ₂	117,4±15,66	90,27±12,17	178,25±34,14	167,12±14,12	<0,05	>0,05
SI ₂ /SI ₁	2,03±0,31	1,71±0,21	2,34±0,54	2,04±0,33	>0,05	>0,05

Примітка: p₁ – динаміка у жінок Гр.2; p₂ – динаміка у жінок Гр.3

Women (Gr. 3) showed a positive trend in all cardiointervalography indicators, but none of them underwent statistically significant changes. The initial autonomic tone varied within the limits of eutonia with pronounced hypersympathicotonic reactivity. A high index of SI₂ indicates the presence of tension in the regulatory autonomic and humoral systems in the body of women (Gr. 3), which is a consequence of an uncontrolled increase in blood pressure.

Thus, this study confirms the conclusions of many scientists that with an increase in blood pressure, the influence of not only the sympathetic part of the nervous system increases, but also the activation of the parasympathetic part, which leads to the development of severe cardiac disorders.

Conclusions / Discussion

Thus, the results of this study indicate the presence of autonomic imbalance in older women with a predominance of the activity of the sympathetic division of the autonomic nervous system and overstrain of the regulatory systems. Such data can be considered as a predictor of the occurrence of potentially threatening conditions of the cardiovascular system, especially in the presence of an uncontrolled increase in blood pressure, which is confirmed by the data of the authors (O.I. Grinov, L.V. Glushko (2017), Kovalenko, S.A. (2017) [4,6]. The data obtained indicate the need for cardiointervalography with orthostatic test for elderly people, as a screening method for identifying a group of people at risk of developing threatening cardiac

arrhythmias, and for further, more advanced, examination and development of preventive measures for each individual. All of the above is confirmed by the work of V. Jandackova, et al. (2016), Yadav R. (2017), Andreeva Ya.A., Mirny D.P. (2017) [3, 14, 15].

Thus, the development of health-improving and motor activity programs will contribute to improving the health status, prolonging the active and full life of the elderly and the elderly. All women are recommended to continue to study according to the program, and women (Gr. 3) are additionally recommended to undergo an in-depth examination with a family doctor.

Prospects for further research in this direction are associated with cardiointervalography in women Gr. 2 and Gr. 3 after 6 months of active health and motor activity.

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