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Стаття надійшла 14.02.2024 р.

DOI 10.26724/2079-8334-2025-1-91-45-49

UDC 616-072.7:616.12-008.331.1:616.12-008.318.4

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## WELL-BEING, PHYSICAL ACTIVITY, AND RESPONSE TO PHYSICAL ACTIVITY IN PATIENTS WITH STAGE II HYPERTENSION AND FREQUENT EXTRASYSTOLES

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A total of 124 patients with stage II hypertension and frequent symptomatic extrasystoles aged 27 to 75 years were examined. They formed the main clinical sample of the study. Supraventricular extrasystoles (SVE) were recorded in 74 (59.7 %) patients, and ventricular (VE) in 50 (40.3 %) patients. It should be assumed that in patients with stage II hypertension and frequent extrasystole, the supraventricular variant is more common. Also, we examined 32 patients with stage II hypertension without any cardiac arrhythmias who were included in the comparison group. In addition to the mandatory examination methods, all patients were analyzed using visual analog scales of well-being and physical activity and an exercise test. Patients with frequent extrasystole, regardless of the location, have significantly ( $p < 0.001$ ) worse well-being according to the visual analog scale with relatively preserved physical activity. According to the results of our analysis, in 73.4 % and 70.0 % of the subjects with SVE and VE respectively, the physical activity (walking upstairs 10 floors at usual pace), leads to the vanishing or significant reduction in the frequency of extrasystoles, which indicates a better functional state of the heart and the absence of severe cardiovascular pathology in those patients.

**Key words:** stage II arterial hypertension, supraventricular extrasystole, ventricular extrasystole, Holter ECG monitoring, exercise test.

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## САМОПОЧУТТЯ, ФІЗИЧНА АКТИВНІСТЬ ТА РЕАКЦІЯ НА ФІЗИЧНЕ НАВАНТАЖЕННЯ У ПАЦІЄНТІВ З ГІПЕРТОНІЧНОЮ ХВОРОБОЮ ІІ СТАДІЇ ТА ЧАСТОЮ ЕКСТРАСИСТОЛІЄЮ

Було обстежено 124 пацієнти з гіпертонічною хворобою ІІ стадії та частою симптомною екстрасистолією віком від 27 до 75 років, які склали основний клінічний масив дослідження. Серед обстежених пацієнтів в 74 (59,7 %) осіб реєстрували суправентрикулярну і в 50 (40,3 %) – шлуночкову екстрасистолію. Слід вважати, що в пацієнтів з гіпертонічною хворобою і частою екстрасистолією суправентрикулярний варіант є більш частим варіантом екстрасистолії при ІІ стадії захворювання. Крім того нами обстежено 32 пацієнти із гіпертонічною хворобою ІІ стадії без будь-яких порушень серцевого ритму, які увійшли до групи порівняння. Усім пацієнтам, окрім обов'язкових методів обстеження, був проведений аналіз за візуальними аналоговими шкалами самопочуття та фізичної активності, а також проведена проба з фізичним навантаженням. Пацієнти з частою екстрасистолією, незалежно від топічного варіанту, мають достовірно ( $p < 0.001$ ) гірше самопочуття згідно оцінки за візуальною аналоговою шкалою при відносно збереженій фізичній активності. За результатами нашого аналізу спостерігалось, що у 73,4 % і 70,0 % обстежених на тлі фізичного навантаження (ходьба на 10 поверхів у середньому темпі) реєстрували зникнення та суттєве зменшення частоти суправентрикулярної та шлуночкової екстрасистолії, що свідчить про кращий функціональний стан серця і відсутність важкої серцево-судинної патології у обстежених нами пацієнтів.

**Ключові слова:** артеріальна гіпертензія ІІ стадії, суправентрикулярна екстрасистолія, шлуночкова екстрасистолія, холтерівське моніторування ЕКГ, проба з фізичним навантаженням.

*The study is a fragment of the research project "Cardiovascular remodeling, structural and functional state of the liver and kidneys and their relationship with cardiometabolic risk factors in patients with cardiac pathology and comorbidities. Possibilities of treatment optimization", state registration No. 0124U002036.*

Arterial hypertension (AH) is one of the most common chronic diseases in the world, a non-communicable pandemic of the modern civilized world, and a major risk factor for cardiovascular disease and its complications [2, 5, 6]. Patients with arterial hypertension often have a variety of cardiac arrhythmias, the most common of which are extrasystole and atrial fibrillation. These arrhythmias can cause patients to experience subjective palpitations and/or interruptions in the heart region but

sometimes may be completely asymptomatic [1, 7]. The main pathophysiologic mechanisms of arrhythmias in this category of patients are left ventricular hypertrophy, left atrial dilation, and myocardial electrical instability. Increased myocardial stress in the setting of hypertension, along with excessive afterload, stimulates myocardial hypertrophy and its structural remodeling with a disproportionate increase in fibrous tissue, reduction of coronary blood flow, and occurrence of myocardial diastolic dysfunction [12, 14]. Besides an increase in blood pressure (BP), other factors, such as angiotensin exposure, demographic determinants, and genetic polymorphism, play an important role in the progression of hypertrophy [4]. Myocardial hypertrophy leads to impaired myocardial kinetics of  $\text{Ca}^{(2+)}$ ,  $\text{Mg}^{(2+)}$ ,  $\text{Na}^+$ ,  $\text{K}^+$  ions, which contributes to the prolongation of the action potential and is a trigger in the mechanism of re-entry, early postdepolarization, and trigger activity [11]. Along with left ventricular hypertrophy, endothelial vascular dysfunction plays a role in the occurrence of arrhythmias [2, 3, 8]. The presence of both of these factors significantly increases the risk of cardiac events in the future, including arrhythmias. The number and severity of extrasystoles can change under the influence of physical activity: an increase in the number of extrasystoles during exercise or in the first minute after its completion indicates its possible association with organic heart damage; a decrease or disappearance of extrasystoles during exercise indicates its "benignity" [1, 7].

To date, a certain relationship between various arrhythmias and AH has been proven. In the presence of high blood pressure and left ventricular hypertrophy, the risk of supraventricular extrasystole (SVE), ventricular extrasystole (VE), and sudden arrhythmic death increases significantly [9, 10]. Humoral and structural-functional factors also play an important role in the further progression of arrhythmias. A variety of noninvasive techniques for the evaluation of arrhythmia with different diagnostic values and availability exist now. Nevertheless, this issue is still open today and continues to be studied.

**The purpose** of the study was to assess the state of health and physical activity, as well as the response to physical activity in patients with stage II AH and frequent extrasystoles.

**Materials and methods.** All patients underwent examination and treatment in the outpatient diagnostic department, the cardiology department for patients with rhythm disorders of the Communal non-profit enterprise "Vinnytsia Regional Center of Heart and Vessel Pathology" during 2016–2019, as well as in the cardiology department with rehabilitation beds for cardiac patients of the Communal non-profit enterprise "Vinnytsia Regional Clinical Hospital named after M.I. Pirogov" during 2018–2020.

The study included 124 patients with stage II AH and frequent symptomatic extrasystole aged 27 to 75 (mean  $58.2 \pm 0.9$ ) years, who formed the main clinical sample of the study. Among the patients with AH and concomitant frequent extrasystole, SVE were recorded in 74 (59.7 %) persons, and VE – in 50 (40.3 %). The arrhythmic history in the main clinical group ranged from 1 to 27 (mean  $8.06 \pm 0.42$ ) years. Respecting the specifics of our study (spontaneous recruitment of patients as they came to the medical institution), it should be assumed that in patients with AH and frequent extrasystoles, the supraventricular variant is a more frequent variant of extrasystoles in stage II of the disease.

In addition, we examined 32 patients with stage II AH without any cardiac arrhythmias (excluded by Holter electrocardiogram monitoring (HM ECG)) aged 32 to 72 (mean  $55.9 \pm 1.7$ ) years, who formed a comparison group against the main clinical sample. Among the patients, 50 (40.4 %) were male, and 74 (59.6 %) were female with the ratio of 1:1.5. In turn, 15 (46.9 %) men and 17 (53.1 %) women were registered among the patients of the comparison group with a male-to-female ratio of 1:1.1.

Indications for inclusion of patients in the study:

1) age from 25 to 75 years; 2) stage II AH according to the ESC 2018 guidelines and the unified clinical protocol and the current order of the Ministry of Health of Ukraine № 1581 of 12.09.2024; 3) frequent ( $> 30$  extrasystoles per 1 hour of study) symptomatic extrasystoles verified by HM ECG data and 4) absence of antiarrhythmic treatment at the time of inclusion in the study.

Criteria for not including patients in the study:

1) age younger than 25 and older than 75 years; 2) AH of stages I or III and symptomatic arterial hypertension; 3) concomitant coronary heart disease, which was excluded according to the recommendations of the Ukrainian Association of Cardiology through the absence of a history of myocardial infarction and typical angina attacks in combination with negative results of instrumental examination (exercise test); 4) heart failure of functional class III-IV according to NYHA and the presence of systolic myocardial dysfunction (left ventricular ejection fraction according to echocardiography  $< 40$  %); 5) the presence of persistent attacks ( $> 20$  s) and permanent atrial fibrillation and paroxysmal tachycardia in history; 6) diabetes mellitus, thyroid pathology, clinically significant concomitant diseases of internal organs with impaired function; 7) alcohol or drug abuse; 8) severe neurological and mental disorders.

All patients underwent a comprehensive clinical, instrumental, and laboratory examination, including: 1) general clinical and anthropometric examination, blood pressure measurement, and visual analog scales of well-being and physical activity; 2) ECG in 12 standard leads; 3) daily blood pressure monitoring; 3) HM ECG, exercise test; 4) echocardiography; 5) laboratory methods of examination: fasting glucose level, serum lipid spectrum, uric acid level, blood electrolytes.

The general clinical examination included identifying indications and contraindications for inclusion of patients in the study, establishing the main diagnosis and concomitant pathology, assessing the characteristics of the anamnesis and forming clinical study groups; anthropometric examination was performed to determine the body weight and height of patients with the subsequent calculation of body mass index by the Kettle formula as the ratio of body weight in kilograms to height in meters squared ( $\text{kg/m}^2$ ), waist circumference and hip circumference were measured.

Various scales have been used recently to characterize the clinical condition in more detail and assess its dynamics in patients during treatment. Regarding this, we analyzed our patients using two original visual analog scales. Our well-being and physical activity scales reflect the patient's self-assessment of his subjective status and physical activity (according to the usual physical activity assessment) as a mark on a 100 mm segment (visual analog scale). The size of the marked segment was measured in mm (the maximum value that a patient could mark was 100, and the minimum was 0).

HM ECG was performed using the software and hardware complex of the DiaCard system ("Solvaig" JSC, Ukraine) according to the standard protocol. To evaluate the nature of arrhythmias, we determined the following: the number of SVE and VE during 24 hours of ECG monitoring; the number of SVE and VE registered during 1 hour of the study; the number of patients with paired and group VE and their number during 24 hours. In addition, we analyzed the frequency and the features of episodes (arrhythmia duration up to 30 seconds) of supraventricular tachycardia and atrial fibrillation recorded during the day.

A standardized exercise test was performed to determine the response of arrhythmia to physical activity – walking the patient 10 floors at a rate of 1 step per second. The test assessment was executed during HM ECG. Three ways of arrhythmia response to exercise were considered: 1) complete disappearance or a significant decrease (more than 50 % from the baseline) in the total number of extrasystoles; 2) an increase in the frequency of extrasystole, and 3) no reaction or a slight decrease (less than 50 % from the baseline).

The statistical processing of the study results was performed by the StatSoft Statistic v. 12.0 software concerning the recommendations of using statistical methods. The results were presented in the form of median and percentage (%), which reflected the frequency of the feature in the sample. A comparison of relative values (%) was done using the criterion  $\chi^2$ , quantitative values of independent samples – using the Mann-Whitney and Kruskal-Wallis criteria.

**Results of the study and their discussion.** The study enrolled patients with frequent symptomatic extrasystoles (> 30 extrasystoles per 1 hour of HM ECG). According to the HM ECG, two ECG variants of extrasystole were distinguished: 1 – supraventricular and 2 – ventricular extrasystole. It was determined that only 30 (24.2 %) of the subjects had experienced arrhythmia constantly in the form of various subjective symptoms over the past year, among which the most common were the sensations of dips and pauses in the heartbeat. At the same time, the vast majority of patients (75.8 %) experienced arrhythmia episodically in the form of intermittent episodes. Of these, in 32 patients (27.4 %) arrhythmia occurred during the active time of day (from 6:00 to 21:00) and been associated with physical and psychoemotional stress, and in 14 (11.3 %) – during the inactive time of day (from 21:00 to 6:00) at rest in the complete absence of physical and psychoemotional stress, in a horizontal position and during sleep. 48 (38.7 %) patients were found unable to name a clear association of arrhythmia with the time of day – the development of arrhythmia was observed regardless of the daily activity at any time of the day. After analyzing the complaints of patients about the feeling of interruptions in the heartbeat by the topical variant of extrasystole, it was noted that in 36.5 % of patients with SVE arrhythmia was felt constantly throughout the day, which significantly ( $p=0.0001$ ) differed from patients with VE, among whom only 6.0 % noted a constant arrhythmia (Table 2.1.4). At the same time, 36.0 % of patients with VE noted that extrasystoles occurred mainly during the active time of day, while patients with SVE had significantly fewer extrasystoles during the active time of day (18.9 %,  $p=0.03$ ). The occurrence of extrasystoles mainly at rest and at night was noted by fewer patients (10.8 % of patients with SVE and 12.0 % of patients with VE ( $p>0.05$ )), while more than a third of patients (33.8 % of patients with SVE and 46.0 % of patients with VE,  $p>0.05$ ) indicated that arrhythmia occurs episodically at any time of the day.

According to the visual analog scale, self-assessment of well-being in the patient groups ranged on average from 55.7 to 39.5 and physical activity from 51.0 to 54.6 mm (Fig. 1).

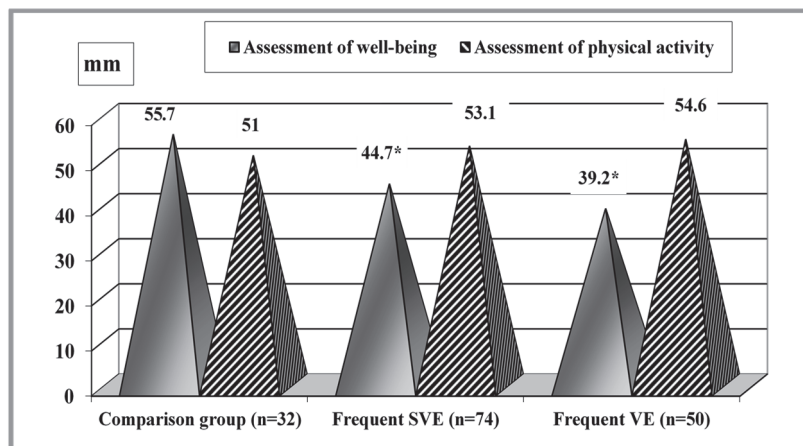


Fig. 1. Patients' assessment of well-being and physical activity using a visual analog scale in the control and clinical groups.

Notes. The “\*” sign indicates the significance of the difference compared to the comparison group ( $p < 0.001$ ).

The response of arrhythmia to various patient activities, primarily physical activity, is of some practical and academic interest. In this regard, we executed a standardized exercise test of walking 10 floors at an average pace 1 step per second). Three types of arrhythmia response to physical activity were distinguished based on the HM ECG data: 1) complete disappearance or significant decrease (at least 50 % of the baseline); 2) no response or non-significant decrease (less than 50 % of the baseline) and 3) an increase in the frequency of extrasystole. The analysis of the extrasystole response to exercise is shown in Fig. 2.

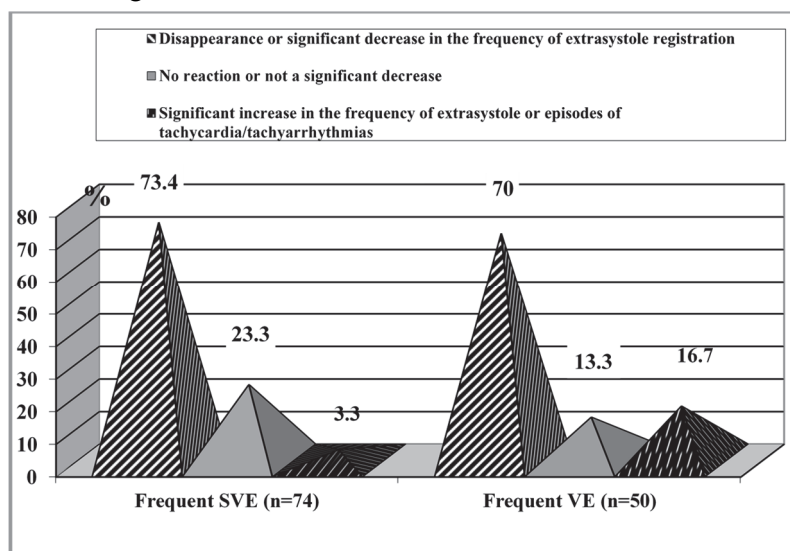


Fig. 2. Extrasystole response to exercise in patients of different clinical groups.

in the frequency of extrasystole recording was 98 (92; 116) per 1 min).

Extrasystoles in individuals without structural heart disease are not life-threatening. They are detected on HM ECG in most practically healthy individuals of all ages. In general, extrasystoles do not necessarily indicate concomitant cardiac pathology, and in the absence of heart disease, they are not a harbinger of increased morbidity and mortality. On the other hand, in patients with severe structural heart damage and myocardial dysfunction, especially in the setting of post-infarction cardiosclerosis or heart failure, the detection of frequent SVE, and especially of PE, is an additional prognostically unfavorable factor [1, 7, 4].

Among our patients with stage II AH and concomitant frequent extrasystole, the supraventricular extrasystoles were recorded significantly more often than the ventricular ones ( $p < 0.05$ ), which can be explained by the absence of severe organic cardiac pathology in such patients. Our data coincides with the literature data that in patients with AH and frequent extrasystoles, the supraventricular variant is a more frequent variant of extrasystoles than the ventricular. [9, 13, 14].

Significant differences were determined only in self-assessment of well-being: the average score in patients without arrhythmias was significantly higher than in patients with frequent SVE and VE ( $55.7 \pm 1.5$  versus  $44.7 \pm 2.3$  and  $39.2 \pm 2.5$  mm, respectively,  $p < 0.001$ ). There were no significant differences between patients of different groups assessing the average physical activity score. Thus, the mean physical activity score in patients without arrhythmia was 51 mm, in patients with SVE – 53.1 mm, and in patients with VE – 54.6 mm.

The majority of subjects (73.4 % and 70.0 %, respectively) showed the disappearance and significant decrease in the frequency of SVE and VE during physical activity. At the same time, the threshold heart rate, against which these changes were recorded, was 114 (106; 132) per 1 min. In less than a third of patients (23.3 % and 13.3 %, respectively), the frequency of extrasystole did not change, and in 3.3 % and 16.7 % of cases, respectively, an increase in the frequency of recording of SVE and VE, respectively, during exercise was determined (threshold heart rate for an increase

The analysis showed that patients with HF and frequent extrasystoles, according to the analog scale, have significantly worse health compared with patients without arrhythmias with relatively preserved physical activity. The data obtained are probably related to the presence of symptomatic extrasystole in the patients we examined, which affected the quality of life of this category of patients. In turn, in the vast majority of patients, physical activity improved the general condition of patients, because the number of extrasystoles significantly decreased or even disappeared, which can be considered as a sign of a better functional state of the heart and the absence of severe organic cardiovascular pathology in the patients we examined [2, 6].

Thus, studies of cardiac rhythm disorders, in particular, extrasystoles, in patients with AH, depending on its ECG variant, are an important component of assessing the total cardiovascular risk and developing effective methods for preventing complications in this category of patients.

### Conclusions

1. Among patients with stage II AH, extrasystoles are observed in the vast majority of patients (79.5 %), and SVE is recorded significantly more often compared with VE (59.7 % vs. 40.3 %, respectively).

2. In the vast majority of patients with stage II AH with frequent extrasystoles (75.8 %), subjective arrhythmia manifestations occur sporadically in the form of intermittent episodes. The portion of patients with permanent arrhythmia sensation throughout the day is significantly ( $p=0.0001$ ) higher in patients with SVE (36.5 %) compared with HF (6.0 %).

3. Patients with frequent extrasystole, regardless of the topical variant, have significantly ( $p<0.001$ ) worse well-being and relatively preserved physical activity according to the visual analog scale of self-assessment.

4. In the vast majority of patients with both SVE and VE, the frequency of extrasystoles decreases with exercise, which confirms the existing hypothesis about the “benignity” of extrasystoles in patients with stage II AH and probably a better prognosis for the course of the disease in this category of patients.

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Стаття надійшла 10.02.2024 р.