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VEGETATIVE CHANGES, ENTROPY AND HEART RATE DISORDERS IN PATIENTS WITH MYOCARDIAL INFARCTION

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Annotation
The need to monitor the heart rate in patients with myocardial infarction is generally recognized, while timely prevention of severe complications and sudden death is extremely important.

Purpose of the Study
Comparison of the parameters of the entropy of the heart rate (HRV), the state of vegetative change and the electrical pathological activity of the myocardium.
Materials and methods. We examined 48 patients who underwent large-focal myocardial infarction (MI) 1.5 months - 4 years ago, in whom the HRV parameters were studied using short 5-minute ECG sections and the data of Holter monitoring (HM) ECG were analyzed.

Results
The subjects showed a significant polymorphism of the manifestations of electrical instability of the myocardium; patients with increased activity of the parasympathetic nervous system (PSNS) prevailed (67%). The severity of the influence of the sympathetic nervous system (SNS) significantly increased as the severity of heart rhythm disturbances increased. Supraventricular arrhythmia of all types more often occurred with increased PSNS activity, ventricular arrhythmias more often occurred with a predominance of SNS activity in combination with a significant decrease in HRV.

Conclusion
Analysis of HRV in patients after myocardial infarction, especially in combination with HM ECG, makes it possible to objectively assess various manifestations of cardiac dysfunction and to prescribe adequate therapy in a timely manner.

Keywords: Heart rate variability, heart rhythm disturbances

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Introduction

The possibilities of using the results of studying heart rate variability (HRV), including in patients with myocardial infarction (MI), are widely discussed in domestic and foreign literature [1-13]. The relationship between MI and its complications with the state of the autonomic nervous system [8,10], in particular its segmental divisions - the sympathetic nervous system (SNS) and the parasympathetic nervous system (PSNS) - has been described. Data on the possibility of predicting life-threatening cardiac arrhythmias, in particular, ventricular tachycardia (VT) and ventricular fibrillation using HRV analysis, has been obtained.

The aim of this work is to compare the HRV indices, the state of the autonomic balance and the pathological electrical activity of the myocardium in patients after myocardial infarction.

Materials and Methods

We examined 48 patients aged from 34 to 62 years, who had undergone large-focal myocardial infarction, the prescription of which was 1.5-4 months in 32 people, and from 1 to 4 years in 16. The most frequent manifestation of the disease was attacks of exertional angina pectoris I-III functional classes (FS), diagnosed in 33 patients. Signs of congestive heart failure were detected in 6 patients; cardiac arrhythmias, mainly in the form of extrasystolic arrhythmias, recorded on a standard ECG, were noted in 7 cases. All patients underwent planned drug therapy, which was ineffective in 3 cases.

To clarify the functional state of the myocardium in conditions of temporary cessation of drug treatment, all patients underwent a comprehensive examination, which included, in addition to HRV analysis, standard recording and ECG analysis using 12 conventional leads. For Holter monitoring (HM) ECG, a Cardiosens-4000 device (Kharkov) was used.

HRV was studied at short 5-minute intervals using a generally accepted technique using time and frequency analyzes and the method proposed by R.M. Baevsky [2]. Only the RR intervals, free from extrasystoles and artifacts, were taken into account, for which the RR values were automatically normalized, as a result of which a new series of NN intervals was formed, satisfying the condition: dX / RRNN <0.5 where dX is the variation range (in ms), RRNN is the average duration of the normalized interval NN (in ms). In some cases, manual editing of sections of rhythmograms was carried out.

When studying the state of the autonomic nervous system, we used the standards proposed by Baevsky R.M. et al. [2]. The vegetative balance was assessed visually according to the rhythm and histogram of the distribution of NN intervals, their

scathegram, as well as using mathematical indicators: the duration of the RR interval filtered from extrasystoles and implementation hindrances - NN; the most frequent interval NN-Mo (in s; ms); the number of intervals NN corresponding to Mo-Amo (in%); variation range - the difference between the maximum and minimum interval NN-dX; standard deviation of NN-SDNN interval values; square root of the sum of the square root of the sum of the squares of the differences in magnitude of consecutive N-N-RMSSD intervals; spectral power for the entire period-TF (in ms2) (<0.4 Hz); power in the very low frequency range - VLF (in ms2) (<0.04 Hz); power in the low frequency range LF (in ms2) (0.04-0.15 Hz); rated power in the range LF - LFn (in%): (LF / TF-VLF) 100; power in the high frequency range-HF (in ms2) (0.15-0.4 Hz); normalized power in the HF-HFn range. An increase in sympathetic influences was indicated by a decrease in dx, RMSSD, an increase in Amo and the power of the LF part of the spectrum. The prevalence of PSNS was determined by an increase in dX, the amplitude of the HF portion of the spectrum, and a decrease in Amo and RMSSD. The criterion for heart rate stabilization was SDNN <50ms and pNN 50 <4%.

HM ECG was performed on the day of HRV analysis. Variants and the number of supraventricular and ventricular extrasystoles, paroxysmal rhythm disturbances - supraventricular and ventricular tachycardias, atrial fibrillation were determined.

The results of the study were entered into an Exsel 7.0 spreadsheet with subsequent processing by methods of variation statistics using application programs for Windows-2010.

Results and Discussion

During the HM ECG, episodes of arrhythmia were recorded in the majority of the surveyed (43, or 90%). The absence of pathological electrical impulses was observed only in 4 patients. Attention is drawn to the polymorphism of electrical ectopia. So, in isolation, rhythm disturbances were determined only in 3 (5%) of the examined patients who had arrhythmias of various types. The rest of the patients showed a combination of ventricular and supraventricular arrhythmias. Significantly more often, combinations of extrasystoles were detected, the source of which was various parts of the heart (in 30, or 63%) or a combination of various supraventricular (in 18, or 38%) or ventricular (in 14, or 29%) cardiac arrhythmias. The nature of the identified arrhythmias. In patients who have undergone myocardial infarction, the appearance of both supraventricular and ventricular ectopia is quite often noted; the incidence of ventricular arrhythmias increased significantly with deterioration of the coronary reserve. The fact of an increase in the number of single ELEs in patients with

stable FC III angina pectoris should be recognized as unexpected, which can be explained by the involvement of not only the ventricular myocardium, but also the atria, in the pathological process. At the same time, the frequency of occurrence of group and paired LLEs varied insignificantly.

Analysis of HRV showed an increase in PSNS activity in 33 (67%) patients, the prevalence of SNS was revealed in 9 (20%) patients. Autonomic balance was determined in the remaining 6 patients. The state of the vegetative balance in persons who have undergone myocardial infarction. In patients at the outpatient stage of rehabilitation, PSNS predominated significantly more often in the vegetative balance, which is understandable, given the timing from the onset of the disease, and corresponds to the previously obtained results [10, 11]. However, if PSNS equally often prevailed in persons with chronic coronary insufficiency of varying severity, then SNS activity significantly increased as the FC of stable angina pectoris increased. An increase in such activity was noted by N.A. Mazur. et al. [9] that they are associated with an unfavorable course of the disease.

Attention is drawn to the results of comparing the state of vegetative balance and electrical pathological impulses. So, out of 32 examined patients who had single ULEs during HM ECG, the SNS activity was increased in 16 (50%) cases, the PSNS activity prevailed in 13 (40%) examined. A similar state of the autonomic nervous system took place with a single PVC. At the same time, group ELE was significantly more often detected in individuals with pronounced RSND activity (84%). On the contrary, group PVC was associated with a predominance of SNS activity (in 40%), and episodes of VT that occurred in 3 patients occurred only against the background of more pronounced sympathetic activity.

It is known that in the implementation of the re-entry mechanism in cases of ventricular arrhythmia, one of the triggering factors is a violation of the autonomic regulation of the rhythm. In this case, there is a shift in the sympatovagal balance towards the prevalence of the SNS. At the same time, the value of parasympathetic activity as a protector of the electrical stability of the myocardium was experimentally established. Based on these positions, it becomes clear the role of increased SNS activity in the occurrence of ventricular arrhythmias and the parallelism of these changes as the coronary myocardial reserve deteriorates in patients with myocardial infarction.

Interesting, in our opinion, data were obtained when comparing the supraventricular pathological activity and the state of vegetative balance in patients after MI. Regardless of the type of supraventricular arrhythmias, they all occurred mainly with increased PSNS activity. However, a single ELE was associated with both SNS

and PSNS activity. At the same time, group and paired ELE in (67%) patients was associated with a predominance of vagus activity, and MA attacks occurred exclusively in individuals with a parasympathetic nature of the autonomic balance. It is noteworthy that the PSNS activity in these patients was significantly different. Thus, between patients with paired and group NDEs and patients with MA, significant differences were revealed in the power of the HF range - 516 ± 11.4 and 921 ± 12.2 ms2, respectively ($p < 0.01$), which characterizes MA as a state with more pronounced the influence of the PSNS on the pathological electrical activity of the atria. At the same time, the indicated indicator in individuals who had a single ULE turned out to be significantly lower - 313 ± 11.1 ms 2 ($p < 0.01$), which characterizes the state of the PSNS and SNS as equilibrium with a slight predominance of the first of these links of the autonomic nervous system.

It is known that paired ULE and group ULE are often precursors of MA paroxysms, i.e. are links of one pathological chain [15]. At the same time, the important role of the vagus in the development and maintenance of MA is confirmed by many researchers [6, 8]. The increase in PSNS activity recorded by us during the transition from a single ELE to a group one and MA confirms the opinion about, possibly, a single mechanism of these arrhythmias, including in persons who have undergone myocardial infarction.

Recently, close attention has been drawn to the fact of destabilization of the heart rate as a harbinger of serious, including life-threatening arrhythmias [2,6,9]. At the same time, attention is paid to the indicators SDNN and pNN50, a decrease in which is considered markers of an unfavorable outcome of the disease. Comparison of HRV indices in individuals with different autonomic supply showed that, regardless of the state of autonomic balance, SDNN values did not differ significantly, while pNN50 and dX levels were significantly lower in individuals with a predominance of SNS. It should be emphasized that these patients also had significant ventricular ectopia, especially in the form of paired and group PVCs, as well as VT, which are considered potentially dangerous in terms of the development of ventricular fibrillation.

At the same time, stabilization of the heart rate as an independent prognostic factor is recognized at SDNN <50ms and hNN50 <4%. A similar combination of changed values of HRV indices was revealed in 8 surveyed. An isolated decrease in SDNN to less than 50 ms was observed in 22 patients, a decrease in pNN50 to less than 4% was observed in 12 patients. pNN50 was below 4% in all patients with severe PVC and episodes of VT, SDNN was below 50 ms in all patients with VT and in 44 patients with complex PVC. Due to the small number of these groups, it is difficult to draw a final conclusion about the diagnostic significance and changes in these indicators of HRV,

however, the more common decrease below the critical level of pNN50 may, in our opinion, closely correlate with severe electrical instability of the myocardium [16-20]. Thus, the results of the study show a significant heterogeneity of patients after MI in terms of autonomic support and electrical stability of the myocardium. The predominance of SNS activity at the stage of outpatient follow-up is undoubtedly associated with the possibility of cardiac arrhythmias. Moreover, the most dangerous ventricular arrhythmias are associated with both a pronounced predominance of SNS activity and a significant decrease in HRV. At the same time, supraventricular arrhythmias, especially MA, are largely associated with the prevalence of PSNS. It can be assumed that the analysis of HRV in patients with myocardial infarction, especially in combination with HM ECG, will allow to objectively assess various manifestations of cardiac dysfunction and to prescribe adequate therapy in a timely manner.

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