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INTEGRATION OF SCIENCE AS A MECHANISM OF EFFECTIVE DEVELOPMENT

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COMPARATIVE CHARACTERISTICS OF ECG CHANGES IN ATHLETES AT DIFFERENT STAGES OF LONG-TERM TRAINING

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Formulation of scientific problem and its significance. The sport of the highest achievements is an acute competitive process in which achieving the required result sometimes requires significant cardiorespiratory endurance from the athlete. Competition in modern sports leads to the maximum mobilization of functional reserves and compensatory - adaptive capabilities of the athlete [10, 15]. The cardiovascular system is one of the leading systems of the body in ensuring the high performance of athletes. Overstrain of the cardiovascular system is accompanied by serious metabolic disorders in cardio myocytes, which leads to dysfunctional disorders both in the system itself and in the athlete's body as a whole [7, 14]. Therefore, it is important to investigate the features of ECG changes in track and field athletes at various stages of long-term training.

Analysis of the latest research on this problem. Under the influence of significant physical and psychoemotional loads, changes occur in the heart of almost every athlete, which is evidenced by the deviation of its functioning indicators from normal values [2, 16]. The problem of the "sports heart" continues to occupy many scientists around the world even now. G. F. Lang singled out two versions of the "sports heart" - physiological and pathological, that is, the heart is more capable of working as a result of systematic and adequate training or the heart, pathologically changed, with reduced performance as a result of excessive stresses of a sports nature [5,6].

For the prevention of pre-pathological and pathological conditions, the correct selection of training loads, a comprehensive control of the functioning of the blood circulation system of athletes is necessary [8,12]. A sustained increase in cardiac output over a long period of time during physical exertion is associated with structural and functional changes in the athlete's heart and, therefore, leads to ECG changes [3, 9].

Electrocardiographic research is the most widespread method of instrumental research of the bioelectric activity of the heart, the contractility of the heart, disturbances in the rhythm and conduction of the structures of the heart, hypertrophy of the ventricles and atria, etc. [1]. So, from the point of view of a cardiologist who does not work with athletes, every second ECG of an athlete can be considered pathological. The number of athletes who have an absolutely normal resting ECG is relatively small - 27% [11]. Among them, no changes in the ECG were noted in the process of stress testing. It should be emphasized that the frequency of ECG abnormalities is different in athletes of different groups of motor activity, age and gender. In recent years, attention has been drawn to the increase in the frequency of heart rhythm disorders, apparently in connection with the increase in stressful loads in training and the increase in the volume of competitive loads [4].

The purpose of the work is to study the characteristics of ECG changes in athletes at various stages of long-term training.

Presentation of the main material and substantiation of the obtained research results. The work summarizes the results of the examination of 27 sportsmen (athletes) aged 18-21 at the stages of multi-year training. The examinees were divided into two groups: the first group - (10 athletes) - athletes at the stage of specialized basic training preparation and the second group (17 athletes) - athletes at the stage of preparation for higher sports achievements.

The research participants have a high level of sports qualification (II category - 6 athletes, I category - 14 people, KMS - 6 people, MS - 1 person).

The survey was conducted in several stages during the 2013-2014 academic year in building № 7 of the National University of Physical Education and Sports of Ukraine.

Recording of the electrocardiogram was carried out in the morning, in the supine position, in the conditions of the main exchange, in a room with a temperature of 22 ^{o} C. The device " Cardio +" (for the examination of athletes of the first group) and the electrocardiograph EK1T-03M2 with thermal recording were used to record the ECG. The recording was performed after the appropriate calibration of the device, because the ECG recording must be carried out at a standard voltage (1 mV = 10 мм) - i.e. . control mV. The ECG was recorded in the following leads - I, II and III standard leads according to Einthoven , a VR, aVL , aVF according to Goldberger and 6 chest leads (V_1, V_2, V_3, V_4, V_5, V_6).

The ECG was evaluated according to the following scheme:

1. Analysis of heart rhythm and conduction (estimation of regularity of heart contractions, calculation of heart rate, determination of sources of excitation, evaluation of conduction function).

2. Determination of rotations of the heart axis around the anteroposterior longitudinal and transverse axes (determination of the position of the electrical axis of the heart in the frontal plane, determination of rotations of the heart around the longitudinal axis, determination of rotations of the heart around the transverse axis).

3. Analysis of the atrial P wave (amplitude, duration, polarity).

4. Analysis of the ventricular complex (amplitude, duration of the QRS T complex, analysis of the segment and ST segment, analysis of the T wave, analysis of the QT interval).

The evaluation of the results of the conducted research was carried out by quantifying the detected changes using the method of determining the average arithmetic and statistical error.

The results of the study showed that all athletes of the first group had a correct sinus rhythm with a normal heart rate of 67.3 ± 9.3 beats/sec. (Table 1.). In the second group, 2 examinees had sinus arrhythmia (10.5%), heart rate in the group was 56.3 ± 6.9 beats/sec. In both groups, migration of the pacemaker inside the sinus- atrial node was observed in approximately half of the examined subjects (in the first group - in 50%, and in the second group - in 43%, another 10.5% - sinus arrhythmia).

Therefore, the changes in the function of automatism in the second group are more in line with the changes in athletes, which were described in literary sources [13, 14].

Table 1.

ECG indicators in track and field athletes at different stages of long-term training.

Indexes	Units of measurement	The value of indicators			
		first group (n=10)		second group (n=17)	
		x	Sx _	x	Sx _
heart rate	sw. per min.	67.3	9.3	56.3	6.9
PQ	with	0.15	0.01	0.136	0.015
Angle alpha	Hail.	58.9	12.7	69.2	18.7
The amplitude of the R wave	mm	1.9	0.9	2.0	0.8
The duration of the R wave	with	0.1	0.0	0.07	0.015
Duration of the complex QRS	with	0.085	0.01	0.083	0.015
Segment duration S-T	with	0.30	0.03	0.30	0.025
The amplitude of the T wave	mm	8.3	5,6	9.7	3.0
Duration of the QT interval	with	0.38	0.03	0.41	0.02

When the position of the axis of the heart in the frontal plane was studied, it was found that the tendency to its deviation to the right was more pronounced in the subjects of the second group: the average value of the alpha angle in the first group was smaller than in the second group - 58.9^0 and 69.2^0, respectively . The frequency of deviation of the heart axis did not differ significantly in the groups and was approximately 10-11% (in 1 subject of the first group and in 2 subjects of the second group).

When studying the rotation of the heart relative to the longitudinal axis, it was found that 11 subjects of the second group (64%) had a right turn of the heart; in the first group, none of the subjects had a turn of the heart around the longitudinal axis.

When examining the turns of the heart relative to the transverse axis, no significant differences were found in the examined subjects of both groups. In the 1st examinee in the first group and in the 1st examinee in the second group, an intermediate position of the heart was noted, in the rest of the examinees - vertical and semi-vertical positions - in approximately the same ratio in both groups.

Analysis of the atrial P wave did not reveal significant differences in the amplitude and duration of the P wave in both groups. However, in the second group, more often than in the first group examined, changes in the P wave were noted, which may indicate morphological changes and disturbances in their function (decrease in amplitude, splitting, violation of polarity). In the first group, the frequency of detection of such changes was approximately 60%, and in the second group - 73.4%.

Analysis of the ventricular QRS complex revealed various abnormalities (deformation of the teeth) in 50% of the examinees of the first group and in 90% of the examinees of the second group (in 5 and in 15 examinees, respectively).

It should be noted more significant changes in the ST segment and their greater frequency of detection in the examinees of the second group. Thus, in the first group there was a rise of the ST segment above the isoline at 1,3 мм, and in the second group this rise was equal to 2,35 мм, which is significantly higher than in the first group. The rise of the ST segment above the isoline more than 1 ммin the first group was noted in 3 examinees (30%), in the second group - in 14 out of 17 examinees (approximately 82.2%).

Analysis of the T wave revealed an increase in the amplitude of the T wave in 3 out of 10 subjects (30%) of the first group and in 14 subjects (82.3%) out of 17 subjects of the second group. The increase in the amplitude of the T wave in the subjects of the second group was more significant than in the subjects of the first group. In the first group, the amplitude of the T wave was on average 8.3 ± 5.6 mm, and in the second group - 9.7 ± 3.5 mm. Such changes in the T wave can be explained by the working hypertrophy of the athletes' heart. However, unfortunately, the shape of the teeth in all cases of their increase indicates the possibility of insufficient blood supply to the myocardium. And in this regard, the athletes of the second group are in worse conditions, compared to those examined in the first group. This is evidenced by the presence of athletes in the second group (2 out of 17 – 11.7.5%), in whom negative T waves were determined.

In the second group, ECG showed signs of left ventricular hypertrophy more often than in the first: in the first group, 3 out of 10 examinees (30%), in the second group - in 9 out of 17 examinees (53%).

The duration of the QT interval (electromechanical systole) was longer in both groups (0.38±0.33 in the first group and 0.41±0.02 in the second). This fact indicates an increase in the time of contraction of the left ventricle, which may be due to the deterioration of the contractility of the myocardium.

Conclusion. With the increase in the qualification of athletes, EGC changes are more often observed and become more pronounced, which indicate a violation of the function of automatism, excitation and contractility of the myocardium.

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