ANALYSIS VEGETATIVE REGULATIONS ATHLETES ENGAGED IN CYCLING USING HEART RATE VARIABILITY METHOD

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1.Introduction

In modern sports, much attention is paid to the development of sports medicine. The coach and doctors are obliged to monitor the training process in order to assess the state of health, reserve and adaptive capabilities of the body during high physical exertion. To improve the quality of preventive measures and identify pre- pathological conditions, today it has become possible to analyze the heart rate variability of athletes, which in turn is a significant study for predicting sports success. The introduction of this method into the in-depth medical examination (IME) of athletes will contribute to the early detection of signs of overexertion and symptoms of overtraining. The method is based on the study of RR intervals, their variability, the construction of time series of cardiointervalogram, which are further analyzed by a mathematical method.

Heart rate variability (HRV) provides information about the ability to adapt, exercise tolerance, functional reserves of the body. The main rule in the analysis of heart rate variability is the application of all recording standards and the interpretation of the results [1,3].

When admitting to sports, many sports federations, unfortunately, do not take into account the adaptive-reserve capabilities of athletes, so the frequency of overtraining at the initial stages of the preparatory process is very high [2]. With the help of the mathematical approach of R.M. Baevsky [1,6] and V.M. Pokrovsky [6] distinguish four types of regulation. The basis is not the sympathetic and parasympathetic autonomic nervous system, but the central and autonomous circuits of regulation [5]. There is a moderate predominance of the central circuit of regulation (type I), a pronounced predominance of central regulation (type II), a moderate predominance of autonomous regulation (type III), with a pronounced predominance of autonomous regulation (type IV), which in athletes can be "physiological and "pathological" [2,3,5]. Good fitness is characterized by type III regulation, i.e. with this type of regulation, it is possible to achieve sports results without overstressing the control system. With types I and II, regulation is suppressed, which quickly brings the athlete's body out of balance, thus the athlete needs to make greater efforts to achieve high sports results than an athlete with type III regulation. HRV indicators can have different values at all stages of the training process. Good fitness is characterized by a decrease in such indicators as MxDMn, TP, HF, LF, VLF and an increase in SI during an orthostatic test. The autonomic circuit, for which the parasympathetic nervous system is responsible, contributes to a good adaptation to physical exertion. Overtraining is characterized by an increase in such indicators as MxDMn, TP, HF, LF, VLF and a decrease in SI during an orthostatic test. So, in a state of overtraining, there is a sharp decrease or increase in such indicators as MxDMn, TP, HF, LF, VLF, ULF, a sharp decrease in SI (<10 c.u.) with a sharp increase in the values of MxDMn, TP> 15000 ms², VLF at rest; decrease in variability against the background of bradycardia at rest; with an increase in heart rate, an increase in rhythm variability at rest; adverse reaction to orthostasis; slowdown of recovery processes, especially HRV indicators after a training day and competitions [6]. Systematic training can improve and expand the adaptive-reserve potential of the athlete's body, however, the state of overtraining can lead to deregulation of all systems [4].

Thus, the study of body variability provides important information about the adaptive-reserve potential of an athlete and the prognosis of his success [1,2]

2.Purpose of the Study

Assess the type of autonomic regulation of heart rate based on HRV data in athletes involved in cycling.

3.Materials and Research Methods

The study was conducted on the basis of the Republican Scientific and Practical Center for Sports Medicine in the period 2020-2021. The first group of the study consisted of 15 young men of the national cycling team of Uzbekistan, whose average age was 20.3 ± 2.1 years; the second group of the study included 12 girls (19.3 ± 1.8). The study was conducted preparatory stage of the training process. Assessment of the type of autonomic regulation of the heart rate was carried out on the basis of the analysis of indicators of heart rate variability. HRV indicators were obtained using the Festbit apparatus, the analysis of HRV indicators was carried out using the Kubios software. The ECG signal was recorded in the supine position, the duration of the recording was 5 minutes in the supine position and 5 minutes in the standing position. The study of HRV was carried out 2 hours after breakfast, with the elimination of all interference (phone calls, conversations, in adolescent girls, HRV studies during the menstrual period were excluded). The assessment of the type of autonomic regulation of the heart rate was determined based on the classification of N.I. Shlyk (table 1).

Table 1. Assessment of the type of autonomic regulation of the heart rate based on heart rate variability data

Type of regulation	Stress index (c.u.)	VLF (ms²)
I	> 100	> 240
II	> 100	<240
III	> 25<100	> 240
IV	<25	> 500

In the course of the study, all indicators of heart rate variability were analyzed, however, the main emphasis was placed on the indicators of the stress index, which characterizes the central contour of regulation and VLF, which characterizes metabolic reserves. The obtained data were processed in the program "SIATISTICA" using the "Exel" application for "Windows" with the calculation of indicators of normal distribution, the significance of differences according to Student. Results at $P<0.05$ were accepted for discussion.

4.Research Results

According to the classification of N.I. Shlyk (table 1), all 27 athletes examined by us were divided into 4 groups, in accordance with the predominant type of regulation of cardiac activity (table 2).

Table 2. Distribution of athletes-cyclists by types of regulation

Indicator \ Type of regulation	I type	II type	III type	IV type

Stress index (c.u.)	>100	>100	<100 and >25	<25
VLF (ms2)	>240	<240	>240	>500
n=15	one	2	10	2
n = 12	one	2	7	2

n = 15, boys; n = 12 girls

According to the results of our study, among male athletes in 66.6% of cases, type III regulation was determined, in 13.3% - II and IV. types and in 6.6% - type I (Table 2), girls have a slightly different picture, in 58.3% of the studied athletes revealed type III regulation, in 16.6% of cases II and IV, in 8.3% – I type.

As practice shows, athletes with type III regulation are more likely to achieve high sports results, the stress index characterizes the degree of predominance of the activity of the central circuit of regulation over the autonomous one, and VLF reflects the mobilization of energy and metabolic reserves during physical and psycho-emotional stress. According to the results of our research, in two groups of surveyed athletes involved in cycling, a larger percentage falls on type III regulation, which indicates a good prospect of athletes.

Application of N.I. Shlyk, allowed us to more deeply and individually analyze the features of the autonomic nervous system in the examined athletes - cyclists (table 3).

Table 3. Characteristics of the autonomic nervous system in the subjects athletes involved in cycling

Indicator / Type of regulation	I type n=2	II type n=4	III type n=17	IV type n=4
Stress index (c.u.)	128.56 26.1	248.175 112 *	48.85 ± 5.36*	15.49 ±3.62
VLF (ms²)	658.32 393.1 *	67 59.7 *	428.38 ±92.2	588.75 ±166.2
VLF (%)	13, 2 3.34	3.96 1.49	14.54 12.86	2.32 0.64
LF (%)	52.95 11.1	62.18 19.1	55.09 16.00	42.66 18.3
HF (%)	33.75 7.82	33.81 19.6	30.32 16.97	54.9 17.9

LF/HF (c.u.)	1.65 0.5	3.51 2.06	4.26 ±6.81 *	0.932 0.63*
Heart rate, beats/min	105 5.65	91.25 12.5	104.25 27.9	99.01 29.25

* - sign difference, in comparison with type I, II and III regulation is significant, p <0.05

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According to the obtained data presented in Table 3, with a change in the type of autonomic regulation from sympathetic to parasympathetic, a pronounced deviation of physiological parameters occurs, a significant decrease in the stress index and the ratio of low to high frequency (indicator of ANS-LF/HF activity) is observed, and the indicator of very low rhythm frequencies increases. heart (VLF, ms²). There are no significant differences in heart rate. If we consider the frequency indicators as a percentage, we can see that the predominance of parasympathetics is characteristic of IV type of autonomic regulation, and sympathetic - for type II (Table 3).

Thus, according to the data obtained, it can be stated that with an increase in the level of sportsmanship in athletes, an increase in the parasympathetic influence of the ANS is observed and the most optimal functional state is observed in athletes with type III regulation, regardless of gender (most of the examined).

5.Conclusions

The success of an athlete is determined by the ability for a pronounced economization of body functions at rest, their maximum mobilization during exercise and full recovery after it. Athletes involved in cycling with type III regulation have a greater reserve of body strength, therefore they can endure large load, thereby increasing the chances of winning. In sports medicine, the assessment of heart rate variability as a method of analyzing the functional capabilities of the cardiovascular system plays an important role in maintaining the health of an athlete and early detection of maladjustment conditions. Intense physical activity should correspond to adaptive capabilities, so athletes with stable I type of regulation, and even more so II, the load must be strictly dosed.

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