THE SIGNIFICANCE OF DETERMINATION THE BODY'S ENERGY SUPPLY BEFORE AND AFTER COMPETITION AMONG YOUNG ATHLETES

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ABSTRACT — In 47 children 7–10 years old who are engaged in swimming there are studied the activity of myocardial and brain fractions of creatine phosphokinase, the level of troponin-T in blood serum and the main parameters of heart rate variability before and after the competition. The expenditure of usage this complex of energy supply of the myocardium and brain in young athletes has been established. The definitions of the studied laboratory and instrumental tests can be used in the diagnosis of the physiological, pathological *sports heart*.

KEYWORDS — children involved in sports, biochemical indicators of (MB-CFC, BB-CFC, troponin-T), spectral indicators of heart rate variability, physiological and pathological *sports heart*.

It is known that under physical and emotional stress, young athletes may experience energy problems with the body [1, 2]. Increased energy expenditure and energy (mitochondrial) deficiency lead to the formation of pathological *sports heart*, neurotic disorders and changes in other organs [2, 3].

To assess metabolic and energy changes in the myocardium, we use the determination of the activity of the MB-fraction of creatine phosphokinase (MB-CFC), troponin-T and the main spectral parameters of heart rate variability (HRV), reflecting the vegetative and energy supply of the organism. The activity of the BB- fraction of CFC characterizes the metabolic process of the brain and in combination with the change in the levels of the main parameters of HRV, may indicate the state of its energy supply [3, 4].

The particular interest is the study of energy supply of the heart and brain in young sportsmen before and after the competition.

Objective

To establish the significance of determation the body's energy supply before and after competition among young athletes.

The characteristics of children and research methods. 47 children aged 7–10 years (mean age 8.5±1.5) involved in swimming were under observation. The clinical examination was held on the basis of the SBHI AR Regional Medical Exercise Center and sports club. Athletes with organic diseases of the cardiovascular and nervous systems and acute respiratory infections within 1 month were excluded.

The examination included the collection of anamnesis, examination of the organs and systems, with an accent for the cardiovascular and nervous systems. The levels of activity of MB-CFC, BB-CFC by ELISA, the content of troponin-T with the help of the enzyme-immune test-system Beringer Manheim were studied in all the observed ones. From instrumental methods, standard electrocardiography (ECG), echocardiography (ECHO-CG) and electroencephalography were used according to indications, with the interpretation of the data obtained according to the standards. In addition, we studied the state of the main spectral parameters of HRV on the Polyspectr-12E apparatus of Neurosoft Company.

RESULTS AND DISCUSSION

Careful analysis of clinical, laboratory and instrumental data in 47 young athletes made it possible to form 2 groups of children. The first consisted of 22 (46.8%) athletes involved in 3–4 months. The second group consisted of 25 (53.2%) children, with experience in sport for 1.5–2 years.

In children of the first group, complaints of fatigue were noted after exercise in 7 (31.8%) cases, a decrease in heart tones was detected in 8 (36.3%), mild systolic murmur — in 5 (22.7%) cases.

Laboratory indicators of energy supply activity of MB-CFC, BB-CFC and the level of troponin-T did not significantly differ from the norm (pl>0,5; p2>0,05; p3>0,05).

ECG detected: sinus bradyarrhythmia in 7 (31.8%) cases, T wave inversion in 2 or more leads in 2 (2.1%) athletes, segment ST depression in isolated cases. On the echocardiogram, left ventricular diastolic dysfunction in 3 (13.6%), an increase in its mass over 220g/m^2 was detected in 4 (18.2%) children. The

spectral parameters of HRV were not significantly changed: TP>0,05; VLF>0,05; LF<0,05; HF>0,05 (Table1).

All observed children were further examined after the competition in 1–2 days. Athletes of the first group had complaints of fatigue in 17 (77.3%) cases,

Table 1. *The condition of laboratory and instrumental indicators before and after the competition*

Data	MB-CFC (f/l)	BB-CFC (f/l)	Troponin-T (mg/l)	TP (мс2)	VLF (мс2)	LF (мс2)	HF (мс2)
Groups	Befor competition						
First (n=25)	34,7±0,4	19,8±0,3	0,039±0,005	2740±616	1350±418	940±120	680±124
Second (n=22)	35,4±0,5**	28,1±0,3*	0,042±0,005**	2710±504*	1240±340*	1710±121**	970±120**
	After competition						
First (n=25)	29,5±0,3###	18,4±0,3##	0,042±0,005#	2450±512##	1280±41#	730±134##	810±130#
Second (n=22)	37,1±0,3###	32,5±0,4##	0,039±0,05#	2890±514##	904±141#	1600±450#	740±100##

Note: *Reliability p* — when comparing the indicators of the respective groups among themselves p>0,05*, p<0,05**, p<0,01****
 # — when comparing the values of each group before and after the competition p>0,05#, p<0,05##, p<0,01###

Thus, in children of this group, there were no marked disorders in the energy supply of the myocardium and the brain. This is confirmed by the values of the levels of activity of MB-, BB, CFC and troponin-T in combination with the stored relatively high levels of total spectrum capability (TP), low-frequency and high-frequency ranges. Identified deviations from the norm of clinical, laboratory and instrumental indices are due to not fitness or impaired adaptive abilities in athletes.

In the second group (25 observations), there were no complaints for long-term athletes, bradyarrhythmia was clinically observed — 11 (44.1%), loud heart sounds — 15 (60,0%).

Laboratory: indicators of energy supply of the organism, the activity of MB-CFC, BB-CFC was moderately increased (p_1<0,05; p_2>0,05), with unchanged levels of troponin-T (p_3>0,05).

ECG detected: sinus bradyarrhythmia in 11 (44.0%) cases, deviation of the electrical axis of the heart to the left — 10 (40.0%), moderate left ventricular hypertrophy 7 (28.0%). The echocardiography revealed an increase in the mass of the myocardium of the left ventricle in 9 (36.0%) children and diastolic dysfunction in 2 (8.0%).

When analyzing the spectral parameters of HRV, changes in the low-frequency (LF) and high-frequency (HF) ranges were found in 8 (32.0%) cases at normal values of the total power of the spectrum (Table 1). The changes correlated with the increase in the activity of MB-CFC and BB-CFC (k^1=0,9; k^2=0,7).

Consequently, the young athletes of the second group determined a sufficiently high energy supply of the body. The revealed changes in clinical and instrumental indices are probably due to the development of the *sports heart*.

half of the heart sounds were muffled in half, mild systolic murmur in 5 (22.1%) and bradyarrhythmia with the same frequency.

Laboratory parameters were characterized by an increase in the levels of MB-CFC (p_1<0,01) BB-CFC (p_2<0,05) with moderately reduced troponin-T (p_3>0,05) compared with those before the competition (Table 1).

On the electrocardiogram, the changes detected before the competition were maintained after. The frequency of distolic dysfunction on echocardiography increased in 15 (68.2%) with a preserved level of intex myocardial mass in 9 (40.9%). The overall power of the spectrum was reduced (p<0,05) at a low level of the low frequency range LF (p<0,05). It indicates the lack of energy in the organism.

When comparing clinical, laboratory, and instrumental data before and after the competition, a decrease in the energy of the myocardium and brain associated with the lack of fitness of young athletes was established. This clearly reflects changes in the levels of myocardial and brain fraction of CFC (p_1<0,05; p_2<0,05) in combination with reduced overall power of the HRV spectrum (p_3<0,05; Table 1).

Further observation after 1 month among these young athletes, we managed to single out a subgroup (9 people) with significantly changed clinical, laboratory and instrumental indices. Clinically, they had muffled heart sounds, half had mild systolic murmur, sinus bradyarrhythmia-7 (77.8%), tachyarrhythmia-2 (25.8%). Levels of MB-CFC, BB-CFC were below normal (p_1<0,05; p_2<0,05). On ECG, sinus arrhythmia was detected in all children, signs of impaired repolarization in 7 (77.8%). On echocardiography, diastolic dysfunction was detected in 7 (77.8%).

These young athletes were at risk of developing the pathological *sports heart*. In the future, after 2–3 months, their examinations confirm this condition.

In the observables of the second group, 1–3 days after the competition, the frequency of occurrence of bradyarrhythmia and changes in heart tones remained the same as before the competition. They showed ECG sinus bradyarrhythmia-15 (60,0%) with signs of left ventricular hypertrophy-8 (32,0%) and diastolic dysfunction on echocardiography-7 (28,0%). These disorders can be interpreted as a physiological *sports heart*. When comparing the results of HRV before and after the competition, an increase in the levels of indicators MB-CFC, BB-CFC and the spectrum of TP (p_1<0,01; p_2<0,05; p_3<0,05; Table 1). Consequently, the body's energy supply after the competition was quite high, or probably due to the formation of *sports heart*.

Thus, the determination of the levels of activity of MB-CFC, BB-CFC, the content of troponin-T in serum, variations in HRV ranges before and after the competition may allow to do the objective assessment of the body's energy supply. The use of this laboratory and instrumental complex makes it possible indirectly to characterize the combined energy changes in the myocardium and brain. The disorders occurring in these organs in young athletes are probably related to cerebrocardiac syndrome of physical and emotional stress. Investigation of the activity of MB-CFC, BB-CFC and the condition of the main indicators of HRV (TP, HF, LF) can be assumed to diagnose the pathological *sports heart*, and the degree of fitness of young athletes.

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