PECULIAR FEATURES OF HEART ACTIVITY METABOLIC CORRECTION IN CHILDREN AND ADOLESCENT ATHLETES

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ABSTRACT

53 children aged 10–14 years, involved in athletics during 1–1,5 years were treated against stress-dependent cardiomyopathy of varying degrees by coenzyme Q10 and inosine dosage by age for 6 weeks. The feasibility of cardiometabolic therapy with this combination of drugs at the preclinical stage of the disease and the need to control the effectiveness of the treatment with the help of both biochemical indices: the level of troponin-T and the activity of the myocardial fraction of creatinephosphokinaza in the blood serum, and the main spectral parameters heart rate variability (TP, VLF, HF) are established. In case of children with a significant deviation from the norm the course of therapy should be more than 6 weeks.

KEYWORDS — children involved in sports activities, stress-dependent cardiomyopathy, coenzyme Q10, inosine, biochemical indices (MF-creatinphosphokinaza, troponin-T), spectral indices of cardiac rhythm variability.

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The problem of sport pathology at the tender age is particularly topical nowadays. And this is due to the development of sport among children and young people, early sport specialization and absence of individual approach at various stages of training process. 40% of sportsmen have desadaptative changes, known as stress-dependent cardiomyopathy because of the unbalance between physical and mental activities and individual performance capacity. Behind this disease lies the disfunction of stress-limiting system, disorder of autonomic regulation of cardiovascular system, dysmetabolism with energy production deficitsand oxidative stress. When diagnosing stress-dependent cardiomyopathy it is very important, together with other medical and clinical data, to consider changes in the rate of cardiac injury markers: troponin-T and activity of myocardial fraction of creatinphosphokinaza (MF-CPhC) fraction in blood serum and basic spectral variables of heart rate variability (HRV) reflecting bothvegetative sufficiency and myocardium energy supply [1, 2].

Careful monitoring of cardiovascular system condition during sport activities enables to diagnose heart disorderson a timely basis and hence adequately providemedical and preventive care and treatment.

Recurrent energy (mitochondrial) deficiency develops during strenuous exercises and thisfact reasonably determines the prescription for sportsmen of metabolic drugsthat contribute to the process of energy supply [3,4].

A component of mitochondrial respiratory chain, coenzyme Q10, is one of the most common metabolic drugs in sport cardiology. It is known to be used for rehabilitation and preventive purposes during the period after and before sporting competitions, as well as forfast recovery after strenuous exercises especially for sportsmen with significant repolarisation abnormality. The evidence reveals that a course of inosine treatment decreases troponin-T level and activity of MF-CPhK. This medicine increases myocardium energy balance, has antihypoxic and antidysrythmic effect [5].

The aim of investigation is to establish peculiarities of combined use of coenzyme Q10 and inosine in management of stress- dependent dysfunction of cardiovascular system of young sportsmen.

The characteristic of children and methods of investigation. 146 children at the age of 10–14 (average age 12±0,5) were observed. They were doing athletics for 1–1,5 years. These children had periodic medical examination of SBEHP AR Regional curative-physical-culture dispansery. Sportsmen with organic heart and nerve diseases, and those who had acute respiratory infections (during last month), as well as the ones who were taking any metabolic drugs, were not examined. The research was conducted during basic course of training in autumn and winter period.

The research included physical examination of organs and systems, with special attention to cardiovascular system. Sportsmen underwent tests to determine the condition of activity rate of MF-CPhC by method of IFA and troponin-T rate was checked with the help of enzyme immune test-system produced by Beringer Manheim company. Moreover, sportsmen underwent standard electrocardiogram (ECG), echocardiography (Echo-CG) for medical reasons with the interpretation of data in compliance with the standards. Besides, research of the condition of basic spectral variables of HRV was made using "Polyspectr-12E" unit of Neurosoft both at rest and via orthostatic test for the evaluation of myocardium energy supply. The analysis of the results in investigation was done with the usage of variative statistics general methods.

Results and discussion: a very thorough analysis of clinical, laboratory, instrumental results of 146 young sportsmen allowed to establish that 53 children had symptoms of stress- dependent cardiomyopathy. All children were prescribed 2 mg/kg/day of coenzyme Q10 (ubihinon) by mouth during breakfast and 0,6–0,8 g/day of inosine by mouth before meal 3 times a day for 6 weeks.

Using randomizing technique, there were formed 2 groups comparable to the age and gender, physical exertions level and condition cardiovascular system. The first group consisted of 22 (41,5%) sportsmen with expressed features of heart abnormality, which were diagnosed with stress- dependent cardiomyopathy. The 2nd group consisted of 31 (58,49%) children that just had some laboratory abnormalities affected by changes of spectral variables of heart rate variability.

When generating their clinical evidence, the following factors were considered: complaints, condition cardiac border, heart rate, peculiaritiesofauscultatory presentation such as heart tone, heart murmur, abnormality level of biochemical data: troponin – T level and activity of creatinphosphokinaza-MB in blood serum. Besides, attention was paid to the changes in ECG and echocardiogram – condition of diastolic myocardium function, the left ventricular myocardium mass index and the condition of the basic spectral parameters of HRV: total frequency (TP), very low frequency (VLF), low frequency (LF), high frequency (HF) ranges at rest and during orthostatic tests. When estimating HRV parameters it was noted that the most expressedchanges were during orthostatic tests rather than at rest. That's why, the condition during orthostatic tests will be considered hereafter.

Children from the first group most commonly had the following clinical results:16 children (72,7%) complained of the shooting heartache, 18 (81,8%) had fatigue after training, 12% (54,54%) of young sports-

men had heart tone dullness, 10 (%) sportsmen had soft systolic noise at the apex, more rarely sportsmen had bradyarythmia- 9 (40,9%) cases. Most sportsmen (17 children (77, 7%)) had increased activity of MF-CPhC, 15 (68, 18%) sportsmen had increase of troponin – T level. The ECG results showed: sinus bradyarrhythmia in 11 cases (50%), T-wave inversion at 2 and more leads was diagnosed for 12 (54,5%) sportsmen, ST segment depression in 2 and more left chest leads was diagnosed in 9 cases (40,9%).Echocardiogram revealed diastolic dysfunction for 12 (54,5%) athletes, increase of left ventricular muscle mass index over 220 g/m^2 in 6 (27,3 %) children.

According to analysis of HRV spectral parameters it was revealed that a lot of children (21 children (95,5%) have a decrease of the basic HRV spectral parameters. It was pointed out that the following indices changed a lot: total frequency ($p_1 <0,01$), very low frequency ($p_2 <0,01$), and high frequency index ($p_3 <0,001$). The decrease of these indices is the result of predominance of influence of sympathetic outflow to the heart. Therefore, the sympathicotonic type of rate regulation can be observed as being predominant, and this fact is the evidence of inner stress rhythm tensionand thus proves that the diagnosisis accurate.

No distinct clinical changes were revealed in the second group. Significant abnormality of biochemical indices was found: increase of MF-CPhC activity was observed for 20 (64,5%) children, increase of troponin-T level was diagnosed in 24 (77,4%) cases. When comparingthe values of basic of HRV, their decrease was noted for 8 (25,8%) athletes of the group under examination comparing to normal level. However, the intensity of these indices in the first group was notably higher: TP ($p_1 <0,05$),VLF ($p_2 <0,01$), HF ($p_3 <0,01$). It speaks of lower degree of incidence and intensity of changes in such variablesfor this group.

It was noted that the increase in the activity of MF-CPhC and troponin-T for the observed children correlated with the decrease in the values of TP, VLF, HF (k=–0, 75; k_1=–0,77; k_2=–0,79). This is caused by metabolic disorders occurring in the myocardium associated with muscle loading that leads to decrease in myocardium energy security.

Thus, the increase of the level of cardiomyocyte damage markers detected in the observed group of young athletesin addition to decrease in the values of the basic HRV variables, enables to diagnose preclinical stage of stress-related cardiomyopathy which needs appropriate metabolic management.

Immediately after the course of treatment all observed children were examined. Patients of the first group after the medicines were cancelled had improvement in some individualperception: the number of

complaints of pain in heart was decreased by 31%, the fatigue after exercisereduced by 50%. The objective data showed: 3 (13,6%) children had a reduction in the heart rate, diminished heart tone was detected in 4 (18,2%) cases, only 5 (22,72%) young athletes still had soft systolic noise at the apex. In addition, positive shifts in laboratory-instrumental indicators were revealed. Optimization of hemodynamics was accompanied by a decrease in the levels of biochemical markers of myocardial damage for significant part of children in this group. The increase in activity of MF-CPhC was preserved in 8 (36,4%) cases, deviation from the norm of Troponin-T levels in 7 (31,8%) cases. Notably, there was a decrease in the level of this abnormality which also indicated the effectiveness of the therapy.

ECG shows that complex medication regimen contributed to a double decrease in the severity of disadaptation changes in the cardiovascular system: recovery of heart rate,that was initially reduced, in 4 (18,2%) cases, 50% decrease in the frequency of repolarization anomalies. However, attention was paid to the fact that not all children had normalization of ECG-indicators. Echocardiogram showed the retention of diastolic dysfunction in 5 (22,72%) cases together with normalization of the main index of diastolic function of the myocardium for the majority of observed children. In addition, there was a tendency towards recovery of the basic spectral variables of HRV, but at the same time they differed significantly from the norm (Table 1).

In the second group, after treatment, biochemical and instrumental parameters came back to norm. The level of troponin-T (p> 0.05) and the activity level of CPhC-MF (p_1>0,5) in blood serum did not differ significantly from the norm(Table 1). The instrumental tests showed the same trend for the basic spectral parameters of HRV (Table 1): TP (p>0,05), VLF (p_1>0,05), HF (p_2<0,5).

Thus, combined use of cardiometabolic drugs has been proved: coenzyme Q10 and inosinefor children with stress-related cardiomyopathy of varying severity. With regard to the above mentioned, the course of such treatment for young athletes with a significant deviation from the norm of laboratory-instrumental indices should at least 6 weeks or more. Moreover, the use of cardiometabolic therapy for children at the pre-clinical stage of disease and monitoring their condition, both with the help of biohemical indicis and the basic parameters of HRV, was proved to be reasonable and consistent.

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Table 1. *The state of laboratory-instrumental data in the studied groups of children before and after therapy*

Data	MF-CPhC(f/l)	Troponin-T (ng/l)	TP (мс 2)	VLF (мс 2)	LF (мс 2)	HF (мс 2)
Groups	Before therapy					
First (n=22)	56,6±0,4***##	0,076±0,005***##	2120±526,4***##	910±218***##	710±112**#	480±128 ***##
Second (n=31)	38,7±0,5***	0,044±0,006 ***	2890±504,1**	1120±422,1**	890±124*	690±144**
After therapy						
First (n=22)	45,3±0,5	0,045±0,05	2970±507	1248±418	930±134	640±134
Second (n=31)	31,6±0,4	0,039±0,05	3221,4±556,4	1369,2±432,4	1011,2±465,4	712,4±284,1

* — value of reliability by comparing values with conditionally healthy ones;
* — p>0,05; ** — p <0,05;*** — p<0,01;
 # — reliability values by comparing data in the first and second groups among themselves; # — p > 0,05; ## — p <0,05.

Consequently, the combinationuse of coenzyme Q 10 and inosine for children engaged in sports contributes to the normalization of the main symptoms of stress-related cardiomyopathy. However, the fact that there were still changes in clinical-biochemical and instrumental indices among some of the athletes from this group indicated that there should be a longer course of treatment with these medications.

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