CHARACTERISTICS OF THE PHYSICAL HEART TRAINED AND UNTRAINED STUDENTS DEPENDING ON THE LEVEL OF BIOELEMENTS IN THE BODY

Reshetniak O.A.
Tavricheslkiy national university, named after V.I. Vernadskiy

Annotation. The functional inspection of cardiac activity is conducted at 80 physically trained and untrained students, who have been surveyed about the maintenance of cadmium, potassium and calcium in an organism. The research of the element balance of students revealed that study of chemical elements in the organism of sportsmen was more satisfactory, than for the physically untrained students which showed the deficit of essential elements. The research of features of reaction of the cardiovascular system on the physical loading showed that physiological role of toxic cadmium for the state of the cardiovascular system was more expressed for sportsmen, than for the physically untrained students, though its content in an organism was within the limits of the existing norm. The physiological role toxic and essential elements for an action of the heart of sportsmen and the persons who are not going in for sports is revealed.
Keywords: cardiovascular system, sportsmen, chemical, elements, students.

Introduction

It is known that systematical physical trainings lead to substantial optimization of functional state of cardiac vascular system of organism, to raising of functional reserves of this system that require appropriate provision with microelements.. Besides, systematical physical loads are favorable factor, facilitating excretion of toxic elements from organism [3, 7]. In connection with it, studying of element balance status in organism in conditions of polluted environment, especially with systematical physical loads, is an urgent direction of physical culture and sports. The group of important for sportsman's organism elements includes (Ca++) calcium and (K+) potassium, with deficit or excess of which the abnormalities of muscles tissues' functioning is observed. At the same time some of the most spread pollutants, for example cadmium (Cd++), can be physiological antagonists of for these elements [6].

At present time there is rather limited quantity of works about interconnections between microelements' content and heat activity's indicators of sportsmen, which do not give full picture about how interaction of elements is realized in organism, how this interaction reflects on blood circulation system' functioning and affects on training and competition activity [9].

The researches have been conducted as per the plan of scientific & research works of Tavricheskiy national university, named after V.I, Vernadskiy "Medical and biological grounding of physical education system. Development and improvement of medical-pedagogical observations' methods in training process" (State registration No. 0101U005752) and of Crimea state medical university, named after S.I. Georgiyevskiy by program "Physiological approaches to estimation of ecological risk for health" (State registration No.0102U006172).

Purpose, tasks of the work, material and methods

The purpose of the work: to study peculiarities of cardiac vascular system's functional state of physically trained and not trained students, depending on cadmium, calcium and potassium content in organism in the state of physiological rest, under physical load and in the period of recreation.

The methods of the research: X-ray-fluorescence method, ECG method, statistical data processing by means of density-free correlation analysis by Spirman, statistical comparison by Manna Witny's method.

The organization of the research. The research covered 80 students (male) of 18-22 years old, from whom: 40 are students-sportsmen, professionally doing football (1^{st} group) and 40 students, attending only academic classes in physical culture – (2^{nd} group). The tested were examined for the content of Cd++, Ca++ и K+ in biologically constant tissues (hairs) with the help of X-ray-fluorescence method in laboratory of scientific & research center "VIRIA", Kiyev.

Heart activity was estimated by registration of indicators with the help of ECG on apparatus "Ergocard" (Italy). During research, identification of such ECG indicators as: intervals PQ© and QPST ©, segment ST (S), complex QPS © and interval R-R (c) was carried out.

ECG was registered in physiological rest state, with combined step-by-step physical load on bicycle ergometer, which consisted of 8 stages (3 minutes each) and in recreational period (during 5 minutes).

Statistical processing of data was fulfilled by Spirman's density-free correlation analysis and statistical comparison by Manna-Witny's method.

Results of the researches

First of all it should be noted that average content of the studied chemical elements in organisms of the tested sportsmen was within conventional, accepted as on to day, norm [4, 8, 10], while not trained students had deficit of Ca^{++} and, especially K^{+} in hairs (table 1).

doi: 10.6084/m9.figshare.644776

Table 1

Concentration of chemical elements in hairs of the tested students (mkg/g)

Chemical element	Minimal	Maximal	X±Sx	Conventional norm
Cd^{++} (cadmium)				
1st group	0,00	0,28	0,08±0,01	0-1
2nd group	0,00	0,17	0,05±0,01**	
Ca^{++} (potassium)				
1st group	183,67	929,69	353,31±28,40***	300-700
2nd group	145,62	718,19	179,50±25,38	
K^{+}(calium)				
1st group	0,00	185,34	84,90±10,26	70-170
2nd group	0,00	301,21	40,49±8,87***	

Note: Differences between groups are authentic ** with p<0,01; *** with p<0,001.

The obtained data are in compliance with the data about differences in the content of professional sportsmen's hairs, mainly it is increase of most chemical elements concentration (Ca, Mg, Na, P, K) in comparison with healthy, but not doing sports, male students' indicators [5].

So, it is considered that increased concentration of Ca^{++} in sportsmen's hairs can rather show its intensive turnover and excretion under systematic physical loads (cumulative effect of physical loads) than reflect its high content in organism. On the other hand it can point to "hidden" risk of its deficit appearing. The increased Ca^{++} metabolism also can reflect affect of training and competition processes and may be using of pharmacological remedies by sportsmen. It can also be illustrated by increased content of Cd^{++} in sportsmen's organisms, assimilation of which worsens Ca^{++} [6].

IAE, higher content of the researched elements can say about both: better elements' status of sportsmen's organisms and eliminating affect of muscular loads, which influence not only on dynamics of toxic elements but on the content of indispensable to life chemical elements.

The reduced calcium content in students' not doing sports organisms can be, in its turn, conditioned by a number of reasons. First of all Ca^{++} deficit is connected with its low content in food, and in this respect Ca^{++} deficit is rather spread phenomenon for modern young generation [2, 6]. Its reduction can also be observed in connection with its increased consumption resulting from stresses, excessive consuming of caffeine containing products, smoking. The latter also results in K+ deficit in the hairs of students, who are not go in for sports, and is noticeable usually with psychic overstrain, weakening of adaptive mechanisms.

Average values of the studied indicators of heart activity in physiological rest state of students-sportsmen and students not doing sports did not sufficiently differ and, in general, complied with normative values, i.e. they were either within the limits of accepted physiological norm or differed from it insignificantly for some of the tested [1], (table 2).

Table 2

Heart activity's indicators of the tested students in the state of physiological rest

Indicators	Average± standard deviation		Norm
	sportsmen (n=40)	Not sportsmen (n=40)	
Interval PQ (c)	0,128±0,001***	0,131±0,002	0,12–0,20
Complex QRS (c)	0,090±0,002	0,093±0,003	0,06–0,09
Segment ST (c)	0,057±0,001***	0,065±0,001	0,02–0,12
Interval QRST (c)	0,148±0,001***	0,158±0,001	0,35–0,42
Interval R-R (c)	0,825±0,101	0,833±0,129	0,75–1,0

Note: Differences between groups are authentic ** with p<0,05; ***with p<0,001.

The results of comparative analysis of students sportsmen's ECG indicators and the students, not doing sports, witness that the found authentic differences of intervals PQ and QRST, as well as segment ST (see table 2) can be the results of organism's adaptation to high physical loads, which, during long time, do not cause distortions of myocardial-hemodynamics homeostasis, but only lead to some shifting of physiological indicators. This shifting is conditioned by long term structural mechanisms of adaptation to systematical loads during long time [1, 3], that, probably, took place in this research.

The results of correlation analysis obtained in the present research, witness in favor of this theoretically grounded assumption. They are characterized by the presence of ECG heart characteristics' dependence on the level of

the studied chemical elements in organism on all stages of testing, expressed in different extent and manner (see table 3, table 4).

Table 3

Correlative analysis of heart activity indicators and chemical elements in the hairs of physically trained students (1st group, n=40)

Chemical element	Indicators	Rest		Load		Recreation	
		(r)	(p)	(r)	(p)	(r)	(p)
Cd^{++}	PQ interval	-0,47	0,01	-0,52	0,01	-0,43	0,05
	QRS complex	-0,47	0,01	-0,35	0,02		
	QRST complex			-0,50	0,02	-0,56	0,01
	ST segment					0,52	0,01
	R-R interval			-0,31	0,04		
Ca^{++}	QRST interval			0,44	0,05		
	R-R interval			-0,46	0,01	-0,37	0,04
K^{+}	QRST interval			-0,54	0,01		

Table 4

Correlative analysis of heart activity indicators and chemical elements in the hairs of physically not trained students (2nd group, n=40)

Chemical element	Indicators	Rest		Load		Recreation	
		(r)	(p)	(r)	(p)	(r)	(p)
Cd^{++}	PQ interval			0,37	0,01		
	QRS complex			0,46	0,02	-0,37	0,02
	QRST complex			0,36	0,02		
K^{+}	ST segment			0,36	0,02	0,31	0,05
	R-R interval			-0,33	0,03		
	QRST interval			0,36	0,02	0,40	0,02
	R-R interval			0,40	0,01		
	QRST interval						

First of all it should be noted that the 2nd group students manifested this dependence only after physical load and, to a less extent, in recreational period with two elements from three (table 4). The first group students had such dependence also in rest; in anyway ECG characteristics responded to all three elements and the character of this response was other than of not trained students (table 3).

The quantity of responding parameters and found correlating connections of students-sportsmen were also greater and this, probably, permits to affirm that their organisms are more sensible to oscillations of these elements level in organism that can be connected with higher demand in appropriate microelement provision with systematical physical loads.

From this point of view, correlation links of intervals QRST, R-R , for example, with Ca^{++} level of sportsmen, but not of students, who do not go in for sports and also opposite by character correlation with its functional antagonist K^{+} (table 3). Correlation with concentration K^{++} were found among not trained with ventricle complex. With it, their multidirectional potassium influence on different stages of ventricles excitement phase.

But the most substantial influence of both groups students' ECG characteristics was found from the side of toxic Cd^{++}, though its content in organism was very insignificant, So, for physically not trained students, the more Cd^{++} content was, the longer time excitement form auricle to ventricle passed under physical load

An opposite situation was observed with trained students on all stages of testing: before, after physical load and during recreational period. For the students of the 2nd group, Cd^{++} influence took place only for the time of duration of full excitement of both ventricles (segment ST), while for the 1st group students they were the different stages of ventricles excitement, with it the character of dependence was opposite: the higher Cd level the less time was required for excitement's passing. In other words positive dromotropic effect took place.

Summary

1. It was found that average content of chemical elements in organisms of sportsmen was within the frames of conventional physiological norm, while concerning the students, not doing sports deficit of calcium and, especially, potassium, was observed in organisms.

2. It was established that cadmium affected in a certain way on electrophysiological indicators of sportsmen's heart activity: interval PQ, complex QRS, interval QRST, segment ST, interval R-R with

0,31≤r≤0,52 и 0,01≤p≤0,05, in rest on different stages of load and in recreational period. For not trained students cadmium did not have so expressed significance, with the exception of its general influence on the duration of heart cycle at the expense of elongation of atrio ventricular excitement's passing (interval PQ (r=0,37; p≤0,01) and the period of general excitement of ventricles (segment ST (r=0,46; p≤0,02) though
in opposite manner in comparison with sportsmen and practically only under physical load.

3. Functional significance of essential elements for not trained students manifested only after physical load and, to less extent, in recreational period, while for sportsmen such dependence was observed also in physiological rest. This showed at higher demand in appropriate microelement provision under systematical physical loads.

Further researches are offered to be conducted in direction of studying of other problems, connected with analysis of heart activity indicators.

References:

1 Vaniushin Iu.S. *Fiziologiia cheloveka* [Human Physiology], 1998, vol.24(3), pp. 105-108.
2 Notova S.V., Burceva T.I. *Mikroelementy v medicine* [Trace elements in medicine], 2004, vol.4, pp. 103-105.
3 Prodius P.A., Sazontova T.G., Golancova N.E. *Adaptaciia k fizicheskoj nagruzke povyshaet ustojchivost' k povrezhdaiushchemu dejstviiu adrenalina i kal'ciia* [Adaptation to physical activity increases the resistance to the damaging action of adrenaline and calcium], 1997, vol.5, pp.711-714.
4 Revich B.A. *Gigiena i sanitaria* [Hygiene and sanitation], 1990, vol.3, pp. 28-30.
5 Skal'nyj A.V., Ordzhonikidze Z.G., Katulin A.N. *Pitanie v sporte: makro- i mikroelemeny* **[**Nutrition in sport: the macro- and micronutrients], Moscow, Gorodec, 2005, 144 p.
6 Skal'nyj A.V., Rudakov I.A. *Bioelementy v medicine* [Bioelements in medicine], Moscow, Oniks, 21 century, World, 2004, 272 p.
7 Solodkov A.S. *Adaptaciia k myshechnoj deiatel'nosti - mekhanizmy i zakonomernosti. Fiziologiia v vysshikh uchebnykh zavedeniiakh Rossii i SNG* [Adaptation to muscular activity - the mechanisms and patterns. Physiology in higher educational institutions of Russia and CIS], Sankt Petersburg, SMU, 1998, pp. 75-77.
8 Grandgjean P., Frentsos J.A., Baer J.A. Mercury Risks: Controversy or Just Uncertainty? *Public Health Reports*, 1999, vol. 114, pp. 512–517.
9 Spencer C.I., Barsotti R.J., Berlin J.R. Loading of calcium and strontium into the sarcoplasmic reticulum in rat ventricular muscle. *Jounal Nol Cell Cardiol*, 2000, vol. 32, pp. 285–300.
10 Valkonic V. Human hair. *Fundamentals and methods for measurement of elemental composition*, Boca Raton, CRC Press, Inc, 1988, vol. 1, 164 p.

Information about the author:

Reshetniak O.A.: olga_sport_tnu@mail.ru; Tavricheskiy National University; Student str. 13, Simferopol', 97000, Ukraine.

Cite this article as: Reshetniak O.A. Characteristics of the physical heart trained and untrained students depending on the level of bioelements in the body. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2013, vol.3, pp. 47-51. doi:10.6084/m9.figshare.644776

The electronic version of this article is the complete one and can be found online at: http://www.sportpedagogy.org.ua/html/arhive-e.html

Received: 11.02.2013
Published: 31.03.2013