THE INFLUENCE OF PHYSICAL ACTIVITY ON THE MORPHOMETRY OF THE HEART OF TRACK AND FIELD ATHLETES

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Knowledge of the morphological changes in the hearts of athletes depending on the focus of the training process will allow sports physicians to detect the early stages of myocardial hypertrophy and reduce the risk of deadly forms of cardiac remodeling in athletes.

By establishing a relationship between the focus of the training process of athletes and their hearts' morphometric parameters the process of left ventricular hypertrophy can be controlled. This relationship has a particular practical importance to optimize the adaptation of the heart to the physical stress and minimize the risk of sudden cardiac death in athletes.

ABSTRACT

Under the influence of physical loads on the body of athletes there occurs an adaptation in accordance with the thrust of the training process. A particular focus of the training process changes and specializes as the morphology and function of the body of an athlete changes. There are peculiarities in the adaptation of an athlete's cardio-vascular system to the specific type of sport activity. Taking into account these peculiarities, one can estimate the intracardiac sizes of the athletes of various sports specializations. The quantitative values of the echocardiographic parameters in athletes of different kinds, establishes the presence of changes in the geometry of the left ventricle of the heart of athletes with various orientations of the training process.

KEYWORDS: myocardium, left ventricle, hypertrophy, adaptation, athletes.

INTRODUCTION

In general, no doubt, sports have a positive impact on human health. However, it is the heart of the body which is most often overloaded and over-voltaged. The heart of an athlete might be bigger than that of an untrained person, but no histological changes in its structure are necessary.

The structural changes of the heart in athletes are represented by two processes: hypertrophy and dilatation of its walls. Physiological dilatation and hypertrophy of the heart are of great importance in making athletes perform at high levels [1].

The greatest performance of athletes is due to a specific ratio of the thickness of the ventricular wall to the size of its adjacent cavity [3]. This ensures that the cardiac output reaches such values that allow the athlete to withstand maximum amounts of exercise. Thus there is an increase in the absolute thickness of both right and left chambers of the heart.

Economization of heart function at rest, and maximal heart performance during high intensity workouts are the distinct features that characterize the physiology of an athletic heart [4].

Cardiac hypertrophy of athletes is an adaptive reaction of the central circulatory organ to demanding workload due to systematic training [2]. High performance level of an athlete's heart is thus due to a long-term adaptation of athletes to strenuous physical work.

Myocardial hypertrophy is a change characteristic of high level functionality of the cardiovascular system in athletes. Proper and efficient exercises cause positive cardiovascular morphological changes [4, 5, 6]. Morphological changes characteristic of an athlete's heart are not of pathological nature and depend on the nature of the muscular load, whether it is static or dynamic. Classification of physical activity on the static and dynamic basis is important in determining the various influences on the athlete's body, as the prevalence of one type of loads leads to different effects on the cardiovascular system. However, the classification is also conditional, due to a combination of static and dynamic loads in each sport.

The study involved athletes doing track and field. Track and field is a complex type of sport that involves discipline associated with different motor abilities, as well as combining a variety of patterns of muscular loads. In this connection, track and field can be regarded as a model for many sports.

The question that still has not been decisively answered is how the various kinds of physical activity (high-speed direction, speed–power, endurance) on the morphometric parameters of the heart of athletes engaged in different kinds of athletics. The aim of the study was to determine how those various kinds of physical activity affect the morphometric parameters of the left ventricle (LV) of athletes.

The main research objectives were:

1. Complex study of morphometric parameters of the heart of athletes with sports categories 1- 3 (1 being beginner and 3 pro) and other highly skilled athletes.
2. To examine morphometric changes in the LV of the heart of athletes as a function of the focus of training and to identify groups of athletes with changes in the geometry of their LV.
3. To identify the various adaptive rates of change in the LV's myocardium of different athletes.

MATERIALS AND METHODS

170 athletes were surveyed who specialize in different kinds of athletics. Of these, a control group (CG) of 70 people was selected (35 men and 35 women), aged 15 to 27 years (mean age – 18,57±2.09 years) with 1-3 sports categories in athletics. The experimental group (EG) included 100 track athletes (52 men and 48 women) of high athletic qualifications (candidate master, master of sport, master of sports of international class) aged 16 to 34 years (mean age – 22.45 ± 3.40 years).

The EG athletes were divided into three groups based on the predominant training target: Group 1 (n=39) – high-speed thrusts; Group 2 (n=41) – speed-power; Group 3 (n=20) endurance.

The study of morphometric parameters of the heart of athletes was conducted using the method of echocardiography. Comparative analysis included the following indicators of heart morphometry : left ventricular end-diastolic diameter (LVDd) and left ventricular end-systolic diameter (LVDs), mm; absolute posterior wall thickness of the left ventricle in diastole (PWTd) and systole (PWTs), mm; interventricular septal thickness in diastole (IVSTd) and systole (IVSTs), mm. In addition, echocardiography determined the left ventricular mass (LVM, g).

From the numerical data obtained the following statistical parameters were calculated: mean (M), standard deviation (σ) and the standard error of the mean (m). When comparing the mean values Mann-Whitney nonparametric statistical tests were used.

RESULTS AND DISCUSSION

The results of statistical processing data revealed the presence of morphometric changes of the LV of the heart in a group of athletes with high qualifications (EG, Table 1).

TABLE 1.

The morphometric parameters of the left ventricular myocardium of the heart of athletes (M±σ)

Parameter	EG		CG	
	men (n=52)	women (n=48)	men (n=35)	women (n=35)
IVSTd, mm	8,36±0,84	7,73±0,86*	8,09±0,79	7,33±0,90*
IVSTs, mm	11,23±1,36*	10,33±1,43	10,65±1,27*	9,94±1,10

PWTd, mm	8,75±0,92	8,29±1,00**	8,44±0,91	7,70±0,71**
PWTs, mm	15,22±1,34	14,29±1,64*	14,99±1,74	13,56±1,53*
LVDd, mm	50,13±4,46*	45,65±4,01	48,29±4,16*	44,34±3,80
LVDs, mm	33,37±4,18*	30,42±3,21*	31,63±3,06*	28,94±3,11*
LVM, g	199,16±47,07	158,49±36,04**	181,99±38,80	137,75±32,41**
* p<0.05; ** p<0.01.				

All of the above parameters for the CG athletes normal —and were significantly less than the corresponding parameters of elite athletes (p <0.05, p<0.01). Improving all the morphometric parameters of the LV in EG compared with CG indicates a significant impact of intense exercise on the morphometric parameters of LV heart failure. exercise duration affects the increase in morphometric parameters of the LV of athletes. These morphometric changes are an adaptive response of the heart to intense exercise.

Changes in LV morphometry in the three groups of athletes (depending on focus of the training process) of high sports training are shown in Table 2.

TABLE 2.

Echocardiographic parameters of the left ventricular myocardium of the heart (highly qualified athletes (M±σ))

Parameter	Group 1		Group 2		Group 3	
	men (*n*=18)	Women (*n*=21)	men (*n*=24)	women (*n*=17)	men (*n*=10)	women (*n*=10)
IVSTd, mm	8,09±0,58	7,59±1,00	8,45±1,07	7,84±0,81	8,63±0,44**	7,85±0,63
IVSTs, mm	11,03±1,51	9,94±1,15	11,40±1,31	10,32±1,73	11,18±1,31	11,17±1,15*
PWTd, mm	8,52±0,59	7,96±1,01	8,90±1,21	8,60±1,02	8,80±0,42**	8,46±0,78*
PWTs, mm	14,81±1,41	14,11±1,88*	15,39±1,42	14,09±1,31	15,55±0,84	15,00±1,56
LVDd, mm	50,06±2,94	45,24±4,16	50,58±5,12	45,29±4,18	49,20±5,29	47,10±3,41*
LVDs, mm	33,39±3,48	30,33±3,58	33,71±4,94	30,24±3,19	32,50±3,57*	30,90±2,64

LVM, g	185,67±20,61	151,80±32,76*	209,06±62,64	156,54±37,45	199,71±33,18*	175,84±38,22*
* $p<0.05$; ** $p<0.01$.						

The values of the LVDd and LVDs in all experimental groups of athletes had very similar value ranges. Consequently, the focus of the training process has no significant effect on the LV's diameter.

Group 2 male elite athletes had the highest LVM index (speed-strength oriented training process), and for women it was group 3 (endurance). These 2 focuses of the training process had the greatest impact on the increase in LVM of the heart.

Group 2 highly skilled athletes had the highest values of PWT in the diastole (both men and women). In addition, men belonging to this group had the largest amount of IVSTs. Thus the researchers concluded that physical strength conditioning increases in the thickness of LV's walls. Configuration of heart cavities remained unchanged.

Experimental group 3 (both men and women) showed maximum IVST in diastole and PWT in systole. Athletics with a predominance of physical activity was most pronounced signs of myocardial hypertrophy of the LV of the heart. Athletes specializing in long-term endurance work had a tendency for a linear increase in heart size.

All morphometric parameters had the lowest values in group 1 (with speed oriented workouts) elite athletes.

CONCLUSION

Adaptations occur in the body of athletes in accordance with the training process. Particular targeting of the training process changes the morphology and function of an athlete's heart.

The set of professional-sports factors (sport, training process efficiency, duration and intensity of training) have an impact on the prevalence of certain LV geometry and on the characteristics of its remodeling. Genetic factors are also important.

Analysis of the data allowed ~~us~~ the researchers to: 1) identify the features of adaptation of the cardiovascular system of athletes for a specific types of sports , 2) to determine the quantitative values of echocardiographic parameters for athletes specializing in different kinds of athletics, 3) to establish the presence of changes in the geometry of the left ventricle in athletes with different orientation of the training process, 4) to evaluate the intracardiac dimensions in athletes of various sports specializations.

Further studies in those groups of athletes that had altered left ventricular geometry will determine the specific type of left ventricular hypertrophy of the heart, depending on the focus of the training process.

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