

Adaptation rearrangements of heart of young sportsmen depending on the orientation of the training activity

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Purpose: studying of the main parameters of morphofunctional condition of the left ventricular cavity of heart of sportsmen in the conditions of the training and competitive activity.

Material & Methods: three groups of children ($n=30$) of 7–9, 10–12, 13–14 years old, who begin to train in sports with the manifestation of endurance and high-speed and power qualities, the qualified sportsmen at the age of 15–16 years old, who are engaged in run on 400 m with barriers, and karatekas ($n=15+n=15$), not engaged children of the same aged groups ($n=40$). The following methods of the research were applied: analysis of special literature, pedagogical supervisions, pedagogical experiment, echocardiological methods of the research.

Results: the considerable connection of types of heart of young sportsmen with indicators of exercise stress of various orientations is established. Sportsmen with the optimum vegeto-rhythmic indicators have the essential advantages in adaptation morphofunctional displacements in heart and warm productivity at sportsmen with satisfactory vegetative-rhythmic indicators.

Conclusions: adaptation morphofunctional displacements in activity of the cardio-respiratory system are closely connected with the prevailing orientation of the training process and can be used as the objective test of adaptation to the special loadings in sport.

Keywords: echocardiological indicators, vegetative-rhythmic indicators, training work, endurance, high-speed and power qualities, sportsmen.

Introduction

The new term “sports heart” appeared in scientific literature last century. Big experimental material which confirms legitimacy of the existing term is collected in modern literature. Wide opportunities of studying of structural and functional changes of heart, which are formed under the influence of exercise stresses, were received by the method of ultrasonic echocardiography, which is offered by I. Edler, S. Hertz [12].

The first researches in the USSR, which were carried out with use of ultrasonic echocardiography, showed big informational content and value for supervision over sportsmen. But indications of these researches had a contradictory character.

So, the researches of A. G. Dembo [6] established that the accurate thickening of the back wall of myocardium of left ventricle at rather small increase in its cavity is established at most of athletes, who are engaged in sports, where the advantage is endurance.

The increase in cavity of left ventricle is observed at wrestlers at the same time at the full absence of the increase in thickness of myocardium of the back wall. A. G. Dembo with co-authors [6; 8] gives examples of hypertrophy of myocardium of left ventricle at weight-lifters and its notable dilatation at skiers-racers. The powerful data on condition of cavities and walls of myocardium after loadings of different character and

in the renewal period after the termination of their performance are obtained [5; 7; 10; 15].

Modern researches which are conducted with skiers-racers of high qualification and healthy people, who do not play sports, demonstrate the increase in stroke output of blood at representatives of both groups [2; 3; 4]. At the same time it increases mainly due to the reduction of sacral-systolic at sportsmen, and at not sportsmen – due to the increase in sacral-diastolic volume. This fact, according to authors, is caused by fuller supervision of left ventricle at sportsmen.

Much earlier [12; 13; 16] the results were received with sportsmen skiers-racers and wrestlers, which demonstrate that there is not increase in sacral-diastolic diameter of left ventricle at the top of loading, but its reduction.

The researches of condition of cardiac cavities at sportsmen at load of endurance showed that cavities of left ventricle increase whereas high-speed and power loading promotes the increase in thickness of warm wall of left ventricle [1; 4; 9; 11].

The majority of researches were conducted with highly skilled adult sportsmen and adults who did not play sports.

However, as show researches of some authors, morpho-functional changes of heart, are observed at early stages of sports activities and depend on specifics of motive activity of sport.

At the same time the systematic researches of condition of heart walls and cavities at children were not carried out. It is proved that the method of ultrasonic echolocation of morpho-functional reorganizations of heart activity allows receiving objective indicators and is of great importance for the creation of the training process at all stages of preparation.

Purpose of the research

Studying of key parameters of morpho-functional condition of cavity of left ventricle and myocardium of back wall of left ventricle which will allow determining the studied parameters at all sportsmen in the conditions of training and sports activity.

Material and Methods of the research

Ultrasonic researches of young sportsmen were conducted by means of echocardiograph MARK-300 which provides the qualitative echogram in the mode of monoplaned cut through vertical projection of heart.

The locator sensor in the 5–4 – th intercostals space, to the left of breast in the place of absolute warm dullness was attached to investigated in situation, lying.

Runners on 400 m with barriers of 16–17 years old and karatekas of the same age took part in the research. The control group was made by young men of 16–17 years who do not play physical education and sports.

The following parameters were defined during the research: D_s – systolic size of left ventricle; D_d – diastolic size of left ventricle; T_{ms} – thickness of myocardium of back wall in the diastole, $\% \Delta S$ – extent of reduction of the front and back size; V_s – systolic volume of left ventricle; V_d – diastolic volume of left ventricle; SO – stroke output; FE – fraction of emissions in %. Indicators of D_s , D_d , T_{ms} and T_{mu} were registered directly from echocardiogram by the direct measurement. D_s and T_{ms} were measured on electrocardiogram at point R, and D_d and T_{mu} – at the beginning of the complex. Such formulas were applied to calculation of parameters which are not possible for measuring in the direct measurement:

$$\%S = \frac{Dd - Ds}{Dd} \% ; V_s = 0,994 D_s^3 ; V_d = 0,837 D_d^3 ; SO = V_s - V_d ; FE = \frac{SO}{Vd} 100.$$

Results of the research and their discussion

It is established that indicators of Echo of CG of the studied sportsmen significantly differ from children of the same age who do not play sports (tab. 1). Indicators of the general fitness testify to considerable thickening of back wall of myocardium of left ventricle, increase of the front and back size of cavity of left ventricle and its total amount. The powerful hypertrophy of myocardium is observed at insignificant increase in volume of cavity of left ventricle at karatekas who used in training process high-speed and power loading.

Training regime of runners on 400 m with barriers which are aimed at the development of high-speed endurance promoted more substantial increase of heart emissions due to increase in total amount of left ventricle.

Materials of the research of sportsmen demonstrate that the absolute sizes of heart, thickness of back wall of left ventricle, volume of its cavity much more in both groups, than in the investigated control group.

It gives the grounds for the statement that the myocardium hypertrophy already at early stages of preparation is the most characteristic sign of adaptation of heart to exercise stresses. At the same time in nature of hypertrophic changes at children it is observed considerable variety, which can play crucial role in the achievement of sports achievements in sports, which are connected with endurance development. Rather moderate hypertrophy of walls of left ventricle at significant increase in its cavity characteristic for this group of children. Shock emissions at the same time increase, reduction of volume of cavity of left ventricle in systole much more, than at children who have considerable hypertrophy of left ventricle.

The typical changes of heart – moderate hypertrophy of wall of left ventricle are established at significant increase in its cavity [9; 14] in special series of researches of sportsmen of high qualification runners on average distances. This group of sportsmen has also optimum vegetative-rhythm ratio (HR and steps, the frequency of breath and steps). It confirms our researches, and the vegetative-rhythm index can be applied as the test to selection of young sportsmen with orientation to sports with endurance manifestation.

Researches of aged features of formation and development of cardio-respiratory functions in children (tab. 2) during the systematic motive activity give the grounds for estimation of positive displacements of adaptation processes at application of long low-intensive motive activity. This type of muscular activity needs to be considered as the main development tool of endurance at children with orientation to sports with manifestation of types of endurance.

It is established earlier [12; 15; 16] that differences of adaptation changes in heart are result of heterogeneity of age groups. Our researches demonstrate that the powerful communication between adaptation reorganizations of heart with orientation of the training process is established at early stages of sports specialization. The more certain increase in volume of left ventricle at insignificant thickening of its walls is observed at young sportsmen who train with low-intensive loadings. The considerable hypertrophy of myocardium is followed insignificant to increases in volume of left ventricle at young sportsmen who train with orientation on manifestation of high-speed and power qualities.

It is possible to consider that the first type of adaptation reorganizations of heart is more charitable. It leads to significant increase in stroke output of heart and provides thus the increased blood-groove volume, without forcing heart rate. It promotes possibility of change of stride rate at distance [4; 9; 11].

Conclusions

1. The increase in volume of left ventricle at insignificant hypertrophy of myocardium is observed at young sportsmen-runners on 400 m with barriers.

Table 1

Echocardiological indicators at young sportsmen and children who do not play sports

Direction of the training process	Age	Main indicators of Echo of CG								
		D _s	D _d	T _{ms}	T _{mu}	%	V _s	V _d	SO	FE
Runners on 400 m with barriers	15–16	3,90	5,33	1,40	0,97	26,3	59,09	125,44	66,69	52,38
Karatekas	15–16	3,37	4,52	1,59	1,06	25,13	37,79	76,92	39,13	50,42
Young men who do not play sports	15–16	3,23	4,43	0,87	0,61	29,50	33,60	82,71	50,56	60,70

Table 2

Aged changes of adaptive opportunities of heart on the basis of Echo of CG of indicators with different orientation of the training process

Direction of the training process	Age	Main indicators of Echo of CG								
		D _s	D _d	T _{ms}	T _{mu}	%	V _s	V _d	SO	FE
On development of high-speed endurance	7–9	3,22	4,44	0,97	0,68	25,80	33,9	72,69	38,78	53,0
	10–12	3,30	4,89	1,28	0,88	28,93	42,66	92,78	48,16	52,8
	13–14	3,73	5,02	1,36	0,94	25,2	51,54	104,94	53,58	50,18
On development of high-speed and power qualities	7–9	2,84	3,99	1,23	0,88	28,53	22,6	52,7	30,11	56,8
	10–12	3,05	4,29	1,32	0,98	28,30	28,17	65,56	37,34	56,33
	13–14	3,13	4,38	1,48	0,89	28,09	30,46	69,93	39,47	55,94
Children who do not play sports	7–9	2,82	3,92	4,71	0,47	27,02	22,24	50,02	27,70	50,0
	10–12	3,04	4,30	0,85	0,58	28,8	28,13	66,02	37,86	56,9
	13–14	3,05	4,43	0,85	0,59	32,45	28,81	72,12	46,31	63,82

2. The considerable hypertrophy of myocardium of left ventricle at insignificant increase in its cavity is observed at young sportsmen-karatekas.

3. The adaptation morpho-functional displacements in activity of the cardio-respiratory system are closely connected with overwhelming orientation of the training process and can

be applied as the objective test of adaptation to specific loadings in sport.

The prospect of the subsequent researches consists in studying of regularities of the development of morpho-functional characteristics of heart depending on orientation of training and competitive activity.

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