



Analysis of the influence of various means of general physical training on the indicators of intracardiac hemodynamics and diastolic heart function in athletes of senior ranks in boxing

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Abstract

Objective of the study was to analyze the effect of various means of general physical training on the indices of intracardiac hemodynamics and diastolic function of the heart in senior athletes in boxing.

Methods and structure of the study. Two equivalent groups of boxers of the 1st category were formed, 10 people in each group: the experimental group (EG) and the control group (CG). The indicators of intracardiac hemodynamics and diastolic function of the heart were studied using various means of general physical training of senior athletes.

Results and conclusions. It is noted that the use of general physical training means, involving the muscles of the lower extremities, contributes to the maximum and adequate activity of the cardiovascular system, which is qualitatively reflected in the indicators of the general physical training of senior athletes.

Keywords: *indicators of intracardiac hemodynamics and diastolic function of the heart, senior athletes, general physical training (GPT) in boxing.*

Introduction. An analysis of a significant number of modern scientific literature sources suggests that the indicators of special speed-strength training in boxing among senior athletes are formed on the basis of general physical training exercises (GPT) [1-4, 7]. We noted that the improvement of various strikes is performed by boxers through various intermuscular interactions, forming a different motor stereotype [2]. At the same time, the performance of strikes of various types contributes to the involvement in the activity of different muscle groups, which play a significant role in increasing the speed-strength capabilities of the performed action [2, 5].

A number of scientists in the field of sports scientifically substantiate the influence of various intermuscular interactions on the cardiovascular system in the study of long-term adaptation of athletes, at the same time, leaving the process of urgent adaptation without significant attention, which is reflected in a decrease in the indicators of motor and functional training in boxing [4, 7].

Thus, the means of general physical training, used to improve the speed-strength capabilities of impact actions in athletes of senior ranks in boxing, should correspond to an increase in their coordination and functional training, taking into account various motor activities performed by athletes [2].

Objective of the study was to analyze the effect of various means of general physical training on the indices of intracardiac hemodynamics and diastolic function of the heart in senior athletes in boxing.

Methods and structure of the study. Two equivalent groups of boxers of the 1st category were formed, 10 people in each group: the experimental group (EG) and the control group (CG). All athletes were represented in the weight category up to 71 kg at the age of 18–19 years.

Within four months, the athletes were given the task of improving general physical fitness based on the characteristics of the motor stereotype, while improving shock movements with maximum strength and speed. Boxers using a play style of fighting (box-



ers-players) used means aimed at a more significant development of the muscles of the lower extremities (EG). Athletes who use a strong blow to achieve the result (boxers-knockouts) performed a significant amount of exercises to develop the muscles of the upper limb girdle (CG).

At the beginning and at the end of the experiment, athletes from various studied groups were tested on the En Visor CHD Philips ultrasound system at rest and after exercise to assess the morphometric parameters and the nature of the hemodynamics of cardiac activity, due to the activity of muscle groups used in the impact movement. Boxers from the EG performed squats at a maximum pace for 30 seconds, athletes from the CG performed push-ups from the floor from a lying support at a maximum pace for 30 seconds.

The following research methods were used: Echo-KG (ultrasound of the heart) [3]. A comprehensive 2D B-mode transthoracic Doppler-Echo-CG study was performed on the En Visor CHD Philips ultrasound system. Morphometric indicators of end-systolic (ESV) and end-diastolic volume (EDV) of the left ventricle (LV) were determined. Indicators of intracardiac hemodynamics were assessed by the values of the maximum blood flow rate in the phase of rapid filling (Peak E); maximum blood flow rate in atrial systole (Peak A); indicator of the ratio of the maximum rates of early and late filling of the transmitral blood flow (E/A). We recorded the values of ejection fraction (EF), minute volume of blood flow (MOB), heart rate (HR) and stroke volume (SV).

The obtained data were processed using the statistical analysis program Statistica 10.0. The nonparametric Mann-Whitney test was used to assess the significance.

Results of the study and their discussion. When testing athletes at rest at the beginning of the study, we did not note the statistical significance of differences in the values recorded in both study groups. After the expiration of the period of multidirectional general physical training in various experimental groups, we noted the following results (see table; $p < 0.05$). The values of ESV and EDV, observed at rest and after exercise, were not noted by us with significant differences in the various studied groups. Analyzing the values of the maximum blood flow rate in the phase of rapid filling, we did not record any significant differences between the experimental groups. At the same time, the values of the peak (E) observed after testing in the EG were 30.1% higher than the values recorded at rest (see Table 1; $p < 0.05$). In the CG, similar data prevailed by 24.5% (see table; $p < 0.05$). Thus, the performance of a test load of the global nature of activity (squatting at a maximum pace) creates a more significant positive chronotropic effect in athletes from the EG, which qualitatively affects the nature of intracardiac hemo-

dynamics and reduces the blood flow rate in the rapid filling phase.

Assessing the nature of physical activity in terms of the maximum velocity of blood flow in the atrial systole (peak A) after the time interval of the study (4 months), we recorded the following results. At rest, the data observed in athletes from the EG by 21.9% exceeded the values noted in the CG (see table; $p < 0.05$). After the testing, the results of the EG became 32.7% higher relative to the level observed at rest and exceeded the similar values in the CG by 20.4% (see Table 1; $p < 0.05$). In the control group, when performing a load of a regional nature of muscle involvement in activity (push-ups from an emphasis lying with a maximum pace), the results became 34.3% higher relative to the data observed at rest (see table; $p < 0.05$). We noted a more significant effect of heart rate on the rate of blood flow in atrial systole in athletes from the EG. A more significant chronotropic effect with an adequate response to the load in the EG contributed to a decrease in the flow of the peak (E) in favor of the peak (A), which is fixed at a heart rate of more than 100 beats/min. A more significant muscle involvement in the work of the EG athletes set a higher pressure in the left ventricle, which qualitatively reflected on the state of blood flow in the atrial systole. At the same time, the magnitude of the peak (A) in both experimental groups did not go beyond the normal values of this indicator.

Analyzing the results of the transmitral flow (E/A) during general physical training of different directions in athletes of senior categories, we noted the following values. The ratio $E/A > 2$ was observed by us in CG athletes aged 18 years without cardiac pathology (see Table 1; $p < 0.05$). Given the significant number of subjects in the study group, this affected the statistical results carried out at the conclusion of the time period of testing. At the initial stage of the study, the values of the CG athletes were recorded as the ratio $E/A > 1$, not statistically different from the EG data observed at rest.

We have noted that sportsmen-dischargers at the age of 18 due to a more significant load on the belt of the upper extremities when performing general physical training exercises, a similar profile is formed according to the type of restrictive. According to numerous studies, this profile is not a pathology and will disappear when athletes reach a certain age threshold. In this example, we noted the ambiguity of assessing the ratio of intracardiac hemodynamics values for this value in athletes of the studied age.

When evaluating the effect of multidirectional general physical training on the contractility of the heart muscle, we did not note the statistical significance of differences in the values of EF in different segments of the study between athletes from the EG and CG. Observing the diastolic function of the cardiac activity, we

Indicators of intracardiac hemodynamics and diastolic function of the heart in athletes of the 1st category with multidirectional general physical training at the final stage of testing, $X \pm m$

Boxers of the 1st category				
Indicators	Control group		Experimental group	
	Rest	Load	Rest	Load
ESV LV (ml)	47,8±4,3	41,6±4,1	45,6±4,2	39,4±3,9
EDV LV (ml)	121,2±13,1	121,6±11,5	120,8±13,3	119±12,1
E (m/s)	1,02±0,03	1,27±0,04#	0,83±0,02	1,08±0,03#
A (m/s)	0,402±0,03	0,54±0,02#	0,49±0,03*	0,65±0,04#*
E/A (c.u.)	2,59±0,05	2,41±0,04	1,81±0,03*	1,7±0,04*
EF (%)	60,8±4,3	66±5,1	62,6±4,8	67,2±6,1
MVB (l/min)	4,7±0,2	7,4±0,5#	5,4±0,3	9,8±0,8*#
Heart rate (beats/min)	64±3,9	92,6±7,8#	70,8±4,5	122,6±8,4*#
SV (ml)	73,4±4,4	80±5,2	75,2±4,7	79,6±4,9

* – reliability of differences between EG and CG data, $p < 0.05$; # – reliability of load data relative to the level of rest, $p < 0.05$.

noted that the pumping action of the skeletal muscles involved in the activity during the performance of general physical exercise exercises has a more significant effect on the EG athletes performing the exercise of the global nature of motor activity. When comparing heart rate, we observed the predominance of values in the EG after testing by 32.4% relative to similar CG values (see Table 1, $p < 0.05$). In the EG, the values of heart rate observed after exercise prevailed by 73.2% over the data observed at rest, and in the CG - by 44.7% (Table 1, $p < 0.05$). When comparing the values of SV, we did not record any significant differences between the studied groups at different intervals of the study. At the same time, the values of the MOB in athletes from the EG, due to a more pronounced chronotropic effect after performing a load with more significant muscle involvement, were 32.4% higher relative to the control level, exceeding the data recorded at rest by 81.5% (Table 1, $p < 0.05$). In the CG, after the regional nature of muscle activity, a similar predominance was 57.4% (Table 1, $p < 0.05$).

Conclusions. Performing general physical training exercises, which have a global nature of motor activity, contributes to the adequate functioning of the cardiovascular system, which leads to an increase in functional training with the simultaneous development of muscle groups necessary to improve speed-strength capabilities.

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