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Influence of Regular Basketball Practice in Adolescence on the Functional Capacity of the Heart

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Abstract

The work was carried out on 36 clinically healthy young basketball players aged 17-21 years old, training in the basketball section for at least 3 years. The created control group consisted of 26 clinically healthy young men aged 17 to 21, who had not previously been involved in any kind of sports. In the study, the examined were subjected to ultrasound examination using an SSD-80 "Aloka" device (Japan) with an assessment of the morphological and functional characteristics of the heart. The statistical analysis of the obtained results of the study was carried out using a personal computer using the Student's t-criterion. Some signs of the development of left ventricular muscle hypertrophy were found in young basketball players. At the same time, the basketball players retained the optimum volume of the left cardiac ventricle. The youth basketball players also had a higher diastole rate compared to the control group. Regular basketball training can strengthen the body. They lead to an increase in the muscle mass of the left ventricle, which increases its functional potential and provides an optimal blood supply to internal organs.

Keywords: Basketball, Heart, Myocardium, Hemodynamics, Left ventricle, Physical training

Introduction

Regular practice of any kind of sport stimulates all organs of life support of the body (Boldov, *et al*., 2018; Makhov & Medvedev, 2018b). Low physical activity always weakens the body and its heart (Amelina & Medvedev, 2009; Medvedev, 2018a). Regular physical activity of a feasible nature activates all vital processes in muscles and internal organs (Vorobyeva *et al*., 2018a; Makurina *et al*., 2020). This is due to an increase in the efficiency of adaptive processes in all tissues of the body and the intensification of metabolism (Makhov & Medvedev, 2021). At the same time, the effect of systematic basketball loads on the body requires additional assessment, especially in terms of their impact on physiological processes in the myocardium (Tkacheva & Medvedev, 2020a; Ibrahim *et al*., 2021). The focus of attention of modern researchers is the dynamics of the contractile ability of the heart in the process of physical activity (Makhov & Medvedev, 2018c; Mal *et al*., 2018a; Glamazdin *et al*., 2021).

Often in long-term athletes, the volume of the myocardium, especially the left ventricle, increases, and sometimes its volume decreases (Karpov *et al*., 2018; Wang *et al*., 2021). At the same time, those who have started regular physical training may have a lower ejection volume than physically untrained people (Bespalov *et al*., 2018a; Guo *et al*., 2020; Makhov & Medvedev, 2020b).

Due to the great biological significance of the normal functioning of the heart, it is necessary to continue an active study of the adaptive mechanisms of its activity in conditions of regular basketball loads (Makhov & Medvedev, 2018d; Medvedev, 2018c). To optimize the process of basketball training, designed to ensure high professionalism of trainees, regular studies of various aspects of heart activity in basketball players should be carried out (Oshurkova & Medvedev, 2018a; Stepanova *et al*., 2018).

Purpose: to assess the state of functional characteristics of the heart in young basketball players.

Materials and Methods

The study was carried out on 36 clinically healthy young men aged 17 to 21 years. They regularly participated in basketball training at least 4 times a week. The previous experience of uninterrupted basketball training for all surveyed was at least 3 years. The control group consisted of 26 clinically healthy young men aged 17 to 21 years. They experienced significant muscular loads only in a university setting at academic physical education classes 4 times a week.

All examined patients underwent ultrasound examination of the heart using an SSD-80 echocardiograph manufactured by Aloka (Japan). The diastolic volume of the heart was calculated by calculation. Using the standard method, the mass of the heart

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muscle was determined. The ratio of the degree of myocardial hypertrophy of the left cardiac ventricle and the degree of dilatation of its cavity was calculated. This was done by registering the value of the end-diastolic volume index of the heart muscle.

Statistical processing of the obtained results was carried out by computer by calculating the value of Student's t-test. The presence of differences between the observed groups was recognized as significant in the case of $p<0.05$.

Results and Discussion

The study revealed the differences in the indicators taken into account in basketball players and in boys who made up the control group **(Table 1)**. The greatest differences between these two groups taken into the study were in the morphological parameters of the myocardium of the left cardiac ventricle, which was explained by the presence of regular physical activity (Makhov & Medvedev, 2019; Skoryatina & Medvedev, 2019).

The diameter of the left atrium in the observed basketball players exceeded the value in the control by 9.0%. This indicated a high degree of adaptation of the myocardium to stress (Mal *et al*., 2018b; Glagoleva & Medvedev, 2020; Hao *et al*., 2020). In basketball players, the diameter of the left ventricle in the anteroposterior projection during diastole tended to increase (by 6.3%) compared with the level in physically untrained boys. This change was a consequence of the anabolic processes of the heart muscle (Bespalov *et al*., 2018b; Karpov *et al*., 2020; Alhazmi *et al*., 2022).

In basketball players, the thickness of the left ventricle in the region of its posterior wall at the time of diastole exceeded by 18.3% this indicator in the control group boys ($p<0.05$). This was explained by the fact that it is the left ventricle in the heart that does the most work (Makhov & Medvedev, 2018a; Medvedev, 2018b). Diastolic volume in basketball players tended to decrease in comparison with the control level (by 9.3%). The magnitude of the stroke volume in those observed in both groups was comparable, which indicated the optimum function of the heart in all subjects (Vorobyeva & Medvedev, 2019; Agronina *et al*., 2020; Tkacheva & Medvedev, 2020b).

Table 1. Cardiac indicators in the surveyed

Indicators of cardiac activity	Group of basketball players, M±m, n=36	Control group, M±m, n=26
Diastolic ventricular wall thickness posteriorly, cm	1.23±0.14	1.04±0.06 p<0.05
Diastolic end volume of the heart, cm3 / kg	1.82±0.23	1.99±0.17
The maximum speed of the process of relaxation of the wall of the left ventricle from behind, cm/s	13.7±1.86	10.2±0.56 p<0.05
The ratio of diastolic end volume to myocardial mass, cm^3/kg	0.63±0.14	0.94±0.10 p<0.01
Impact volume, cm^3/kg	1.12±0.18	1.07±0.09
Myocardial mass, cm^3/kg	2.61±0.25	2.12±0.18 p<0.05
Release amount, %	61.62±1.33	60.10±0.75
The diameter of the left atrium, cm/m^2	1.93±0.11	1.77±0.12
Anterior-posterior diastolic size of the left ventricle, cm	5.39±0.19	5.07±0.06
Decrease in the anterior-posterior size of the left ventricle, %	34.62±0.54	32.81±0.79

Note: p – is the mathematical significance of the differences in indicators between the groups.

The mass of the myocardium turned out to be greater (by 23.1%) in basketball players than in young men included in the control group (Medvedev, 2018f). This indicated the development of moderate hypertrophy of the heart muscle during regular basketball physical activity (Makhov & Medvedev, 2020a; Tkacheva & Medvedev, 2020c). At the same time, it did not affect the value of the systolic ejection fraction of the heart (Oshurkova & Medvedev, 2018b; Hu & Li, 2019; Vorobyeva & Medvedev, 2020a; Alanazi *et al*., 2022). Its volume was comparable in both groups of observed young men, indicating the optimum heart function (Vorobyeva *et al.*, 2020b; Medvedev *et al.*, 2021b).

The maximum rate of relaxation of the posterior part of the left ventricle of the heart was noted in basketball players. In them, this indicator exceeded the control level by 34.3%, which was a consequence of an increase in the volume of cardiomyocytes (Medvedev, 2018a; Medvedev, 2021).

The ratio of end-diastolic volume and heart muscle mass in basketball players was lower than in control by 49.2 %. This is due to the high sensitivity of this indicator to systematic physical activity of aerobic nature (Vorobyeva & Medvedev, 2020c;).

The performed observation showed the similarity in both groups of examined young men of the size of the left atrium, the value of the total volume of the left ventricle, and the volume of its cavity (Vorobyeva & Medvedev, 2018b; Medvedev *et al*., 2021c; Abujamel *et al*., 2022). In the outcome, all examined young men showed comparable indicators of central hemodynamics and the severity of myocardial contractility (Makhov & Medvedev, 2020a). The value of the ratio of the value of the end diastolic volume of the heart to the index of myocardial mass on the background of regular basketball training significantly decreased due to an increase in the volume of the heart muscle, especially in the posterior part of the left cardiac ventricle. The decrease in the ratio of diastolic final volume to myocardial mass to 0.63 ± 0.14 in basketball players is a consequence of the prevalence of

cardiac wall hypertrophy in them over the process of expansion of cardiac cavities (Medvedev, 2018e; Mal *et al*., 2020).

We can say that regular basketball loads contribute to the hypertrophy of the muscle elements of the left ventricle. This was indicated by a tendency towards its thickening and an increase in its mass in its posterior part with the optimal value of the volume of the cavity of the left ventricle (Xu *et al*., 2019; Medvedev, 2021).

There is a point of view that the high rate of myocardial relaxation in basketball players is only for those who systematically train in any kind of sport (Medvedev, 2018d). This is confirmed by the high rate of relaxation of the left cardiac ventricle in the posterior part found in them at the same time, this parameter is very changeable during the ultrasound examination and can change even in the course of one examination. For this reason, this indicator cannot be regarded as sufficiently reliable, which requires additional observations.

Conclusion

Regular sports loads during basketball training significantly stimulate the heart and increase hemodynamics. Long-term basketball loads lead to an increase in the volume of the left ventricular muscle while maintaining the volume of its cavity and the functional capabilities of the heart. At the same time, under conditions of regular basketball training, athletes experience a reduction in the time of relaxation of the left ventricle, which greatly facilitates the work of the left ventricle, especially in the region of the posterior wall.

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