TWO-DIMENSIONAL ECHOCARDIOGRAPHIC CHARACTERISTICS IN PRE-ADOLESCENT ATHLETES

Oleksandr Onikiienko

Kharkiv National Medical University, Kharkiv, Ukraine

Among professional athletes the risk of sudden death is more than 2 times higher at 1.6 per 100 000 compared with 0.75 per 100 000 in the general population [1]. In the structure of the sudden death of athletes more than 50% of cases are caused by cardiovascular diseases [2]. However in sportsmen with high achievements economic motivation may affect on the decision to continue his sports career, despite the presence of established and perceived by the athletes with health problems.

Whether the hypertrophy found in the hearts of athletes is physiologic or a risk factor for the progression of pathologic hypertrophy remains controversial. The diastolic and systolic functions of athletes with left ventricular (LV) hypertrophy usually are normal when measured by conventional methods [3].

However, echocardiographic findings in young athletes remain unremarkable and make discussion about its' inclusion in screening program [4].

The aim of study was to evaluate echocardiographic parameters in pre-adolescent athletes depending on duration of training process.

59 boys aged 10-11 years from different football teams were examined. Weakly duration of training was 6-8 hours. Depending on the duration of football playing, children were divided into three groups:

The first group - children who play football up to 3 years, n = 24;

The second group - children who play football 3-5 years, n = 23;

The third group - children who have been playing football for more than 5 years, n = 12.

Based on the values obtained during two-dimensional echocardiography end-diastolic (EDV) and end-systolic (ESV) left ventricular volume (ml), stroke volume (SV), ejection fraction (EF), myocardial mass and left ventricular myocardial mass index was determined by formulas according to Recommendations for Quantification Methods During the Performance of a Pediatric Echocardiogram [5].

Checking for Gaussian division was performed with criteria Shapiro-Wilk or $\chi 2$ Pearson, which proved the use of nonparametric methods (non-parametric U-Mann-Whitney criterion (the MW), Wilcoxon (T), Fisher criterion (F)). Difference in results was considered as statistically significant at $p < 0.05$. During the multiple comparison ANOVA and Kraskal-Wallis tests were used, and the difference was

assessed with Bonferroni correction (at p ^ = p / k, where k - the number of paired comparisons) as follows: p '= p / m -1, where m - number of groups in the experiment. Statistical analysis was performed using the statistical package "Microsoft Excel 2010", "StatSoft 7.0. for Windows ".

Author declares no conflict of interest.

Mean training experience of boys from first group was 2,07 ± 0,7 years, from second 4,34 ± 0,5 years, from third 5,75 ± 0,3 years. Comparison of linear echocardiographic measurements was performed. Results of measurements statistical analysis are described in table 1.

Table 1.

Results of myocardial geometry measurements

Echocardiographic parameters	Statistical values	Observed groups		
		first n=24	second n=23	third n=12
1	2	3	4	5
LV diastolic dimension, mm	Me (Lq; Uq)	41,8 (40,5; 44,3)	41,7 (39,4; 44,2)	42,5 (42,3; 44,7)
Median Test, Overall Median = 42,1000; χ^2= 4,01; df = 2, p = 0,1346; Kruskal-Wallis ANOVA by Ranks; Kruskal-Wallis test: H (2, N= 43) =2,6029, p =0,2721				
LV systolic dimension, mm	Me (Lq; Uq)	26,4 (26,4; 27,2)	25,9 (25,1; 28,2)	25,1 (24,6; 25,8)
Median Test, Overall Median = 25,9000; χ^2= 3,83; df = 2, p = 0,1472; Kruskal-Wallis ANOVA by Ranks; Kruskal-Wallis test: H (2, N= 43) =2,5494, p =0,2795				
Interventricular septum, мм	Me (Lq; Uq)	7,95 (7,65; 8,65)	7,80 (7,12; 8,30)	7,70 (7,40; 8,22)
Median Test, Overall Median = 7,90000; χ^2=0 ,18; df = 2, p =0,9126; Kruskal-Wallis ANOVA by Ranks; Kruskal-Wallis test: H (2, N= 43) =1,1067, p =0,5750				
LV posterior wall, мм	Me (Lq; Uq)	8,15 (7,53; 8,78)	8,20 (6,90; 8,50)	7,90 (7,68; 8,50)
Median Test, Overall Median = 8,00000; χ^2=0,68; df = 2, p = 0,7092; Kruskal-Wallis ANOVA by Ranks; Kruskal-Wallis test: H (2, N= 43) =1,1662, p =0,5582				

Table 1 (continuation)

1	2	3	4	5
LV mass, g	Me (Lq; Uq)	106,9 (96,8; 129,4)	102,1 (88,1; 124,6)	120,8 (110,6; 129,1)
Median Test, Overall Median = 109,067; χ^2=1,03; df = 2, p = 0,5959; Kruskal-Wallis ANOVA by Ranks; Kruskal-Wallis test: H (2, N= 43) =1,9574, p =0,3758				
LV mass index, g/m^2	Me (Lq; Uq)	87,9 (76,9; 91,8)	78,6 (72,9; 90,6)	86,1 (82,9; 90,5)
Median Test, Overall Median = 82,2549; χ^2== 2,01; df = 2, p =0,3647; Kruskal-Wallis ANOVA by Ranks; Kruskal-Wallis test: H (2, N= 43) =2,0164, p =0,3649				
Relative wall thickness	Me (Lq; Uq)	0,38 (0,35; 0,43)	0,37 (0,34; 0,39)	0,36 (0,35; 0,37)
Median Test, Overall Median = 0,375296; χ^2=0,97; df = 2, p =0,6147, Kruskal-Wallis ANOVA by Ranks; Kruskal-Wallis test: H (2, N= 43) =2,0191, p =0,3644				
Left atrium, мм	Me (Lq; Uq)	30,6 (29,0; 33,3)	27,8 (25,2; 30,6)	30,4 (28,3; 30,9)
Median Test, Overall Median = 30,0000; χ^2= 4,12; df = 2, p =0,1274, Kruskal-Wallis ANOVA by Ranks;Kruskal-Wallis test: H (2, N= 41) =4,0553, p =0,1316				
Right ventricle, mm	Me (Lq; Uq)	16,7 (16,0; 18,5)	16,3 (15,7; 18,8)	17,5 (16,7; 18,4)
Median Test, Overall Median = 16,7000; χ^2= 1,13; df = 2, p = 0,5655, Kruskal-Wallis ANOVA by Ranks; Kruskal-Wallis test: H (2, N= 43) =1,2941, p =0,5236				

Based on linear measurements, there was no statistical difference in group comparison. However, it is known that myocardial adaptation to intensive training activity includes atrial diameter enlargement, concentric remodeling [3, 6]. Received results may indicate that duration of sport involvement for 6 years is not enough for cardiac remodeling at this age group [7].

Parameters describing main left ventricle hemodynamics characteristics, such as EDV, ESV, SV and EF fraction were calculated and compared in different groups. Obtained results are described in table 2.

Table 2.

Results of left ventricle function calculations

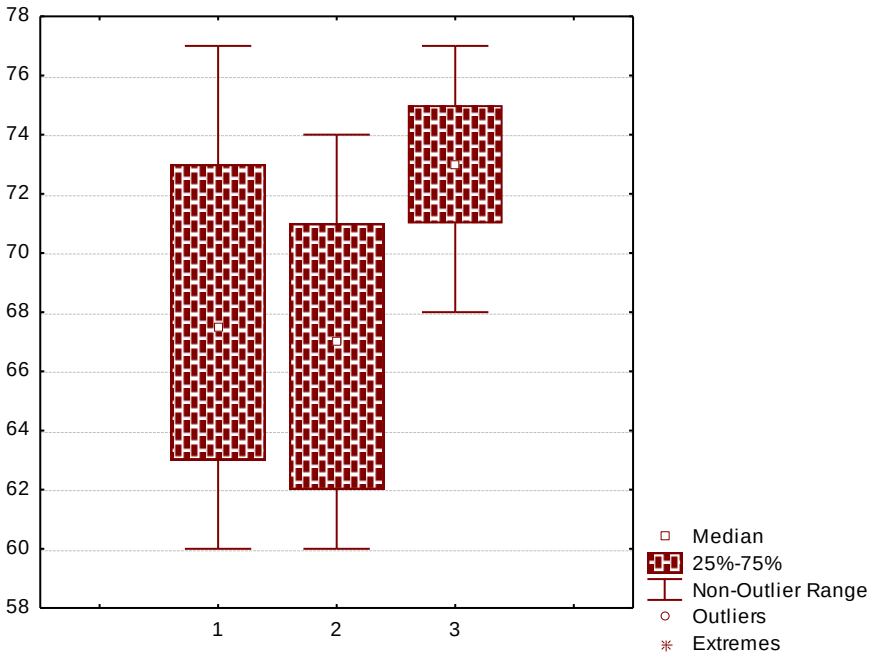
Calculations	Statistical values	Observed groups		
		first n=24	second n=23	third n=12
EDV, ml	Me (Lq; Uq)	77,5 (72,0; 89,3)	77,1 (67,4; 88,5)	80,9 (79,6; 91,0)
Median Test, Overall Median = 79,2000; χ^2= 3,83; df = 2, p =0,1472 Kruskal-Wallis ANOVA by Ranks; Kruskal-Wallis test: H (2, N= 43) =2,3336, p =0,3114				
ESV, ml	Me (Lq; Uq)	25,5 (21,7; 28,6)	24,4 (22,8; 30,0)	22,5 (21,4; 24,2)
Median Test, Overall Median = 24,4000; χ^2= 3,83; df = 2, p =0,1472, Kruskal-Wallis ANOVA by Ranks; Kruskal-Wallis test: H (2, N= 43) =2,7245, p =0,2561				
Stroke volume, ml	Me (Lq; Uq)	53,0 (44,7; 60,3)	52,0 (47,5; 60,4)	58,5 (58,0; 69,4)
Median Test, Overall Median = 53,6000; χ^2= 3,84; df = 2, p =0,1460, Kruskal-Wallis ANOVA by Ranks; Kruskal-Wallis test: H (2, N= 43) =3,8558, p =0,1455				
Ejection fraction, %	Me (Lq; Uq)	68 (63; 72)	67 (63; 70)	73 (72; 75)
Median Test, Overall Median = 68,0000; χ^2= 5,69; df = 2, **p = 0,0579,** Kruskal-Wallis ANOVA by Ranks; Kruskal-Wallis test: H (2, N= 43) =7,1451, **p =0,0281**				

Multiple comparison of LV ejection fraction demonstrates that it was significantly higher in third group comparing to first and second groups.

The Mann-Whitney test for paired group comparison demonstrated difference in LV EF in boys of first and third groups, and in boys of second and third group (pI, II = 0.5257, p I, III = 0.0500, p II, III = 0.0051). We may conclude that LVEF becomes the most valuable characteristic of myocardial function in boys ages 10-11 with an increase in "experience" training over 5 years.

Figure 1.

Left ventricle ejection fraction in boys of different training duration



Cocnlcusions

1. Significant differences were not found in morphological characteristics of the heart and great vessels with the increase of involvement in sports in the boys of age 10-11. This indicated the absence of myocardial remodeling.

2. With the increase of sports involvement over 5 years, LV EF reaches the largest value that characterizes the most the function of left ventricular myocardium in young preadolescent athletes.

References

1. Maron BJ, Doerer JJ, Haas TS (2009). Sudden deaths in young competitive athletes: analysis of 1866 deaths in the United States, 1980-2006. Circulation, 119(8), 1085-1092

2. Makarov L.M., Solokhin Yu.A. (2009). Vnezapnaya vnebolnichnaya serdechnaya smert u detei, podrostkov i lits do 45 let [Sudden outpatient death in children, adolescents and adults under 45 years]. Kardiologija, 11, 33-38.

3. D'Ascenzi F., Solari M., Anselmi F., Maffei S., Focardi M., Bonifazi M., Mondillo S., Henein M. (2016). Atrial chamber remodelling in healthy pre-adolescent athletes engaged in endurance sports: A study with a longitudinal design. The CHILD study. International Journal of Cardiology, 223, 325-330.

4. Koch S., Cassel M., Linné K., Mayer F., Scharhag J. (2015). ECG and echocardiographic findings in 10-15-year-old elite athletes. European Journal of Preventive Cardiology, 21(6), 774-781.

5. Leo Lopez, Steven D. Colan, Peter C. Frommelt, Gregory J. Ensing, Kathleen Kendall, Adel K. Younoszai, Wyman W. Lai, Tal Geva (2010). Recommendations for Quantification Methods During the Performance of a Pediatric Echocardiogram: A Report From the Pediatric Measurements Writing Group of the American Society of Echocardiography Pediatric and Congenital Heart Disease Council. Journal of American Society of Echocardiography, 23, 465-495.

6. Binnetoğlu FK, Babaoğlu K, Altun G, Kayabey Ö (2014). Effects that different types of sports have on the hearts of children and adolescents and the value of two-dimensional strain-strain-rate echocardiography. Pediatric Cardiology, 35(1), 126-139.

7. Csajági E1, Szauder I, Major Z, Pavlik G.(2015) Left Ventricular Morphology in Different Periods of the Training Season in Elite Young Swimmers. Pediatric Exercise Science. 27(2), 185-191.

.

Резюме

В статье приведены результаты ультразвукового обследования 59 детей 10-11 лет, занимающихся футболом. В зависимости от длительности занятий спортом дети были разделены на 3 группы: группа 1 – дети со стажем до 3 лет (24 ребенка), группа 2 - стаж занятий от 3 до 5 лет (23 ребенка), группа 3 – стаж занятий более 5 лет (12 детей). Установлено, что линейные размеры сердца достоверно не отличались в группах обследованных, что может свидетельствовать о более длительном процессе ремоделирования миокарда как адаптации сердца к спортивным нагрузкам. Выявлено, что у более тренированных детей (группа 3) достоверно выше фракция выброса левого желудочка по сравнению с группой 1 ($p = 0.05$) и с группой 2 ($p = 0.0051$).

Ключевые слова: спортсмены, дети, эхокардиография

Резюме

У статті наведено результати ультразвукового обстеження 59 дітей 10-11 років, які займаються футболом. Залежно від тривалості занять спортом діти були розділені на 3 групи: група 1 - діти зі стажем до 3 років (24 дитини), група 2 - стаж занять від 3 до 5 років (23 дитини), група 3 - стаж занять більше 5 років (12 дітей). Встановлено, що лінійні розміри серця достовірно не відрізнялися в групах обстежених, що може свідчити про більшу тривалість ремоделювання міокарда як адаптації серця до спортивних навантажень. Виявлено, що у більш тренованих дітей (група 3) достовірно вища фракція викиду лівого шлуночка в порівнянні з групою 1 ($p = 0.05$) і з групою 2 ($p = 0.0051$).

Ключові слова: спортсмени, діти, ехокардіографія

Summary

Data of echocardiographic characteristics of 59 children 10-11 years old, involved in football is presented in article. Depending on the duration of sports activities the children were divided into 3 groups: group 1 - children who play football up to 3 years (24 children), Group 2 - children who play football from 3 to 5 years (23 children), Group 3 - training duration over 5 years (12 children). It was found that the linear size of the heart were not significantly different in the groups studied, which may indicate that myocardial remodeling as cardiac adaptation to sporting loads takes more time. It was revealed that more trained children (group 3) have significantly higher left ventricular ejection fraction compared with group 1 ($p = 0.05$) and Group 2 ($p = 0.0051$).

Keywords: athletes, children, echocardiography