http://dx.doi.org/10.35630/2199-885X/2020/10/3.15

CHARACTERISTICS OF SINUS BRADYCARDIA IN YOUNG ATHLETES WITH COMORBIDITIES

Received 20 June 2020;
Received in revised form 28 August 2020;
Accepted 31 August 2020

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ABSTRACT — 36 young athletes with sinus bradycardia accompanied by comorbid conditions (vegetative symptoms and visceral manifestations of heart dysplasia) underwent an assessment of creatine kinase-MB levels in their blood serum and the condition of the spectral components of heart rate variability (HRV). It has been discovered that sinus bradycardia is more dependent on vegetative symptoms and high sport loads than on visceral manifestations of connective tissue dysplasia (CTD). However clinical features of vagotonia and visceral manifestations of CTD may serve as risk factors for development of sinus bradycardia in young athletes.

KEYWORDS — sinus bradycardia, comorbid conditions, vegetative symptoms, connective tissue dysplasia (CTD), creatine kinase-MB, spectral components of HRV, young athletes.

INTRODUCTION

Bradycardia is known as either heart rate fall by 10–40% below normal heart rates or these values being less than 10 percent in children. Vagotonic-type vegetative disturbances or cardiac remodeling among young athletes as well as other reasons [1, 3, 5, 6] may also account for slowing of the heart rate.

From the contemporary point of view, the syndrome of connective tissue dysplasia CTD refers to prolapsis of cardiac valves, atrial septal aneurysm, aneurysm of the aortic sinus and ectopic cords of mitral valve. [1, 2, 4, 5].

In young athletes it is difficult to identify the causes for development of sinus bradycardia: whether it attributed to training loads or vegetative disturbances and dysplasia of heart connective tissue. Their manifestations in schoolchildren are interrelated and may significantly facilitate the development of sinus bradycardia [2, 6]. All these factors justify the relevance of our research.

Aim of the investigation:

To define the charateristics of sinus bradycardia caused by vegetative symptoms and CTD disorders in children participating in sport.

CHARACTERISTICS OF CHILDREN AND METHODS OF INVESTIGATION

83 children aged 8–12 years (the mean age was 10±2,0), with 2–3 years of football training were under observation. Bradycardia on the base of vegetative symptoms and dysplasia of connective tissue was identified in 36 children. The investigation was carried out at N.N. Silischeva Regional children clinical hospital and Regional sports medicine dispensary of the city of Astrakhan.

All children were observed in dynamics by a pediatrician and consulted by a pediatric cardiologist. Additionally to clinical-anamnestic estimation of a cardio-vascular condition we studied the signs of vegetative symptoms by means of measuring initial autonomic tonus and autonomic reactivity according to conventional methods [1, 5]. CTD was estimated on E.V. Zemschovsky criteria with consideration of phenotypic and visceral characteristics [1]. Laboratory tests included general tests of blood, urine, levels of CRP, lever enzymes; creatine kinase-MB was measured by ELISA kit. Besides, standard ECG. Echo-cardiographic investigation (EchoCG), holter monitoring ECG (ECG HM) were performed. Sinus bradycardia was detected clinically and by ECG data with the frequency of heart contractions from 30 to 47 beats per minute and was confirmed by ECG HM data.

The manifestation of vegetative symptoms and the influence of physical loads on the organism were assessed with spectral analyses of HRV at rest and orthoposition using Poly-Spectrum-12/E Neurosoft. The results of the study were analyzed in accordance with common methods of multivariate statistics.

RESULTS AND DISCUSSION

All observed schoolchildren were divided into three groups, using the method of simple randomization according to age and sex. Finally, only boys were selected for the study.

The first group included 11 boys with manifested bradycardia (decrease of heart contraction frequency by 30–40%). The second group included 25 children with moderate bradycardia (heart rate decreased by 20–29%), and the third group included 20 young athletes (heart rate decreased by 10–19%) and without vegetative symptoms and CTD (the control group).

Analyzing laboratory and instrumental data we identified vegetative symptoms of asympaticotonic type in the first group, whereas visceral manifestations of CTD were observed in all young athletes. 8 to 12 or even more phenotypic features of CTD were detected in 10 (90,9%) children. The children of this group often complained of weakness and fatigue after school. Clinically the suppressed condition and weak sounds of the heart were observed in 10 (90,9%) as well as soft systolic sound at the apex in 9 (81,8%) and moderate widening of heart borders in 6 (54,5%) children. In a laboratory study, a significant decrease in the levels of activity of MB-CPhC in blood serum was established ($p < 0,05$), which could indicate lower energy supply of the body.

ECG was used to detect sinus bradycardia in all young athletes. At the same time there were inversion T wave and depression of segment ST in two and more precardial diversions in 10 cases (90,9%). In 9 children (81,8%) the echocardiogram showed diastolic dysfunction, visceral manifestations of CTD of the heart: prolapse of mitral valve with regurgitation of 1 or 2 degree in 10 (90,9%), abnormal tendon cords of mitral valve in 9 (81,8%), aneurism of interatrial septum in 6 (54,5%).

In analyses of HRV low levels of common power of spectrum ($p<0,01$) and high data of highfrequent component HF ($p<0,05$) in comparison with normal state were observed (Table 1).

In the second group of children with moderate bradycardia the features of vegetative symptoms of asympaticotonic type were observed in 17 (60,8%), while the rest of the children showed no signs of vegetative disturbances. CTD was displayed in 20 (80%) boys with the presence of 10 to 14 phenotypic features. In 5 (20,9%) boys there were from 6 to 9 phenotypic features. Isolated visceral manifestations of CTD were found in 24 (96,0%), 2–3 combined criteria were rare or may be single. So, bradycardia was combined with comorbid diseases (vegetative symptoms and CTD). The comparison of frequency in cases of vagotomy and visceral features of dysplasia shows significant correlative connection (k=0,72). Laboratory data and levels of MB-CPhC did not change essentially.

ECG showed moderately manifested sinus bradycardia in all children, inversion of T wave in 5 cases (20,2%), in 3 (12%) cases we found depression of segment ST in two and more thoracic directions. EchoCG demonstrated dyastolic dysfunction in 11 (44,1%), prolapse of mitral valve and trycuspid valve in 19 (76,2%), aneurisn of interatrial septum in 8 (32,1%), additional cords in 12 (48,2%) cases. Changes of HRV parameters and their spectrograms seemed characteristic for asympathicotonia. The general power of spectrum was decreased moderately TP;($p<0,05$) in high level of LF ($p<0,01$; Table 1). So, the decrease of level in frequency of heart contractions in case bradycardia at rest may be supported by parasympatic

Table 1. *Comparison of laboratory data in the children*

	Data				
Groups	MB-CPhC(f/l)	TP(мс2)	VLF(мс2)	HF(мс2)	LF(мс2)
First(n=11)	31,4±0,25**##	2240±508***##	946±208**##	910±210**##	640±124**###
Second(n=25)	40,6±0,5**##	2750±526**##	1120±340*#	790±120*#	880±145**##
Third(n=20)	36,6±0,45	3210±520	1370±410	710±210	718±224

Note: ** — reality in comparison of data of the 1st and 2nd groups with the 3rd: *p>0,05, **p<0,05, ***p<0,01*
 # — reality in comparison of data of the 1st and 2nd groups: #p>0,05; ##p<0,05, # ##p<0,01

It proves the prevalence of parasympatic vegetative influence on sinus node of the heart contractions. The estimation of spectrogram in these children shows a low level of energy supply in the organism observed in manifestations of vegetative symptoms and bradycardia in comorbid conditions with CTD. Bradycardia in this group is closely correlated with manifestations of asympaticotony in estimation of HRV (k=0,75) and visceral features of CTD in the heart (k=0,52).

influence and sport loads. Manifestations of bradycardia were correlated with signs of VDS (k=0,61) and to a lesser extent with CTD (k = 0,38). In making up the levels of spectral parameters HRV of this group with the same in the first group it was marked that the changes were more expressed in the first one than in the second ($p<0,05$). At the same time the frequency of cases with visceral features CTD of the heart in comparative groups didn't greatly differ ($p>0,05$). So, the presence of expressed dystonia and visceral features

of CTD were the base for formation of bradycardia in young sportsmen.

In the third group (20) among young athletes with no obvious signs of vegetative symptoms and connective tissue dysplasia, a tendency to bradycardia was noted. The MB-CPhC levels in the children of this group were normal. The heart CTD features were diagnosed in single cases with one of the visceral criteria and practically no influence on the heart rhythm. The changes of the heart rhythm were explained by sport loads.

Thus, sinus bradycardia in young athletes may occur due to the influence of comorbid pathology and sports loads. Among comorbid conditions, an important role is played by vegetative symptoms (asympathicotonia, in particular). At the same time, vagotonic influences can contribute to the development of pronounced sinus bradycardia, which proceeds against the background of a reduced energy supply of the body at rest and visceral signs of CTD. With moderate signs of vegetative symptoms in young athletes, an important role in the development of sinus bradycardia is played by sports loads and, to a lesser extent, visceral signs of heart dysplasia.

The presence of manifestations of vagotonia and visceral dysplastic symptoms from the side of the heart can serve as factors in the development of sinus bradycardia in young athletes. To manage sinus bradycardia, it is important to determine its severity and to assess the state of vegetative manifestations and dysplastic disorders of the heart.

REFERENCES

1. **Cherkasov N.S., Doronina T.N.** Arhythmology of child age: Manurscript – Astrakhan, PH of Astr. State Med. Un., 2016–336 p.
2. Polyorganic disturbances in dysplasia of connective tissue in children. Algorhythms in dyagnostics. Tactic of treatment.Project of Russian recommendations (part 2).Med. Vestnik of Northern Caucasus. 2016 – V. 11, Ed. 2 – P. 239–263.
3. Noninvasive cardiac screening in young athletes with ventricular arrhythmias/ A.Steriotis et al.//Am.J. of Cardiology. – 2013. – Vol.111. – N4. – P. 557–562.
4. **Kenney W.L.,Wilmore J.,Costill D.** Physiology of sport and exercise. 6th Edition With Web Stady Guide. Human kinetics; 2015; 648 p.
5. **Zakharova I.N.** Vegetative dystonia in children and teenagers. Diagnostics. Therapeutical tactic: Acad. Manual SBEI APE «Russian med. Academy of postdiploma edn». M. – SBEI APE RMA PE, 2013 – 60 p.
6. **Sharyikin A.S.** Sport cardiology. Manual for cardiologists, pediatricians, doctors of functional diagnostics and sport medicine / Sharyikin A.S., Batdieva V.A., Pavlov V.I. // PH IKAR – M., 2017–328 p.