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FEATURES OF HEART RATE VARIABILITY IN CHILDREN WITH NEUROCULATORY CARDIAC DYSTONIA

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Annotation. *The article evaluates circadian rhythms and heart rate variability in urban and suburban adolescents with similar neurocirculatory dystonia. In children with neurocirculatory dystonia (NCD), a decrease in parasympathetic effects was found using the heart rate variability method. In children with NCD, the overall influence of regulatory factors on heart rate and overall variability of cardiac intervals during orthostatic examination, activity and reactivity of the parasympathetic division of the autonomic nervous system were lower than control values with increasing stress. index. The observed changes in circadian rhythm and rhythm variability in urban adolescents compared to rural adolescents are associated with living in an industrial area, environmental criteria, diet and additional information load, which is essential for further research.*

Key words*: schoolchildren, neurocirculatory dystonia, cardiac rhythm and conduction disorders.*

ОСОБЕННОСТИ ВАРИАБЕЛЬНОСТИ СЕРДЕЧНОГО РИТМА У ДЕТЕЙ С НЕЙРОКУЛЯТОРНОЙ СЕРДЕЧНОЙ ДИСТОНИЕЙ

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Аннотация. *В статье оценены циркадные ритмы и вариабельность сердечного ритма у городских и пригородных подростков со сходной нейроциркуляторной дистонией. У детей с нейроциркуляторной дистонией (НЦД) методом вариабельности сердечного ритма обнаружено снижение парасимпатических эффектов. Деты с НЦД общее влияние регуляторных факторов на частоту сердечных сокращений и общую вариабельность сердечных интервалов при ортостатическом исследовании, активность и реактивность парасимпатического отдела вегетативной нервной системы были ниже контрольных значений при нарастании стресса. индекс. Наблюдаемые изменения циркадного ритма и вариабельности ритма у городских подростков по сравнению с сельскими подростками связаны с проживанием в промышленной зоне, экологическими критериями, рационом питания и дополнительной информационной нагрузкой, что крайне необходимо для дальнейших исследований.*

Ключевые слова: *школьники, нейроциркуляторная дистония, нарушения ритма и проводимости сердца.*

Introduction. The autonomic nervous system controls all organs, which allows them to control their autonomous functioning and metabolism [5, 13]. Such regulation ensures adaptation to changing environmental conditions. The ever-increasing flow of information and the unfavorable environment affect the health of the entire population, especially the most vulnerable categories of the population, such as children [4, 6, 7].

Chronic stress and emotional overload increase the demand on all organ systems and lead to an overload of adaptive mechanisms at an early age. Among the non-infectious diseases of childhood and adolescence, vegetative-vascular dystonia is the most common pathology from 4.8 to 29.1% [1, 3, 12].

It is known that vegetative-vascular dystonia or its variant neurocirculatory dystonia is a predictor of arterial hypertension, atherosclerosis and cardiovascular diseases in youth [2, 4, 5].The development of autonomic dysfunction in the pubertal period is facilitated by the inherent incompleteness of the morphological and active formation of the autonomic nervous system (ANS) and hormonal changes [5, 6, 7]. Neurocirculatory dystonia is considered a multifactorial disease, in the development of which genetic and acquired factors play a role, including climatic-geographical, socio-economic and household factors. It occurs in various clinical signs and syndromes, occurring in most cases under stress [8, 9, 10, 11].

The role of the autonomic nervous system in the occurrence of many types of arrhythmias, including life-threatening ones, has been convincingly confirmed in experiments with stimulation of the posterior lobe of the hypothalamus, stellate ganglia, reproduction of psychological stress, and stimulation of intracardiac parasympathetic nerves. and others.

The implementation device is associated with the influence of efferent vagal and sympathetic fibers on the electrophysiological qualities of the myocardium and the conduction system of the heart [8, 9, 11, 12]. Currently, the majority of creators have come to a single view, namely, that one of the main pathophysiological mechanisms for the development of arrhythmias in adolescence is considered to be non-compliance with the neurogenic regulation of heart rate, leading to embodied electronic instability and myocardial instability.

In real time, determination of heart rate variability (HRV) is recognized as a more informative non-invasive way to quantify the autonomic regulation of heart rate [2, 7, 10, 11]. It is, in fact, that a decrease in HRV characteristics indicates non-compliance with the autonomic control of cardiac work, and also about the electronic instability of the myocardium. The highest HRV characteristics are recorded in healthy young people, athletes, interim - in people with various organic heart diseases, including ventricular arrhythmias, low - in people who have suffered episodes of ventricular fibrillation. The use of HRV analysis as a way to assess the adaptive probabilities of the body or the current value of stress provides practical attention for various areas of applied physiology,

occupational and sports medicine.The development of prenosological diagnostics has made it possible to distinguish among literally healthy people wide groups of people with the highest and rather high tension of regulatory systems, with an increased risk of failure of addiction and the occurrence of pathological abnormalities and diseases.

The purpose of this study was a comparative assessment of the daily rhythm and heart rate variability in adolescents with similar neurocirculatory dystonia, living in urban and rural areas.

Materials and methods. We examined 77 adolescents aged from 12 to 17 years (average age 14.5 ± 0.35 years, boys -31, girls -46), who were hospitalized with a diagnosis of somatoform autonomic dysfunction, cardiac-type NCD, with January 2022 to February 2023. The information was classified according to age and area of residence (city, rural area). Taking into account the mechanisms of development of the autonomic nervous system, 2 age groups were focused. 1st age group - children 12-14 years old 49.5±4.99% (average age 13.4±0.24), of which 62.5±8.83% lived in Andijan (group IA), 37.5±11.74% of adolescents - in rural areas of Andijan region (group IB). 2nd age group - teenagers 15-17 years old 50.5±4.99% (average age 16.5±0.29), in which 61.2±8.89% of young people lived in Andijan (IIA group), 38.8±11.49% - in rural areas (IIB group). All teenagers live in the Andijan region every day.

The diagnosis of NCD was based on the aspects proposed by [6], which can be divided into personal signs and impartial data. The instrumental study included: electrocardiography (ECG) using a generally accepted method, echocardiography (ECHO-CG) with color Doppler mapping on the “Vivid 3” installation, Holter ECG monitoring with determination of heart rate variability with registration of 3 altered leads.

During daytime ECG monitoring, the characteristics of daytime dispersion of heart rate (HR) and heart rhythm disturbances were taken into account. The circadian index (CI) was calculated as the ratio of the average daytime to average nighttime heart rate (normal 1.24-1.44 a.u., average 1.32±0.08).

Heart rate variability was perceived according to the characteristics of time analysis, including these indicators, such as SDANN (standard anomaly from the average value of R-R intervals in another 5-minute fragments), SDNN (standard anomaly from the arithmetic mean), RMSSD (square root of the average sum squared differences between other R-R intervals). The frequency test was carried out on the following spectra: 1) ultra-low frequencies, ULF up to 0.003 Hz; 2) rather low frequencies, VLF -0.003-0.04 Hz; 3) low frequencies, LF 0.04-0.15 Hz; 4) the highest high frequencies, HF -0.15-0.4 Hz. The ULF and VLF spectra depend, in a key way, on the sympathetic system, HF - on the parasympathetic system, and others - on two systems at the same time. The ratio of LF to HF was interpreted as an indicator of dynamic equilibrium between two independent systems.

Results. Among the examined adolescents with cardiac NCD, complaints of pain in the heart area were similar (in age group I - in 70.8±6.56%, in age group II - in 83.7±5.28% of those examined). The pain, in general, had a temporary (lasting a few seconds), stabbing

character. Interruptions in heart function were noticed by 43.8±7.16% of young people in group I and 55.1±7.11% of young people in age group II.

In addition, 31.3±6.69% of adolescents in age group I and 36.7±6.89% of young people in group II complained of headache, dizziness, impotence, and excessive fatigue.

In all individuals included in the study, the contractility and thickness of the walls of the ventricles of the heart, the dimensions of the ventricles and atria, the structure and function of the valve apparatus were determined using echocardiographic techniques. More often (50.0±7.22% of those examined in age group I and 63.3±□6.89% of young people in age group II), echocardiographic examination revealed slight dilatation of the heart cavities (leading to an increase in the end-diastolic volume of the left ventricle by an average of 4.1±0.5 mm).

12 (25.0±6.25%) adolescents of the 1st age group were diagnosed with mitral valve prolapse (MVP) of the 1st degree without regurgitation, a similar diagnosis was made to 11 schoolchildren (22.5±5.97%) of the 2nd age group. Abnormal left ventricular trabeculae were observed in 29 (60.2 ± 7.07%) subjects of group I and in 30 (60.2 ± 6.99%) subjects of group II. In other adolescents, no pathology was detected during echocardiographic examination.

Table 1

Frequency of occurrence of cardiac arrhythmias and conduction disturbances in the study groups according to a normal ECG at rest (in%)

Index	Groups			
	IA	IIA	IB	IIB
Bradyarrhythmia	26,7 ±8,08	43,3 ± 9,05	16,7 ±9,05	15,8 ±8 ,62
Tachycardia	33,3 ±8,6	11,1 ±7,62	33,3 ±8,61	15,8 ±8,62
Load on the left ventricle	33,3 ±8,6	5,6± 5,58	30,0 ±8,37	2 1,1±9,62

As you can see from Table 1, in adolescents of the first age group living in a metropolis, sinus tachycardia and symptoms of stress on the left ventricle were recorded more often on a normal ECG. However, in age group II, young people living in a metropolis were diagnosed with bradyarrhythmia more often than young people living in rural areas.

table 2

Frequency of occurrence of heart rhythm and conduction disturbances in the study groups according to Holter ECG monitoring (in%)

Index	Groups			
	IA	IIA	IB	IIB
Tendency to tachycardia throughout the day	63,3 ±8,79	22,2± 10,08	36,7 ±8,79	15,8 ±8,58
Autonomic dysfunction of the sinus node	36,7 ±8,79	61,1± 11,82	43,3 ±9,05	15,8 ±8,58

Holter monitoring data (Table 2) showed that the predisposition to sinus tachycardia in the direction of day and night in age group I was more often observed in adolescents living in a metropolis (average heart rate > 90 beats/min). Among urban young people 15-17 years old, autonomic dysfunction of the sinus node was detected more often per day. The concept of dysfunction of the sinus node includes these electrocardiographic configurations, such as sinus bradyarrhythmia (during the day and night, the average heart rate is below the age norm), pieces of movement of the pacemaker, slipping decreases, atrial rhythm throughout the day and night, slowing down of atrioventricular conduction to incomplete atrioventricular block I degree both during the day and at night, for example. In 10.2±4.32% of young people of the second age group, atrioventricular dissociation and incomplete atrioventricular block of the second degree with Samoilov-Wenckebach times were registered per day.

The circadian index in urban and rural adolescents of the first age group was on average 1.33±0.09, in the second age group - 1.38±0.08, which actually fits into the norm. The maximum average rhythm pause in children of age group I was 1.5±0.05 seconds, which actually corresponds to the upper limit of generally accepted standards; in age group II it was 1.7±0.05 seconds, i.e. older than generally accepted standards. Supraventricular extrasystole was recorded in 66.7±6.8% of urban adolescents aged 12-14 years, in rural adolescents - in 44.4±12.05% of cases. In age group II, supraventricular extrasystole was detected in 20.0±7.3% of urban young people and in 15.8±8.58% of rural ones. The largest number of extrasystoles per day is 6331, the smallest is 1. In adolescents with frequent supraventricular extrasystoles, couplets, massive extrasystoles, allorhythmia (bigeminy, trigeminy), as well as polytopic and interpolated extrasystoles were recorded. Ventricular extrasystole was observed in 26.7±8.08% of urban children aged 12-14 years and 16.7±9.05% of rural children, with the largest number per day-1429, the smallest-1. In age group II (15-17 years), ventricular extrasystole was recorded in 26.7±8.08% of urban young people and 15.8±8.59 rural ones. The maximum ventricular ectopic energy per day is -7609, the lowest is -1.

In 45.8±7.19% of children in the first age group, a clear circadian pattern of ectopic energy was noted (as in supraventricular, for example, ventricular extrasystoles), mainly in the daytime (i.e., sympathodependent ectopia), in 25.0± 6 .25% extrasystole was recorded, for the most part, at night (vago-dependent ectopia), in others - both during the day, for example, at night. In the older age group, a reverse desire was noted: 51.0±7.14% of young people had a vagal-dependent arrhythmia, 20.4±5.76 had a sympathodependent arrhythmia, and others had a mixed type of ectopia. These configurations can be associated with the steps in the development of the function of the autonomic nervous system.

According to the SDANN and SDNN indicators, the scatter function was considered (with a sinus tempo they reflect the energy of the parasympathetic nervous system), and RMSSD is responsible for the concentration function (with a sinus tempo they reflect the energy of the sympathetic nervous system) systems).

Confinement In adolescents 12-14 years old with neurocirculatory dystonia of the cardiac type, living in a metropolis, sinus tachycardia and symptoms of stress on the left

ventricle were detected more often on a normal ECG of calmness compared with adolescents of the same age living in rural areas. In the group of young people aged 15-17 years living in a metropolis, bradycardia and arrhythmia were recorded more often than in rural areas. When conducting Holter ECG monitoring in adolescents 12-14 years old living in a metropolis, a predisposition to tachycardia during the day and night was determined more often than in rural children, while in age group II, in urban young people, sinus dysfunction was diagnosed more often. node.

In adolescents aged 12-14 years with neurocirculatory dystonia of the cardiac type, living in a metropolis, compared with rural adolescents, the time SDANN indicator is truly reduced, which actually indicates a decrease in vagal energy. When assessing the spectral characteristics of the HRV, it was revealed that in urban adolescents aged 12-14 years, the indicator of sympathetic-parasympathetic tone is truly higher than generally accepted standards, which indicates the dominance of the sympathetic division of the ANS. In the older age group, a similar indicator among urban young people was truly lower than generally accepted standards, which actually indicates the dominant influence of the vogues in these adolescents.

Summary. The observed changes in heart rate variability reflect the circadian dynamics of octopi: most of the 12-14-year-olds had sympathostatic arrhythmias, and most of the 15-17-year-olds had vagal-related arrhythmias.

When examining adolescents with neurocirculatory dystonia, it is necessary to conduct not only a simple ECG at rest, but also a Holter ECG monitoring with detection of heart rate variability; examination ensures adequate treatment and monitoring of this group of patients.

The observed changes in circadian rhythm and rhythm variability in urban adolescents compared to rural adolescents are probably related to living in an industrial area, environmental criteria, nutrition and more information load. this urgently requires further research.

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