E. N. Mestnikova, N. V. Makharova, I. A. Pinigina, K. S. Gavril'eva

ELECTROPHYSIOLOGICAL ADAPTATION OF CARDIOVASCULAR SYSTEM OF ATHLETES IN THE FAR NORTH

ABSTRACT

The article presents research data of 12-lead electrocardiography at rest (Rest ECG) and Holter ECG monitoring of athletes. Daily assessment of cardiac rhythm and conduction disturbances showed that the cardiac rhythm disorders by type of frequent supraventricular arrhythmia (up to 17 560/day) and frequent ventricular arrythmia (up to 22 450/daymost frequently encountered in endurance-athletes (aerobic exercises), whereas the athletes training speed-strength (dynamic loads) had conduction disturbances by type of the second-degree AV block Mobitz Type 1 (with a maximum duration of pauses up to 3 seconds) However, changes in Holter ECG and EchoCG have not been revealed in athletes with Brugada-like changes, but they are still under close control.

Keywords: athlete's heart, heart rhythm disorder, Holter ECG.

The functional state of a healthy person is always connected with close interaction with the environment. The studies of the health status of the population in the Far North showed that a complex of climatic, geographical, biological, geophysical and environmental factors have the most significant impact on human health [1,4,2,5]. Athletes are in a certain group of healthy people, who lead a unique way of life, and have a severe physical and psychological stress that cause "the restructuring" of the functioning of their organs and systems [10].

The human body has formed in the course of evolution the ability to adapt to changing environmental conditions. Some external factors may cause changes in the physiological status and homeostasis of a person, their morphological characteristics, etc. However, the adaptive capacity of the organism is not unlimited, thus, the athletes are not always fully able to adapt to certain environmental conditions, physical stress, resulting in maladaptation or disease of organs and systems [2].

The invention of new non-invasive methods such as ECG, daily monitoring of ECG and blood pressure, echocardiography (Echo), magnetic resonance imaging (MRI) has made possible the study and evaluation of complex structural-functional and electrophysiological adaptation of cardiovascular system of the athletes known as "athlete's heart".

The changes, resulting from the athletes' examination according to the ECG, EchoKG, may often resemble pathological changes of the myocardium in hypertensive disease (HD), hypertrophic and dilatation cardiomyopathy (DCM) or arrhythmogenic right ventricular dysplasia (ARVD), syndrome of ventricular pre-excitation (Wolff-Parkinson-White), Brugada syndrome. Thus, it greatly complicates the differential diagnosis of both pathological and physiological restructuring of the athlete's heart [10,11,7].

The main characteristics of structural remodeling of the athlete's heart are: increase in the volume of the left and right ventricles (not beyond the normal range), the left atrium on the background of preserved systolic and diastolic function [8]. The degree of these physiological changes depends on anthropometric data, gender, age, race, sport and genetic factors [9]. In our early studies we identified structural and functional features of the athletes' hearts of the Yakut ethnic group (free wrestling). We found developing hypertrophy of the myocardium of the left ventricle in 10% of the athletes. The concentric hypertrophy is characterized by less favorable functional parameters [6].

Since EchoCG does not give a complete electrophysiology picture, we additionally implemented Holter monitoring (Holter ECG).

Our investigation is aimed to study the electrophysiological adaptation of cardiovascular system of the athletes in the Far North.

MATERIALS AND METHODS

We examined healthy athletes (not below the candidate for master of sports) with a different orientation of the training processes. The sports experience was at least 7 years. All tested athletes underwent standard ECG-rest (Shiller-AT-1, Switzerland) (n=400) and Holter ECG ("Cardiosens-K", Russia) (n=62). The following parameters were evaluated: heart rhythm, circadian rhythm of heart rate, conditions abnormalities.

RESULTS AND DISCUSSION

Standard ECG screening (n=400) detected the following changes: sinus arrhythmia - 37,5%, transient arrhythmias and conduction – 67,5%, namely ventricular (0.5%) and supraventricular arrhythmias (5,25%), complete and incomplete right bundle branch block (CRBBB/IRBBB) (25%), second-degree AV block (1.25 %), Brugada-like electrocardiogram abnormalities (3,75%); and early repolarization (50%), dystrophic changes in the myocardium (5%).

Transient arrhythmias and conduction (67.5%) are the most frequent pathology, which is considered as the earliest symptom of disadaptation. These changes are well-adjusted by decrease in physical activity, especially after long flights and desynchronoses. Disadaptation can lead to the development of fatigue, significant performance decrement and, further, occurrence of diseases and injuries. It is alarming that frequent cases of transient asymptomatic Brugada-like electrocardiogram abnormalities (3,75%) have been recorded recently. These ECG changes require daily monitoring of an electrocardiogram.

We performed Holter ECG in 62 athletes with some ECG abnormalities.

The analysis of heart rate during Holter ECG showed, that the average heart rate of the endurance-athletes in the daytime is 67.8 beats/min, while the rate of the athletes training speed-strength – 71,4 beats/min. The Circadian index (CI) of all tested athletes was within the normal range. Accordingly, in the nighttime hours the relevant decrease in the heart rate of these athletes was observed. The episodes of bradycardia at a rate of 39 beats/min were recorded in the endurance-athletes (athletics).

Daily assessment of cardiac rhythm and conduction disturbances showed that the cardiac rhythm disorders by type of frequent supraventricular arrhythmia (up to 17 560/day) (12.9%) and frequent ventricular arrythmia (up to 22 450/day) (3,2%) most frequently encountered in

endurance-athletes (aerobic exercises), whereas the athletes training speed-strength (dynamic loads) had conduction disturbances by type of the second-degree AV block Mobitz Type 1 (with a maximum duration of pauses up to 3 seconds) (9.7 %). However, changes in Holter ECG and EchoCG have not been revealed in athletes with Brugada-like changes, but they are still under close control.

CONCLUSION

Thus, the monitoring of the functional state of athletes' cardiovascular system allows diagnosing the early signs of disadaptation to prevent the development of pre-pathological and pathological conditions. Nowadays, professional sport puts high requirements to level of functional training and health of the athletes. It is impossible to achieve high results, having done enormous amounts of "work" with no cost to health, without the dynamic control of functional training. The important step here is the proper organization of the system of training and recovery.

REFERENCES

1.Deryapa N.R. Ryabinin I.F. Adaptacija cheloveka v poljarnyh rajonah zemli [Human adaptation in the polar regions of the Earth]. Leningrad, Medicine, 1977, p. 297.

2.Zakharova F.A. Jekologo-fiziologicheskie i patogeneticheskie mehanizmy adaptacii i dezadaptacii korennogo naselenija Jakutii: Avtoref… diss. d-ra med.nauk [Ecological, physiological and pathogenetic mechanisms of adaptation and disadaptation of the indigenous population of Yakutia: Dissertation of doctor of medical sciences]. Yakutsk, 2001, p.44

3.Iordanskaya F.A. Udintseva M.S. Diagnostika i differencirovannaja korrekcija simptomov dezadaptacii k nagruzkam sovremennogo sporta i kompleksnaja sistema mer ih profilaktiki [Diagnostics and differentiated correction of symptoms of deadaptation to loads of the modern sport, and a comprehensive system of measures for their prevention]. Teorija i praktika fizicheskoj kul'tury [Theory and practice of physical culture]. 1999, №1, pp.18-24.

4.Kaznacheev V.P. Kaznacheev S.V. Adaptacija i konstitucija cheloveka [Adaptation and human constitution]. Novosibirsk: Nauka [Science], 1986, p. 118.

5.Manchuk V.T. Dogadin S.A. Kapustina T.A. Osnovnye faktory formirovanija patologii u naselenija Krajnego Severa [Major factors of formation of the pathology in population of the far North]. Aktual'nye voprosy profilaktiki neinfekcionnyh zabolevanij: tez.dokl [Topical issues of prevention of non-communicable diseases: thesis report]. Moscow, 1993, p.72.

6.Pinigina I.A. Strukturno-funkcional'nye osobennosti serdechno-sosudistoj sistemy i metabolicheskie pokazateli u molodyh muzhchin s vysokoj fizicheskoj aktivnost'ju v uslovijah Krajnego Severa: Avtorefef… diss. kand. med. nauk [Structural and functional features of the cardiovascular system and metabolic parameters in young men with high physical activity in the Far North: Dissertation of candidate of medical sciences]. Novosibirsk, 2010, p.45.

7.D'Andrea A. D'Andrea L. Caso P. Scherillo M. Zeppilli P. Calabr R. The usefulness of Doppler myocardial imaging in the study of the athlete's heart and in the differential diagnosis between physiological and pathological ventricular hypertrophy. Echocardiography. 2006 Feb; 23 (2): 149–57.

8.Lauschke J. Maisch B. Clin .Athlete's heart or hypertrophic cardiomyopathy? Res Cardiol. 2009 Feb; 98 (2): 80–8.

9.Maron B.J., Pelliccia A. The Heart of Trained Athletes: Cardiac Remodeling and the Risks of Sports, Including Sudden Death. Circulation. 2006; 114: 1633–1644.

10.Pelliccia A., Maron B.J. The athlete's heart: remodeling, electrocardiogram and preparticipation screening. Cardiol. Rev. Cardiology in Review: March/April 2002; 10: 2: 85–90.

11.Popp R. [et al.]. Cardiac anatomy – viewed systematically with two dimensional echocardiography. Chest. 1979; 75: 579–585.

Information about authors

1. Mestnikova Ekaterina Nikolaevna, a cardiologist at the Department of functional diagnostics Center for Sports Medicine and Rehabilitation at the GBU of Sakha (Yakutia) "High school sports", 678000 Yakutsk ul. Oiunsky 26, block B, E-mail: katemestnikova@mail.ru;

2. Makharova Natalia Vladimirovna, MD, a cardiologist, chief medical officer of the Center for Sports Medicine and Rehabilitation at the GBU of Sakha (Yakutia) "High school sports", 678000 Yakutsk ul. Oiunsky 26, block B, E-mail: makharova@mail.ru;

3. Pinigina Irina A., MD, PhD, head of the department of functional diagnostics of the Center for Sports Medicine and Rehabilitation at the GBU of Sakha (Yakutia) "High school sports", 678000 Yakutsk ul. Oiunsky 26, block B, E-mail: Pinigina1986@mail.ru;

4. Christina Gavrilyeva Semenovna, head of the department of physiotherapy and rehabilitation of the Center for Sports Medicine and Rehabilitation at the GBU of Sakha (Yakutia) "High school sports", 678000 Yakutsk ul. Oiunsky 26, block B, E-mail: gks.79@mail.ru.