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HEMODYNAMICS STATE IN STUDENTS OF MEGAPOLIS UNIVERSITIES: SINGLE-CENTER COHORT STUDY

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ABSTRACT — The purpose of this study was to estimate hemodynamics parameters in students during an inter-sessional period. The study included 208 students from medical university in the large metropolis (Nizhny Novgorod, Russia). It was found that this group of population has good adaptive reserves. However, in less than 20% of examined students we may suggest signs of sympathicotonia and a moderate risk of arrhythmogenic events.

KEYWORDS — students, hemodynamics, heart rate variability, microcirculation.

INTRODUCTION

In the light of modern trends in the formation of the population's commitment to physical training and a healthy lifestyle, the willingness of people to follow them, that is, to maintain the level of functional reserves of their body, comes to the fore [1, 2]. In this connection, comprehensive monitoring of the health status of the population is necessary, which is partially implemented through the medical examination procedure [2, 3, 8]. It is well-known that students are the part of the population that is most actively involved in the training process and high physical activity (within the framework of sports activities, physical training and a healthy lifestyle) — [1, 3, 5–8]. Therefore, we have assumed that the assessment of their adaptive capacity should preferably be made on the basis of analysis of the cardiovascular system. It is well-known that this system is most responsive to shifts of homeostasis and change settings for environment exposures [1–8].

Based on our assumption the ***purpose of this study*** was to study the state of hemodynamics parameters in students of the medical university of Nizhny Novgorod during the inter-sessional period.

MATERIAL AND METHODS

The study included 208 students (18–20 years old; 76/132 as male/female) from the medical university of a large metropolis (Nizhny Novgorod, Russia). The study was conducted in the middle of the day, in a calm state (during the inter-session period, outside the days of passing tests or colloquiums) in full compliance with the standard rules of procedure for taking an electrocardiogram (ECG). To register ECG and analyze hemodynamic parameters, including those that characterize heart rate variability, we used the "Medical Soft" sports testing system (MS FIT Pro version, Russia). Standard hemodynamic parameters (blood pressure level, pulse rate, stroke volume, cardiac output, etc.), statistical and spectral parameters of heart rate variability, as well as an integral criterion of the state of microcirculation were used for monitoring. Data analysis was performed in accordance with age standards formed by equipment developers based on age standards [3–6].

Statistical processing of the results was performed using variation statistics algorithms using Microsoft Excel 2007 and Statistica 6.1 for Windows.

RESULTS

Analysis of the main parameters of systemic hemodynamics allowed us to form a comprehensive view of the state of the cardiovascular system in students of the medical university of Nizhny Novgorod (Table 1).

It was found that the level of blood pressure (both systolic and diastolic) of the considered contingent of students does not differ from the age norm, while the average heart rate is at the upper limit of the physiological range, which indicates a tendency to moderate tachycardia. At the same time, other indicators that characterize the pumping function of the heart (stroke volume, cardiac output) remain within the normal range. This indicates the adaptive character of the observed level of pulse rate.

The contribution of peripheral vascular resistance to the formation of systemic blood flow was evaluated by calculating the corresponding parameter, which was also recorded at the upper limit of the age norm. On the other hand, the arterial stiffness index, which indicates the state of the vascular wall, is also determined in the physiological range, which allows us to interpret

Table 1. *Hemodynamics parameters in students*

Parameter	Value (M±m)	Age norm
Systolic pressure, mm.Hg.	121,33±2,94	110-140
Diastolic pressure, mm.Hg.	71,50±2,91	75-90
Pulse rate, min-1	87,58±2,72	70-90
Stroke volume, ml	65,19±1,97	60-90
Cardiac output, l/min	5,60±0,19	higher than 4,5
Total peripheral resistance, rel. un.	1290,94±35,42	lesser than 1300
pNN50, %	30,66±1,07	10-49
Spectral balance index (LF/HF), rel. un.	1,29±0,08	lesser than 2,0
Stress index, points	7,38±0,09	8-10
Arterial stiffness, points	9,89±0,12	8-10
Microcirculation, points	9,50±0,18	8-10

the identified trend as adaptive, which may be due to the peculiarities of the hormonal background of students and an increased number of stressful situations that induce activation of the sympatho-adrenal system. This mechanism is additionally indicated by the level of the stress index, which shifts towards disadaptation and goes beyond the optimal age limit.

Evaluation of the parameters of heart rate variability allowed us to establish the presence of relative instability of hemodynamic support, as evidenced by a fairly high value of the pNN50 indicator (30.66%). Despite falling within the physiological range, this indirectly characterizes the cardiac rhythm in the considered group of individuals as highly variable, which is a predictor of an increased risk of arrhythmogenic events. At the same time, a positive fact in the assessment of heart rate variability in the examined individuals is the finding of the spectral balance index (LF/HF), calculated on the basis of spectral analysis of the heart rate variability, in the age range corresponding to normotonia. Only less than 20% of the students included in the study had signs of sympathicotonia for this indicator. This provides adequate conditions for ensuring blood flow through the microvascular bed, which is reflected in the physiological level of the microcirculation.

CONCLUSION

Using comprehensive hardware testing of the state of the cardiovascular system of medical students in Nizhny Novgorod, it was found that this population group has good adaptive reserves, but some of the examined students showed signs of sympathicotonia and a moderate risk of arrhythmogenic events.

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