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The study of activity indicators of the vasomotor (vascular) center for students of higher educational facilities

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ABSTRACT. The article presents an assessment and analysis of the field of scientific and medical research based on the study of the vasomotor center, indicators of weakening and strengthening of this center. The study of the vasomotor center is a key area of research in the field of neurology and cardiology, since this center plays an important role in the regulation of vascular tone and blood pressure. Despite significant progress in this area, many mechanisms of the vasomotor center remain undisclosed and require further study. Special attention is paid to the weakening and strengthening of this center, which helps in the development of new methods of treatment for various diseases associated with impaired regulation of vascular tone and blood pressure. The article contains information based on research and data analysis. The results of the work can be used in further research and practical medicine, contributing to the development of innovative approaches in the treatment and prevention of relevant diseases.

KEYWORDS: vasomotor center, activity, indicators, research, students, risk factors, student morbidity

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Изучение показателей активности вазомоторного (сосудистого) центра у студентов высших учебных заведений

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РЕЗЮМЕ. Статья представляет собой оценку и анализ области научных и медицинских исследований, основанных на изучении вазомоторного центра, показателей его ослабления и усиления данного. Изучение вазомоторного центра является ключевым направлением исследований в области неврологии и кардиологии, поскольку он играет важную роль в регуляции сосудистого тонуса и кровяного давления. Несмотря на значительный прогресс в этой области, многие механизмы деятельности вазомоторного центра остаются нераскрытыми и требуют дальнейшего изучения. Особое внимание уделяется его ослаблению и усилению, что помогает в разработке новых методов лечения различных заболеваний, связанных с дисрегуляцией сосудистого тонуса и кровяного давления. Статья содержит информацию, основанную на изучении и анализе данных. Результаты работы могут быть использованы в дальнейших исследованиях и практической медицине, способствовать развитию инновационных подходов в лечении и профилактике соответствующих заболеваний.

КЛЮЧЕВЫЕ СЛОВА: вазомоторный центр, активность, показатели, исследование, студенты, факторы риска, заболеваемость студентов

INTRODUCTION

Body's ability to adapt to environmental factors and cope with them with minimal energy expenditure depends on individual psychophysiological characteristics of a person, including strength and stability of the nervous system. This task also arises for students who need the ability to effectively adapt to new conditions. Due to the integrative function of the nervous system, limiting its adaptability does not always lead to a corresponding reaction of other functional systems. Therefore, development of criteria for assessing the adaptive reserves of the body, especially in students, as well as determining stages of adaptation process from health to disease is an urgent task for maintaining public health. The method of analyzing heart rate variability (HRV) in assessing stress of regulatory systems is one of the most important and allows us to evaluate adaptive reserves of the body [1, 2]. Changes in HRV parameters during physical and mental activity depend on the degree of stress and individual characteristics of nervous system reactivity [3]. Studying the modulation of the heart rate based on assessing the current activity of its regulation mechanisms allows us to evaluate the state of the whole organism, the level of its adaptation to environmental conditions [4, 5]. HRV analysis indicators allow us to assess the overall activity of regulatory mechanisms, neurohumoral regulation of blood circulation, relationship between the sympathetic and parasympathetic divisions of the autonomic nervous system, between the central and autonomous regulation circuits [6].

The study of indicators of the vasomotor center, activity of the subcortical center is becoming increasingly important in modern medicine. The growing understanding of the role of centers in regulation of blood pressure and maintaining the body's homeostasis opens up new opportunities for diagnosis and treatment of cardiovascular diseases.

The vasomotor center, located in the medulla oblongata, plays an important role in controlling vascular tone and regulating blood pressure. It includes the subcortical center, which, in turn, is associated with networks of neurons responsible for regulating sympathetic and parasympathetic activity.

Studying the activity of the subcortical center and relationship between it and other areas of the vasomotor center provides valuable information about the health status of the body and its adaptation to various stressful situations. Research methods such as neuroimaging, electrophysiological and hormonal tests provide information about functional activity of these structures and their interaction with other cardiovascular control systems.

Investigation of indicators of the vasomotor center allows us to identify disturbances in the subcortical center and take timely measures to correct them. Imbalance in the vasomotor system can lead to various cardiovascular diseases, including arterial hypertension, coronary heart disease, and stroke. Studying indicators of the vasomotor center can also help us understand the broader mechanisms of blood pressure regulation and overall homeostasis of the body. This, in turn, can lead to the development of more effective methods for treating cardiovascular diseases and improving the overall health of patients [7].

Body's ability to adapt to the external environment with minimal energy expenditure partly depends on the strength and stability of the nervous system, especially in case of students. Therefore, it is important to consider psychophysiological characteristics when developing strategies for adaptation and support of students in academic environment [8].

AIM

The aim of the study is to analyze the distribution of indicators of the vasomotor center in university students taking into account risk factors and results of data forecasting.

MATERIALS AND METHODS

A study was carried out involving students majoring in the humanities. A total of 389 students participated in the study, divided by year of study and gender: 1st year of study — 124 people, including 65 men and 59 women; 3rd year of study — 129 people, including 56 men and 73 women; 6th year of study — 136 people, including 52 men and 84 women. The control group consisted of representatives identical in age and gender, who had professions without harmful working conditions and did not participate in the educational process (165 men and 202 women).

Variation pulsometry method was applied. All subjects underwent electrocardiographic studies. 300 R–R intervals were recorded in each study. The index of activity of regulatory systems was calculated with differentiation of preclinical and premorbid levels using the program for processing the results of variation pulsometry, developed by the Institute for Biomedical Problems of the Russian Academy of Sciences Institute. The analysis of indices of the vasomotor (vascular) center in control group students was carried out and performed. Five gradations of this indicator were assessed: normal activity of the subcortical center; moderate increase in the activity of the vasomotor center regulating vascular tone; moderate weakening of the activity of the vasomotor center regulating vascular tone; pronounced strengthening of the vasomotor center regulating vascular tone; pronounced weakening of the vasomotor center regulating vascular tone. In parallel with electrocardiographic studies, a questionnaire was conducted on anamnesis burden of cardiovascular pathology, assessment of levels of psychical and emotional stress, physical education and sports, living conditions, presence of bad habits, etc. The developed information database contains 81,490 information units.

Parametric and nonparametric statistical tests (correlation, regression) with the development of a regression model of the discriminant function were used to process the indicators.

RESULTS AND DISCUSSION

According to distribution of indicators of the vasomotor center in total sample, it is possible to note prevailing indicator of normal activity of the subcortical center both in the control group and in students, the average value of which is 58.59%. The subcortical center is one of the key structures regulating various processes in the body, such as breathing, cardiovascular system, etc.

The next most common indicator in both databases is moderate strengthening of the vasomotor center with values of 31.21 and 28.49% in the control group and group of students, respectively. The strengthening of the vasomotor center indicates its increased activity. The vasomotor center is responsible for regulating vascular tone, which in turn affects blood pressure, tissue perfusion and overall homeostasis of the body. Increased activity of the vasomotor center can lead to an increase in vascular resistance. This can cause various health problems, such as arterial hypertension, cerebrovascular diseases and other cardiovascular pathologies.

Further, in control group, we can distinguish indicators of pronounced strengthening of the vasomotor center — 5.09%, moderate weakening of the vasomotor center — 4.45% and pronounced weakening of the vasomotor center — 0.63%. At the same time, among students, the most common indicator is moderate weakening of the vasomotor center — 7.82%. The indicator of pronounced strengthening of the vasomotor center is 5.58% with a reliability level of difference of p=0.046. The indicator of weakening of the vasomotor center indicates reduced activity of this structure. Reduced activity of the vasomotor center can lead to vasodilation and a decrease in blood pressure. This can also have a negative effect on the body, causing problems with tissue perfusion and metabolism. Thus, in 1st year students, the indicator of normal activity of the subcortical center is 66.23% and is prevailing, but significantly lower (p=0.049) compared to control group. The next most common indicator, which is 23.38%, is moderate strengthening of the vasomotor center. Then comes the indicator of pronounced strengthening of the vasomotor center, which is 5.19%. In 3rd year students, normal activity of the subcortical center is prevailing and is 55.26%. The next most common is the indicator of moderate strengthening of the vasomotor center with a value of 23.68%, followed by the indicator of moderate weakening of the vasomotor center — 10.53%, pronounced strengthening of the vasomotor center — 10.53%. In 6th-year students, normal activity of the subcortical center is prevailing indicator, which is 50%. The next most common indicator is moderate strengthening of the vasomotor center with a value of 37.5%, followed by moderate weakening of the vasomotor center — 9.37%, pronounced strengthening of the vasomotor center — 3.12%. When compared with the control group, it was found that the state of pronounced strengthening of the vasomotor center occurs in 4.98% of cases, which is statistically significant (p=0.036).

In order to predict various states of indicator of vasomotor vascular center, a regression model of the discriminant function was developed. This model calculated regression coefficients of risk factors. A correlation matrix was built in advance. In the model, statistically significant risk factors acted as a resulting indicator of normal activity of the subcortical cardiovascular center. In particular, this model included 5 factors. The following factors had reliable significant levels: X1 — gender with two gradations of features — male and female; X2 — anamnesis burden of cardiovascular pathology with two gradations of features — aggravated and unaggravated; X3 — psychological microclimate in learning environment with three gradations of features — favorable, moderately favorable, unfavorable; X4 — physical inactivity with three gradations of features — present, moderately expressed, absent; X5 — ecological risk with four gradations of signs — risk low, average, above average, high. The contribution of factors X1–X5 was assessed to enable the alignment of risk factor assessment in the formation of resulting indicator — an indicator of normal activity of the subcortical cardiovascular center. The assessment criterion was the range of centroid, showing the degree of probability of development of the favorable and unfavorable outcome.

Based on standardized coefficients and their influence on the discriminant function (DF), the most significant factors for the index of normal activity of the subcortical cardiovascular center will be those whose coefficients are close to 1 under modulo. In this model, X4 (–0.813) has a strong negative influence — low probability of normal activity of the subcortical cardiovascular center; X2 (0.703) has a strong positive influence — high probability of normal activity of the subcortical cardiovascular center. Thus, changes in these factors greatly affect the value of the resulting index.

CONCLUSION

Normal activity of the subcortical center is the main indicator, but changes in the strengthening and weakening of the vasomotor center can also indicate disturbances in the body's regulatory system. This is important to consider when analyzing and diagnosing various diseases and conditions of the body.

Studying the activity of the subcortical and vasomotor centers is an important area of research in medicine, which helps to better understand mechanisms of regulation of the cardiovascular system and find approaches to correcting possible disorders. Results of such studies can lead to the development of new methods for diagnosing and treating cardiovascular diseases, as well as improving the overall health of people.

Analyzing the presented data, it can be seen that activity of the subcortical center in first-year students is predominant indicator, with a value of 66.23%. This shows that young students are active and willing to receive information. The next most common indicator in this group of students is a moderate increase in the vasomotor center, which is 23.38%. This indicates that some students may experience stress or pressure, perhaps due to the new environment. In order to prevent negative consequences and maintain health and activity in students, it is important to focus on preventive measures, such as organizing stress management training, sports, free psychological support, and an integrated approach to a healthy lifestyle.

In addition, it should be noted that in 3rd year students, normal activity of the subcortical center is predominant and is 55.26%. At the same time, the indicator of moderate strengthening of the vasomotor center has a value of 23.68%. 6th year students also showed the prevalence of normal activity of the subcortical center, which reached 50%. However, the indicator of moderate increase of the vasomotor center with a value of 37.5% indicates that students in this group may also have a high level of stress.

Prevention and support for students at different stages of their educational path plays an important role in ensuring their physical and psychological well-being. It is necessary to develop and implement appropriate programs and activities that will help students effectively cope with stress, improve adaptive skills and develop a healthy lifestyle.

Thus, analyzing data from total sample, we can conclude that normal activity of the subcortical center predominates both in the control group and in students. Also, in both databases, moderate strengthening of the vasomotor center is significantly present. Studying the activity of the subcortical and vasomotor centers is an important area of research in medicine. It allows us to ex-

pand our knowledge of blood pressure regulation and find new approaches to treatment of cardiovascular diseases. Results of such studies can significantly affect the improvement of the quality of life and increase its duration for people around the world.

ADDITIONAL INFORMATION

The author read and approved the final version before publication.

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Конфликт интересов. Автор декларирует отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

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REFERENCES

1. Baevsky R. M., Berseneva A.P. Assessment of the adaptive capabilities of the body and the risk of developing diseases. Moscow: Meditsina; 1997. (In Russian).
2. Sorokin O.V., Manokhar R., Panova A.S., Subotyalov M.A. Stages of formation and development of scientific ideas about pulse diagnostics. Vestnik Novosibirskogo gosudarstvennogo pedagogicheskogo universiteta. 2017;7(1):157–171. (In Russian). DOI: 10.15293/2226-3365.1701.11.
3. Egorova Ya.O., Gavrilova A.A., Sosnina P.S. The use of functional assessment of the autonomic nervous system according to cardiorhythmography data to characterize stress resistance in students. Materialy vserossiyskogo nauchnogo foruma s mezhdunarodnym uchastiyem “Studencheskaya nauka — 2019”. Forcipe. Spetsvypusk. 2019;2:867–868. (In Russian).
4. Heart rate variability: standards of measurement, physiological interpretation and clinical use. Rabochaya gruppa Yevropeyskogo kardiologicheskogo obshchestva i Severoamerikanskogo obshchestva stimulyatsii i elektrofiziologii. Vestnik Aritmologii. 1999;11:53–78. (In Russian).
5. Puzy`rev V.G., Xalfiev I.N., Kolpakova M.V., Sitdikova A.V., Grigor`eva L.V., Sitdikova I.D., Mixajlova S.A., Sajfutdinova E.A., Karchevskaya A.O. Heart rate variability indicators as a cumulative criterion for assessing the body’s adaptive reserves. The General Practitioner’s Handbook. 2023;8(1):33–39. (In Russian).
6. Shlyk N.I. Heart rate and type of regulation in children, adolescents and athletes. Izhevsk: Udmurtskiy universitet; 2009. (In Russian).
7. Puzy`rev V.G., Xalfiev I.N., Ivanova A.S., Ivanova M.K., Sitdikova I.D., Sannikova Yu.A., Kolpakova M.V., Zhernakova A.E., Ivanova E.Yu. Methodological aspects of prenosological diagnostics in the field of human ecology. Medicine and Healthcare Organization. 2022;7(4):74–79. (In Russian).
8. Muzaffarova M.Sh., Puzy`rev V.G., Sitdikova I.D., Kolpakova M.V., Sady`kova A.T., Sultanova K.I. Health status of adolescent children: analysis of heart rate variability. Forcipe. 2022;S2(5):348–349. (In Russian).

ЛИТЕРАТУРА

1. Баевский Р.М., Берсенева А.П. Оценка адаптационных возможностей организма и риска развития заболеваний. М.: Медицина; 1997.
2. Сорокин О.В., Манохар Р., Панова А.С., Суботялов М.А. Этапы становления и развития научных представлений о диагностике по пульсу. Вестник Новосибирского государственного педагогического университета. 2017;7(1):157–171. DOI: 10.15293/2226-3365.1701.11
3. Егорова Я.О., Гаврилова А.А., Соснина П.С. Использование функциональной оценки вегетативной нервной системы по данным кардиоритмографии для характеристики стрессоустойчивости у студентов. Материалы всероссийского научного форума с международным участием «Студенческая наука — 2019». Forcipe. Спецвыпуск. 2019;2:867–868.
4. Вариабельность сердечного ритма: стандарты измерения, физиологической интерпретации и клинического использования. Рабочая группа Европейского кардиологического общества и Североамериканского

общества стимуляции и электрофизиологии. Вестник аритмологии. 1999;11:53–78.
5. Пузырев В.Г., Халфиев И.Н., Колпакова М.В., Ситдикова А.В., Григорьева Л.В., Ситдикова И.Д., Михайлова С.А., Сайфутдинова Э.А., Карчевская А.О. Показатели вариабельности сердечного ритма как совокупный критерий оценки адаптационных резервов организма. Справочник врача общей практики. 2023;8(1):33–39.
6. Шлык Н.И. Сердечный ритм и тип регуляции у детей, подростков и спортсменов. Ижевск: Удмуртский ун-т; 2009.
7. Пузырев В.Г., Халфиев И.Н., Иванова А.С., Иванова М.К., Ситдикова И.Д., Санникова Ю.А., Колпакова М.В., Жернакова А.Е., Иванова Е.Ю. Методологические аспекты донозологической диагностики в сфере экологии человека. Медицина и организация здравоохранения. 2022;7(4):74–79.
8. Музаффарова М.Ш., Пузырев В.Г., Ситдикова И.Д., Колпакова М.В., Садыкова А.Т., Султанова К.И. Состояние здоровья детей подросткового возраста: анализ вариабельности сердечного ритма. Forcipe. 2022;S2(5):348–349.