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L.M. AMREYEVA, G.Z. ZAINELOVA

S. Amanzholov East-Kazakhstan State University, Ust-Kamenogorsk c., Kazakhstan

PECULIARITIES OF THE HEART RATE REGULATION AMONG THE POPULATION OF INDUSTRIAL REGION



Amreyeva L.M.



Zainelova G.Z.

The impact of environmental factors on the human body is realized in the form of activation of the sympathetic division of the autonomic nervous system. The article included an integrated assessment peculiarities of the heart rate regulation among the population of industrial region.

The investigation objective is a study features of vegetative parameters of people the population of industrial region.

Material and methods. The study involved 129 humans of industrial region of Kazakhstan. The analysis of indicators of heart rate depending population ecologically adverse region.

Results and discussion. Revealed increased tone of sympathetic nervous system. It is indicates the incompleteness and less adaptation of the heart functionality and autonomous control mechanisms of its activities, about the clear mechanisms dominance of extracardiac heart rate regulation.

Conclusion. The results indicate that the population of ecologically adverse region leads to the cumulation of fatigue and overwork in the structure regulation of the heart rate as evidenced the tendency of all indicators change of heart rate towards the sympathetic activation of the vegetative nervous system.

Key words: cardiovascular system, vegetative nervous system, heart rate, adaptation, functional voltage.

The cardiovascular system is a thin effector organ, which is closely related to the regulatory mechanisms of the cortex and subcortical structures, and, at the same time, effective indicator of determining the potential level of adaptability of organism vegetative functions [1].

The normal state of life activity is characterized by a balance of organism with the environment and the maintenance of homeostasis within the system. Any change in the level of functioning leads to the restructuring of the organism system activity in order to achieve the desired final result by moving to a new level of regulation through the use of reserve possibilities, involving new and eliminating unnecessary system units. Prolonged tension of regulation system can lead to overstrain it, and in the future – and to the depletion of the protective mechanisms, reducing of an organism functional possibilities [2].

It is known that the adaptation of the organism to various factors is carried out by the regulatory function of sympathetic (SNS) and parasympathetic (PNS) parts of vegetative nervous system (VNS).

Objective

To study peculiarities of the heart rate regulation among the population of industrial ecologically unfavourable region.

Material and methods

The registration and analysis method of heart rate variability allows detecting the shifts of neurohumoral balance, assessing the participation degree of the sympathetic and parasympathetic nervous and humoral units in the regulation of heart rate, the centralization degree of its management.

The information is in serial number of cardio intervals, contains information about the automatism, and reflects the nature of processes taking place in the control system of sinus node, the level of adaptation as a whole [3, 4].

Results and discussion

Analysis of vegetative parameters of people employed in brainwork allowed finding in inspected people the various expression and specificity degrees of shift direction and character of organism response.

So, in inspected people of group with the work experience up to 5 years was registered the following Mo meaning: the

Contacts: Gulmira Zainelovna Zainelova, Professor of the Department of basic military training and life safety of the East-Kazakhstan State University. n.a. S. Amanzholov, Ust-Kamenogorsk c. Ph. + 7 701 111 22 96, e-mail: nailya.alimbetova@gmail.com

Контакты: Зайнелова Гульмира Зайнелова, профессор кафедры НВП и БЖ Восточно-Казакстанского государственного университета им. С. Аманжолова, г. Усть-Каменогорск. Тел. + 7 701 111 22 96, e-mail: nailya.alimbetova@gmail.com

teachers of special schools – $0,82 \pm 0,02$ seconds, the library staff – $0,86 \pm 0,03$ seconds, the indicator AMo of teachers was $33,4 \pm 4,2\%$; library staff at $34,7 \pm 3,0\%$.

The values of the Vegetative index of rate, Index vegetative balance, Indicator of control process adequacy were significantly higher in inspected people of this work experience group than in those with work experience of 5 to 10 years: the teachers of special schools by 12,1%, 39,6% and 31,9%, respectively, the library staff of 16,8%, 14,3%, 32,7%, respectively.

Research results of vegetative regulation of the people employed in brainwork of the second work experience group characterized the decrease of sympathetic influences: the values AMo, Vegetative index of rate, Index vegetative balance, Indicator of control process adequacy had a tendency of significant decrease compared with the values of the previous group, and were the teachers of special schools $26,6 \pm 2,6\%$ ($p < 0,05$), $13,2 \pm 3,5$ standard units, $305,1 \pm 92,8$ standard units, $31,9 \pm 3,9$ standard units respectively, the library staff $31,0 \pm 2,3\%$ ($p < 0,05$), $13,01 \pm 1,2$ standard units ($p < 0,05$), $363,5 \pm 41,2$ standard units, $34,7 \pm 2,9$ standard units ($p < 0,01$), respectively.

According to the theoretical positions [5, 6, 7], this type of response vegetative regulation can be explained by the development of general tiredness, falling tone of vegetative nervous system and inhibition processes in the central nervous system of people employed in brainwork in the group with work experience of 5 to 10 years, compared with the group with up to 5 years.

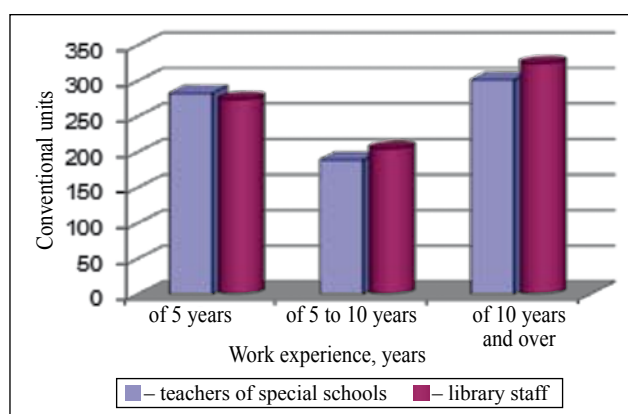
This, apparently, is a protective reaction of the organism, or the observed moderate parasympathetic influence, balancing the detrimental effect of sympathoadrenal system by stressful situation, is one of the factors of individual resistance to the possible changes in the cardiovascular system under conditions of psychic tension [6].

In the inspected people of the group with work experience of 10 years and over recorded an increase AMo, Vegetative index of rate, Index vegetative balance, Indicator of control process adequacy: the teachers of special schools – $32,5 \pm 2,7\%$ ($p < 0,05$), $16,3 \pm 1,2$ standard units., $505,6 \pm 61,2$ standard units, $42,6 \pm 3,2$ standard units ($p < 0,01$), respectively, the library staff $19,8 \pm 2,1$ standard units ($p < 0,01$), $546,4 \pm 76,2$ standard units ($p < 0,05$), $38,9 \pm 2,6$ standard units ($p < 0,05$), respectively.

The observed changes indicate a shift in vegetative balance toward a moderate prevalence of sympathetic part of vegetative nervous system of inspected people with the work experience, indicating the increasing control centralization of heart rate, ie, the amplification modulating influence of the hypothalamus [8, 9].

Predominance in central regulation of heart rate of the sympathetic tone (as evidenced increase in Index of regulatory system tension and AMo), accompanied in this case, and a small decrease in activity of the parasympathetic regulation ($\Delta x - 0,08 \pm 0,004$ s ($p < 0,01$) for teachers; $\Delta x - 0,07 \pm 0,007$ seconds for the library staff), with no significant changes in the magnitude of humoral unit (Mo).

Changes in heart rate, depending on the experience indicate that the value range the most common RR intervals practically unaffected, but the number of interval values corresponding to



Picture 1 – The index of tension in brainwork people, depending on the experience of professional activity

Mo, that is, their expression changes in waves, and the degree of variability (Δx) decreased.

This indicates, on the one hand, an increase of the system regularity, on the other hand a decrease of lability, which naturally leads the inertia of the system, reducing the ability to adequately respond to influences of the environment. This assumption is reflected in the integrative indicators Vegetative index of rate, Index vegetative balance, Indicator of control process adequacy, Index of regulatory system tension, the values of which change with the experience work of professional activity.

Dynamics of changes in tension index as a function of experience is illustrated visually in Picture 1.

According to research by R.M. Baevsky [10] who contributed four degrees of adaptation Index of regulatory system tension of organism, we can say that the subject has a contingent of teachers 13,16% of the subjects had a satisfactory adaptation, 34,21% – tension of adaptation mechanisms, 52,63% – unsatisfactory adaptation, 34,21% – tension of adaptation mechanisms, 52,63% – unsatisfactory adaptation.

In the dynamics of the professional activity the first and the third group had an unsatisfactory adaptation and the values of Index of regulatory system tension, respectively, were $283,2 \pm 92,5$ standard units ($p < 0,001$) and $302,3 \pm 38,5$ standard units ($p < 0,001$). The representatives of the second group with a work experience showed the tension of adaptation mechanisms and Index of regulatory system tension were $189,6 \pm 62,4$ standard units ($p < 0,001$).

In the group of teachers with experience up to 5 years 28,6% of the teachers had a satisfactory adaptation, 14,3% – the tension adaptation mechanisms, 57,1% – unsatisfactory adaptation.

In the group with experience of 5 to 10 years, 42,8% of inspection had a satisfactory adaptation in 28,6% recorded tension adaptation mechanisms, in 28,6% – unsatisfactory adaptation. 41,7% of teachers with 10 years of experience work and have more tension adaptation mechanisms, 58,3% – unsatisfactory adaptation.

In the group of library staff 10,7% of inspected people had a satisfactory adaptation, 7,1% – tension adaptation mechanisms, 71,4% – unsatisfactory adaptation, 10,7% – failure of adaptation.

The analysis of the tension index dynamics as a function of professional work experience has shown that all work experi-

enced groups of library staff had an unsatisfactory adaptation and Index of regulatory system tension values, respectively were as follows: in the young work experienced group – 274,7±36,8 standard units, in the middle work experienced group – 205,6±25,1 standard units, in the old work experienced group – 325,2±44,4 standard units.

Meanwhile in the first work experience group in 16,5% of inspected people was found state of a satisfactory adaptation, in 16,5% – tension of adaptation mechanisms, in 66,6% – unsatisfactory adaptation. In the group with work experience of 5 to 10 years, 25% of expected people had a satisfactory adaptation, 75% – unsatisfactory adaptation. 10% of library staff with experience 10 years and more than 10 years had a satisfactory adaptation, 10% – tension of adaptation mechanisms, 80% – unsatisfactory adaptation.

Increase of Index of regulatory system tension indicates that the work activities of brainwork people, accompanied by a high neuro-emotional tension, carried out at the cost of tension and over-tension regulatory systems of the organism, especially in elder work experience group.

Analysis of gradation on Index of regulatory system tension set belonging 2,6% of special school teachers to vagotonics (IQ<60 standard units), 34,2% were normotonics (60>IN<180 standard units), 63,2% – people with dominated sympathetic section of the nervous system (IQ> 180).

In 42,85% of the special school teachers with work experience of 5 years in the regulation of the cardiovascular system was found a moderate dominance of the sympathetic nervous system, in 14,3% – marked dominance of the sympathetic nervous system, in 42,85% of the teachers the first work experience group – the impact of both parts of the nervous system was balanced. In the group with experience of 5 to 10 years in 57,1% of inspected people was found a vegetative balance of the two sections vegetative nervous system, in 14,3% – a moderate dominance of the parasympathetic section of VNS, in 14,3% – a moderate dominance of the sympathetic section of the VNS, and 14,3% – marked dominance of sympathetic division of the VNS.

In the inspected teacher group with experience more than 10 years and more were registered the following activity ratios of different VNS parts: in 25% of teachers was found vegetative balance of VNS parts, in 58,3% – a moderate dominance of the Somatic nervous system and in 16,7% of cases was found the marked dominance of the SNS.

In determining the level of the ratio of VNS parts activity in the group of library staff set 25% of the inspected people belonging to the normotonics, 75% – people with dominated sympathetic parts of the nervous system.

Meanwhile 66,6% of the library staff with work experience up to 5 years of age in the regulation of the cardiovascular system was found a moderate dominance of the sympathetic nervous system, in 33,3% of inspected people – effect of both parts of the nervous system was balanced.

In the second work experience group in 25% of inspected people was found a vegetative balance of the two VNS parts, 75% – moderate dominance of sympathetic parts of the VNS. In the group of inspected elder work experience group were registered the following ratios of VNS parts activity: in 20% of the library staff was found a vegetative balance of VNS

parts, 60% – moderate dominance of SNS, 20% – marked dominance of SNS.

In most of the inspected people the observed tone increasing of the sympathetic regulation circuit by the heart rate indicates the incompleteness and less adaptation of the heart functionality and autonomous control mechanisms of its activities, about the clear mechanisms dominance of extracardiac heart rate regulation (increasing activity of adrenergic mechanisms in the neurohumoral circuit of the regulation).

It seems that in order to increase the needs of the brain in the process of brainwork local population there is a change from the heart. These mechanisms of regulation, according to the literature, carry the risk of overload and failure of adaptation to the subsequent development of somatic changes of internal organs [6, 7, 8, 9].

Conclusion

The results indicate that the population of ecologically adverse region leads to the cumulation of fatigue and overwork in the structure regulation of the heart rate as evidenced the tendency of all indicators change of heart rate towards the sympathetic activation of the vegetative nervous system (growth of AMo, Index of regulatory system tension, Index vegetative balance indicators).

The dynamics of changes in the vegetative status of the organism of people of ecologically adverse region during work activity is seen as a process of interaction between the vegetative and myocardial-hemodynamic homeostasis. The impact of environmental factors on the organism is realized in the form of cardio-vascular reaction through the autonomic homeostasis, which shifts from one side to another.

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Т Ұ Ж Ы Р Ы М

Л.М. АМРЕЕВА, Г.З. ЗАЙНЕЛОВА

С. Аманжолов атындағы Шығыс Қазақстан мемлекеттік университеті, Өскемен қ., Қазақстан

ӨНЕРКӘСІПТІК АЙМАҚТАҒЫ ТҰРҒЫНДАРДЫҢ ВЕГЕТАТИВТІК СТАТУСТЫҢ СИПАТТАМАСЫ

Адам ағзасына экологиялық факторлардың әсері вегетативті жүйке жүйесінің симпатикалық бөлімінің активтенуі бойынша орындалады. Мақалада өнеркәсіптік аймақтағы тұрғындардың арасындағы жүрек ырғағының реттеуі комплексті бағалауы берілді.

Зерттеудің мақсаты. Өнеркәсіптік аймақтағы тұрғындардың вегетативтік статустың зерттеуі.

Материал және әдістері. Қазақстан өнеркәсіптік аймақтағы 129 адам тексерілген. Өнеркәсіптік аймақтағы тұрғындардың жүрек ырғағының реттеуі жүргізілді.

Нәтижелері және талқылауы. Вегетативті жүйке жүйесінің симпатикалық бөлімінің тонусы жоғарылауы анықталған. Жүрек функционалдық мүмкіндігі және автономды мезанизмдердің бағалауы жетілмегендігі және бейімділеу төмендеуі, жүрек ырғағының реттеуі мезанизмдердің басым болуы көрсетілген.

Қорытынды. Алынған нәтижелер бойынша, өнеркәсіптік аймақтағы тұрғындардың жүрек ырғағының реттеуі қажығандығы және әбден қалжырауы байқалады. Вегетативті жүйке жүйесінің симпатикалық бөлімінің активтенуі жағына жүрек ырғағының барлық көрсеткіштердің өзгеруі көрсетілген.

Негізгі сөздер: қан айналым жүйі, вегетативті жүйке жүйі, жүректің ырғағы, бейімділеу, функционалдық күшейю.

Р Е З Ю М Е

Л.М. АМРЕЕВА, Г.З. ЗАЙНЕЛОВА

Восточно-Казахстанский государственный университет им. С. Аманжолова, г. Усть-Каменогорск, Казахстан

ХАРАКТЕРИСТИКА ВЕГЕТАТИВНОГО СТАТУСА НАСЕЛЕНИЯ ПРОМЫШЛЕННОГО РЕГИОНА

Влияние экологических факторов на организм человека реализуется в виде активации симпатического отдела вегетативной нервной системы. В статье дана комплексная оценка особенностей регуляции сердечного ритма среди населения промышленного региона.

Цель исследования. Изучение особенностей вегетативного статуса населения промышленного региона.

Материал и методы. Обследовано 129 человек промышленного региона Казахстана. Произведен анализ показателей сердечного ритма населения экологически неблагоприятного региона.

Результаты и обсуждение. Выявлено повышение тонуса симпатического отдела вегетативной нервной системы. Это свидетельствует о несовершенности и меньшей адаптированности функциональных возможностей сердца и автономных механизмов контроля его деятельности, о явном доминировании механизмов экстракардиальной регуляции сердечного ритма.

Вывод. Полученные результаты свидетельствуют, что у населения экологически неблагоприятного региона происходит кумуляция утомления и формирование переутомления в регуляции структуры сердечного ритма, о чем свидетельствует тенденция изменения всех показателей сердечного ритма в сторону активации симпатического отдела вегетативной нервной системы.

Ключевые слова: сердечно-сосудистая система, вегетативная нервная система, сердечный ритм, адаптация, функциональное напряжение.

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