ADAPTABILITY OF STUDENTS WITH DIFFERENT INDIVIDUAL AND TYPOLOGICAL PECULIARITIES OF VEGETATIVE FUNCTIONS REGULATION

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ABSTRACT

In the last decade the health of young people in Ukraine as well as in many other countries of the world significantly deteriorated according to the results of screening tests. Because of this the main task of prophylactic medicine is development and introduction of new methods of early diagnostics of diseases. The aim of the work to assess the peculiarities of adaptation of students with different types of vegetative regulation.

Material and methods: 415 second year students of Lugansk State Medical University were tested. The mechanisms of physiological functions of the body regulation were assessed by registration of cardiac rhythm variability (CRV). Analysis of CRV was performed by three methods: statistical, geometrical, and spectral analysis. The express method proposed by Shlyk, N.I. (2009) was later used to determine the prevailing type of vegetative regulation. To assess adaptability the method of R.M. Baevskij (1979) was used.

Results: In the result of investigation 4 types of functional states of regulatory systems were determined: I type – 295 (71 %) of tested, II – in 14 (3 %), III – in 96 (23 %) and IV – only in 10 (2%). I type of functional state of regulatory systems in the wakeful state at rest was characterized by moderate prevalence of central regulation of heart rhythm (MPCR), decreased activity of autonomic regulation. It was noticed that some of the parameters of CRV (like R-R, SDNN, RMSSD and pNN50) which characterize autonomic regulation, were statistically lowere ($p \le 0.01$) compared to type III, and some (like AMo and SI) higher, in both female and male students. Summarized spectrum capacity and components of its wave structure (HF, LF, VLF) which characterize central regulation were statistically significantly lower ($p \le 0.01$) for the I type of regulation compared to the III one which is characterized by moderate prevalence of autonomic regulation of the heart rhythm. In female students with type I autonomic regulation compared to male students such CRV parameters as R-R and AMo were statistically significantly lower ($p \le 0.05$), while the parameters of total potency (TP) and high frequency waves (HF) were higher ($p \le 0.05$), which could point to more centralized heart rhythm regulation in male compared to female. The evaluation of regulatory systems overstress allowed to determine the state of adaptation and risk of overstress or breakdown in students with different types of autonomic regulation.

Conclusions: Thus, evaluation of adaptation state in students with different types of autonomic regulation allows to characterize the current functional state and uncover the risk of disease development.

UDC CODE & KEYWORDS

■ UDC: 61.159.91.613.8 ■ Vegetative regulation ■ Stress ■ Adaptation state ■ Cardiac rhythm variability ■ Students

INTRODUCTION

In the last decade the health of young people in Ukraine as well as in many other countries of the world significantly deteriorated according to the results of screening tests (Zulling et al., 2005). Because of this the main task of prophylactic medicine is development and introduction of new methods of early diagnostics of diseases.

The transition from healthy state to illness is usually considered as the process of decreased adaptability to external environment changes (Stuart, 2006). That is why the questions of integral evaluation of functional capability of the organism in young people remain up to date in theory and practice of adaptation. The main target of the research is mechanisms of young people adaptation to high education (Spitsin & Spitsina, 2011).

Material and methods

The research was carried out on second year students of Lugansk State Medical University (415 people, aged 19±5 years): 174 – male and 241 female. The tested students had CRV assessed, type of autonomic regulation and level of adaptability determined. CRV was registered in supine students in the wakeful state at rest during 5 minutes. The analysis of CRV was performed by three methods. Statistically the following parameters were determined: R-R – the cardiointervals duration in msec, SDNN – summarized determinant of normal intervals R-R (NN) variability during all the period of testing in msec, RMSSD – square root of the sum of squared differences between the subsequent pairs of intervals NN in msec, pNN50 – per cent NN50 of the total amount of registered subsequent pairs of intervals which differ more than in 50 msec. Geometrical method (variational pulsometry) allowed to determine the main parameters of histogram: Mo (mode) in msec, AMo (mode magnitude) in % to selection scope, MxDMn – variation range. Stress index (SI) was evaluated: SI=AMo/2Mo* MxDMn. The results of spectral method were divided into three main spectral components by means of Fur'e transformation: HF – high frequency waves (0.4-0.15 Hz), LF – low frequency waves (0.15-0.04 Hz), VLF – very low frequency waves (0.04-0.015 Hz). For each component absolute summarized capacity in the spectrum (in msec^2) and relative value (in % of total power (TP) in all the spectrums) was calculated.

All the obtained data were processed by the method of Shlyk, N.I. which is based on the analysis of quantitative criteria of CRV parameters: SI; expressiveness of VLF spectrum capacities in the cardio-intervals picture (Shlyk, 2009). According

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to this method, the following types of regulation are determined: type I – moderate prevalence of central regulation (MPCR) with SI>100 relative units, VLF>240 msec^2; type II – significant prevalence of central regulation (SPCR) – SI>100 relative units, VLF<240 msec^2; type III – moderate prevalence of autonomic regulation (MPAR) with SI>30 and <100 relative units, VLF>240 msec^2; type VI – significant prevalence of autonomic regulation (SPAR) - SI<30 relative units and VLF>240 msec^2.

The level of adaptability was assessed with the help of proposed by R.M. Baevskij method to calculate the index of regulatory systems activity (IRSA). This method allows to determine 4 types of functional states: the state of sufficient adaptation, functional stress, insufficient adaptation (overstress) and failure of adaptation (Baevskij, 1979).

Statistical analysis of the obtained data was carried out by means of descriptive statistics and crosstabulational tables with the help of system STATISTICA 10.0 (demoversion) modules.

To assess the normality of data distribution Shapiro-Wylki coefficient was used (with p equal to 0.05). Quantitative data which didn’t have normal distribution were described with the help of median (Me) and interquartile range (25 % - 75 %). Qualitative parameters were described with the help of absolute and relative frequencies. Groups of data from independent samples were compared by calculation of nonparametric U-criterium of Mann-Witney (for quantitative parameters) and χ^2 Pirson criterium (for qualitative parameters). Confidence level was kept at 0.05 (Rebrova, 2002).

Results and their discussion

The method of Shlyk, N.I. allowed to determine all the four types of functional state of the regulatory systems: type I was found in 295 (71%) students, type II – in 14 (3%), type III – in 96 (23%) and type IV only in 10 (2%). We didn’t notice the distribution of the students between different types of vegetative regulation to be influenced by gender. Since there were very few people of types II and IV vegetative regulation we formed only two groups of tested students with type I and III. Among people with type I regulation there were 124 (71%) male and 171 (71%) female students; in the group with type III there were 40 (23%) male and 56 (23%) female students.

Type I of the functional state of regulatory systems at the state of restful wakefulness was characterized by moderate prevalence of central regulation of cardiac rhythm (MPCR) and decreased activity of autonomic contour of regulation. We noticed that some of CRV parameters (R-R, SDNN, RMSSD, pNN50) which characterize autonomic regulation was statistically significantly lower (p≤0.01) compared to type III, while some (AMo and SI) were higher, in both male and female students (Tab.1).

It’s important to notice that in females with type I regulation compared to males such CRV parameters as R-R and AMo were statistically significantly lower (p≤0.05), while total potency (TP) and high frequency waves (HF) were higher which may point out to more significant centralization in heart rhythm regulation in males compared to females.

Table 1 : The parameters of variability of cardiac rhythm in different types of autonomic regulation of heart rhythm

Parameters	Types of regulation (male)		Types of regulation (female)	
	I (n=124)	III (n=40)	I (n=171)	III (n=56)
	Me (25%-75%)	Me (25%-75%)	Me (25%-75%)	Me (25%-75%)
The average value of interval duration	876.3 (777.5-921.6)	916.5 (858-1068)*	804.2 (715.9-878.2)**	906 (869-961)*
Standard deviation of the full set of cardio intervals, мsec	51.9 (41.9-60.6)	89.8 (79.6-96.8)*	53.7 (44.6-66.0)	85.2 (73.8-91.0)*
The square root of the sum differences of consecutive series of cardio intervals, мsec	44.75 (33.8-57.2)	88.4 (76.0-108.1)*	46.4 (33.5-55.7)	84.1 (72.8-102.7)*
The number of pairs cardio intervals with a difference of more than 50 msec % to the total number of cardio intervals in a set	23.5 (7.7-35.3)	49.3 (39.1-55.8)*	24.6 (10.5-37.4)	48.8 (37.1-57.7)*
Mode amplitude, %	38.9 (34.0-49.5)	27.4 (24.7-29.3)*	36.3 (30.5-42.8)**	27.6 (23.1-30.8)*
Stress index	203.2 (145.5-322.3)	67.5 (58.1-79.3)*	187.5 (140.3-301.7)	71.3 (63.3-91.2)*
Total power spectrum, мsec^2	1986 (1322-2607)	5957 (3800-6883)*	2299 (1453-3556)**	5080 (2998-7065)*
Total power spectrum of high-frequency component, мsec^2	482 (310-728)	1726 (1276-3294)*	631 (377-920)**	1754 (882-2014)*
Total power spectrum of low-frequency component, мsec^2	621 (434-987)	1727 (1168-2547)*	746 (460-992)	1494 (10,2-2760)*
Total power spectrum of very low-frequency component, мsec^2	711 (428-1049)	1353 (865-1979)*	815 (458-1428)	1247 (816-2116)*
Note: * – statistically valuable differences (p≤0.01) of parameters compared to type I regulation, ** – statistically valuable differences (p≤0.05) of female parameters compared to male parameters.				

Source: Authors

Summarized spectrum capacity and components of its wave structure (HF, LF, VLF) which characterize central regulation were statistically significantly lower ($p \leq 0.01$) for the I type of regulation compared to the III one which is characterized by moderate prevalence of autonomic regulation of the heart rhythm (MPAR). It is also important to note that the components of very low diapason prevailed in the structure of CRV spectrum for the I type of regulation, while high frequency waves prevailed in the III type (Figure 1, 2).

Figure 1: The structure of the spectrum of cardiac rhythm waves potency in different types of vegetative regulation of cardiac rhythm (I and III) in male students

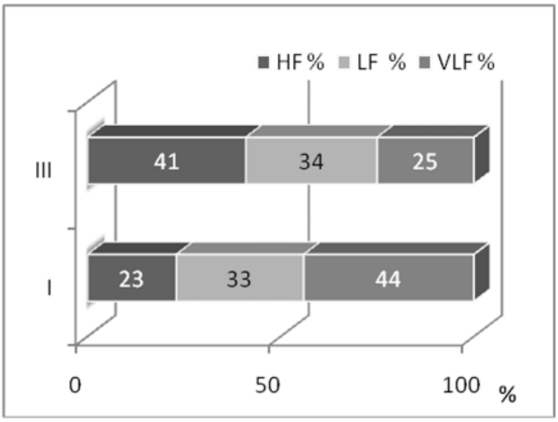
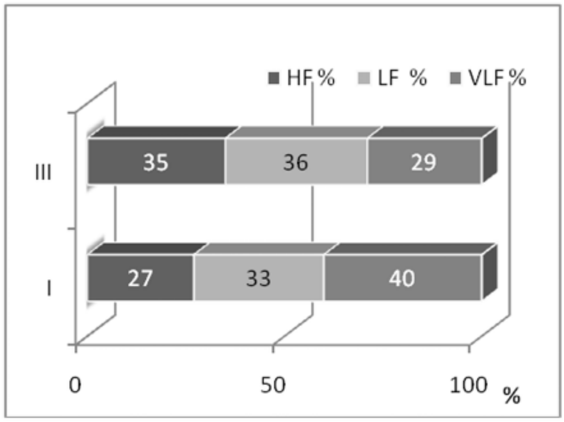


Figure 2: The structure of the spectrum of cardiac rhythm waves potency in different types of vegetative regulation of cardiac rhythm (I and III) in female students

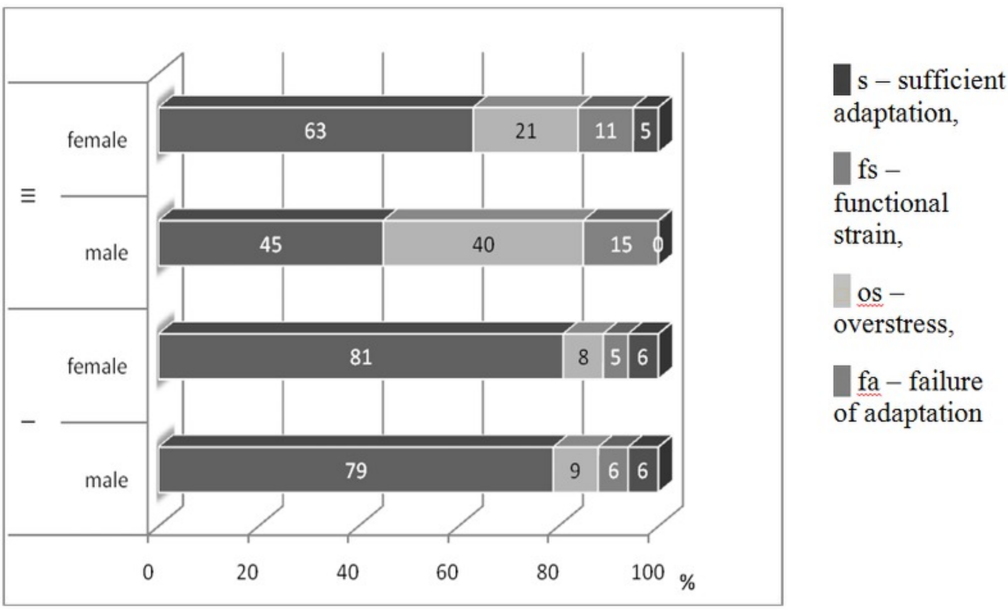


HF - % of high frequency waves, LF - % of low frequency waves, VLF - % of very low frequency waves
Source: Authors (2014)

Thus: the majority of students (about 70%) showed moderate prevalence of sympathetic and central regulation of cardiac rhythm, decreased activity of autonomic contour of regulation, moderate strain of regulatory systems of the body. In some students (23%) on the contrary we noticed moderate prevalence of parasympathetic activity and optimal state of regulatory systems of the body. Only in 7% of students functional state of regulatory systems was decreased. They showed vegetative dysfunction with the prevalence of either sympathetic (3.5%), or parasympathetic (2.5%) regulation.

Method of R.M. Baevskij allowed to refer the results to 4 types of functional states. Sufficient adaptation was characteristic for the students with type I regulation (98 male – 79 %; 139 female – 81 %), functional strain was found in 10% of all the tested students (10 male – 9 %; 14 female – 8 %), the rest had either overstress (8 male – 6%; 8 female – 5%) or failure of adaptation (8 male – 6%; 10 female – 6%). The tested students with type III regulation had sufficient adaptation (18 male – 45%; 35 female – 63%), functional strain was found in both male (16 people – 40%) and female (12 people – 21%), overstress was seen in 6 (15%) male and 6 (11%) female, adaptation failure - only in 3 female (5%) (Figure 3).

Figure 3: Distribution of male and female with different types of vegetative regulation prevalence (I, III) according to their level of functional state



Source: Authors

Thus, we can suspect that the risk of overstress of adaptation is more characteristic for the type III of vegetative regulation.

Conclusion

The majority of students were characterized by type I of cardiac rhythm vegetative regulation with moderate prevalence of central contour of regulation which was more definite in male students compared to female. 80% of students in this group had sufficient level of adaptation.

The state of functional strain was most often found in people with type III of vegetative regulation (40% male and 21% female).

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