

Age features of heart rate variability at mental workload

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Heart rate variability (HRV) is an indicator of autonomic nervous system function that shows the balance between the sympathetic and parasympathetic nervous inputs into the heart. At the same time HRV reflects the functional state of all organism. Chronological age is inversely related to autonomic modulation of heart rate: older people have reduced HRV [2,3]. Acute periods of mental effort also result changes of HRV [1,5].

The aim of the present study was to examine the features of the HRV in three age groups at rest, during the short-term mental effort and after it.

Methods: we assessed 45 healthy participants. The age range of the first group of participants was 17-21 years (15 subjects), the second group's-22-35 years(15 subjects) and the third group's-36-60 years (15 subjects).

Electrocardiograph (ECG) data were collected at rest (5 min), during 7 min of the mental workload (computerized testing demanding the mental effort) and after it (5 min). The mean (RR), standard deviation (SDRR) and stress index (SI) were estimated.

Also the spectral components LF (0.04-0.15 Hz), HF (0.15-0.40 Hz) of RR intervals from ECG obtained by means of fast Fourier transformation were considered. The spectral powers of components were estimated. Not only absolute values of spectral powers of components, but also relative values calculated from TP were examined. The low/high-frequency power ratio LF/HF as the index of sympathovagal balance and the index of activity of regulatory systems (IARS) were assessed. The definitions of the HRV measures for short term recordings by the Task Force of the European Society of Cardiology and the North American Society of Pacing Electrophysiology [4] were adopted with slight modifications.

Statistical analyses were performed with MS Excel 2010. The level of significance between groups was tested by the unpaired t-test.

Results: the results of study showed that the changes of HRV measures for all age groups had the same tendency. Before the testing (during relative rest) some tension of regulatory system of cardiovascular system was observed. During the mental workload the changes of measures indicative of growth of tension of regulatory system were revealed. So in the 1st group Mx and SD decreased by 1,7 % and 12,5%, in the 2nd group-by 1,2 % and 12 % and in the 3rd group-by 2,4% and 14% respectively. At the same time in the 3rd group SD was less than in the 1st and in the 2nd groups during all 3 phases of study. After the mental workload the recovery of these parameters occurred more effectively in the 2nd group. In all three groups significant ($p < 0,05$) increase of SI during the testing was noted. So in the 1st group SI increased by 18%, in the 2nd group-by 22% and in the 3rd group-by 26%. After the mental workload values of SI practically reached baseline values in all three groups. It is noteworthy that in the 1st and in the 2nd groups the increasing of SI was within the norm. In the 3rd SI on all three stages of the study was above norm, indicating of substantial tension of the regulatory mechanisms of cardiovascular system.

Natural changes were observed in the spectral analysis. At rest, there was a partial domination of HF component in all groups. During the test, the LF component prevailed reflecting a moderate tension of regulatory systems. That was evidenced by increasing in the values of the

ratio LF/HF and IARS. After the mental workload decrease of the LF component and the dominance of HF component in the total spectrum of power were observed. Notably there was decreasing of tension of the regulatory systems, decentralization and activation of autonomic circuit of regulation in recovery period. Some differences between age groups were revealed. Compared with the 1st and the 3rd groups in the 2nd group feebly marked tension of regulatory systems was mentioned during the testing. They also had more effective recovery. In the 3rd the reverse tendency was observed. In all probability this is due to weak adaptive capabilities of the subjects in this group.

Thus, in every age group both general patterns, and peculiarities in the mechanisms of regulation of adaptive reactions of the heart were identified. For all subjects in a varying degree the tension of central regulatory mechanisms of the heart during the mental workload is typical. The most favorable nature of the adaptive reactions in middle-aged adults is observed. In young men and elderly the adaptation reactions often are characterized by a high degree of tension of central regulatory mechanisms.

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