Article

Influence of self-regulation breathing techniques on spectral indicators of heart rate variability in men students.

Voronin R.M. [1,*], Semenov U.N.[2]

[1] Ryazan State Medical University named after Academician I.P. Pavlova, Ryazan, Russia;
[2] Institute for the Implementation of New Medical Technologies "Ramena", Ryazan, Russia;
* Correspondence: XXXX@gmail.com; Tel.: +XXX XXX XXX XXX;
XXXX@gmail.com, https://orcid.org/0000-0001-6134-3080 (F.N.L.N.);
XXXX@gmail.com, https://orcid.org/0000-0001-6134-3080 (F.A.);
XXXX@gmail.com, https://orcid.org/0000-0001-6134-3080 (S.A.);
XXXX@gmail.com, https://orcid.org/0000-0001-6134-3080 (T.A.).

Abstract: The purpose of the study was to study the influence of respiratory psychotechniques on the spectral indices of cadets' heart rate variability.

Materials and methods: 21 men aged 18-20 were examined. The standard method of breathing exercises was used, which is used in the training of mental self-regulation in the preparation of employees of the penitentiary system, during which, for 5 minutes, a gradual lengthening of the expiratory phase occurs. Using the hardware-software complex "Varicard 2.6", a 5-minute cardiointervalometry was performed before and after breathing exercises.

Results. There was a decrease in the high frequency component (High Frequency - HF) (at rest - 25.76 ± 4.85 ms, after breathing exercises - 20.04 ± 3.74 ms, $p < 0.01$), an increase in the low frequency (Low Frequency - LF) (at rest - 29.97 ± 3.21 ms, after exercise - 38.48 ± 5.12 ms, $p < 0.05$). The very low frequency spectral component (Very Low Frequency - VLF) did not change (at rest - 18.00 ± 2.63 ms, after breathing exercises - 18.53 ± 2.31 ms, $p > 0.05$). It should be noted that the total power (Total power - TP) in the HF, LF, VLF ranges also did not change statistically significantly (47.44 ± 5.49 ms at rest, 51.51 ± 6.05 ms after exercise, $p > 0.05$).

Conclusion: Respiratory exercises, characterized by an increase in the duration of exhalation in relation to the physiological norm, do not affect the heart rate, but lead to statistically significant changes in the spectral parameters of heart rate variability. The dynamics of HRV spectral parameters after exercise exposure is characterized by a decrease in high-frequency components (HF), and an increase in low-frequency components (LF). The indicators of the very low-frequency components of the spectrum (VLF) do not change statistically significantly. Indicators of the total spectrum power (TP) after exercise do not change, which is associated with a proportional change in the values of high-frequency (HF) and low-frequency (LF) components relative to each other.

Keywords: breathing techniques, mental self-regulation, spectral indices of heart rate variability, cadets.

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1. Introduction

At present, the role of psychological support for the professional activities of employees of law enforcement agencies has significantly increased, the most important component of which is the use of self-regulation methods. At the same time, when introducing these methods into practice, certain difficulties arise, often associated with the lack of objective criteria for assessing their impact on the human body.

The purpose of the study is to study the influence of respiratory psychotechniques on the spectral parameters of cadets' heart rate variability.

2. Patients and Methods

21 male students aged 18-20 were examined. The standard method of breathing exercises [2] was used, which is used in the training of mental self-regulation in the preparation of employees of the penitentiary system [1], during which, for 5 minutes, a gradual lengthening of the expiratory phase occurs. Using the hardware-software complex "Varicard 2.6", a 5-minute cardiointervalometry was performed before and after breathing exercises. The results were processed by the statistical package "Statistika 6". In order to normalize the distribution of the obtained data, their preliminary mathematical transformation (square root extraction) was carried out. Statistically significant differences were confirmed by Student's test for dependent samples.

3. Results and Discussion

It should be noted that studies on the effect of breathing exercises on heart rate variability (HRV) are very fragmented and are mainly devoted to studying the relationship between respiratory rate and HRV [4]. In our study, the influence of the ratio of inhalation-exhalation phases on HRV was assessed in the framework of the standard method of breathing exercises.

The results of the study showed that the heart rate (HR) did not change statistically significantly after performing breathing exercises. At rest, the heart rate was 77.09 ± 4.07 beats per minute, after exercise it was 78.64 ± 3.52 beats per minute ($p > 0.05$). At the same time, when analyzing the dynamics of HRV spectral indicators, statistically significant changes were revealed. For statistical studies of power indicators TP, HF, LF, VLF by parametric methods, their radical expressions were used. Thus, there was a decrease in the high frequency component (High Frequency - HF) (at rest - 25.76 ± 4.85 ms, after breathing exercises - 20.04 ± 3.74 ms, $p < 0.01$), an increase in the low frequency (Low Frequency - LF) (at rest - 29.97 ± 3.21 ms, after exercise - 38.48 ± 5.12 ms, $p < 0.05$). The very low frequency spectral component (Very Low Frequency - VLF) did not change (at rest - 18.00 ± 2.63 ms, after breathing exercises - 18.53 ± 2.31 ms, $p > 0.05$). It should be noted that the total power (Total power - TP) in the HF, LF, VLF ranges also did not change statistically significantly (47.44 ± 5.49 ms at rest, 51.51 ± 6.05 ms after exercise, $p > 0.05$).

Certain changes in HRV after breathing exercises were quite expected, since fluctuations in the high frequency range are closely related to the act of breathing and reflect respiratory sinus arrhythmia (RSA). Given that RSA is modulated by n. vagus, then the high-frequency component of HRV is a reflection of parasympathetic influences. At the same time, the presence of individual differences observed in various breathing patterns suggests that changes in spectral parameters are caused not only by the processes of autonomous regulation. In particular, significant changes in low-frequency HRV, observed after breathing exercises, are associated by some researchers with the resonant characteristics of the cardiovascular system, which affect the final result of the combined action of RSA and baroreflexes [3, 4].

4. Conclusions

1. The breathing exercises used in our study, characterized by an increase in the duration of exhalation in relation to the physiological norm, do not affect the heart rate, but lead to statistically significant changes in the spectral parameters of heart rate variability.

2. The dynamics of the HRV spectral parameters after the impact of exercises is characterized by a decrease in high-frequency components (HF), an increase in low-frequency components (LF). The indicators of the very low-frequency components of the spectrum (VLF) do not change statistically significantly.

3. Indicators of the total spectrum power (TP) after exercise do not change, which is associated with a proportional change in the values of high-frequency (HF) and low-frequency (LF) components relative to each other.

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