ABSTRACT

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Peculiarities of Changes in Respiratory Variability under the Influence of Training Load in Athletes with Cardiovascular Overstrain by Sympathetic Type

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Background:
Taking into account the respiratory system state is an important criterion for evaluation of the cardiorespiratory system in athletes. An informative indicator is the minute tidal volume, which is defined as the product of respiratory rate and tidal volume. However, its informativeness is limited, because it does not take into consideration the rhythmic characteristics of spontaneous respiration, which according to many scientists determine the regulatory effects on external respiration, taking into account the activity of chemo- and mechanoreceptors.
The aim of the study was to determine changes in respiratory variability by short measurements of highly qualified athletes with overstrain of the cardiovascular system by the sympathetic type under the influence of intense training load.

Methods:
202 highly qualified athletes of different sports aged 22.6±2.8 years before (S_1), after (S_2) and the next morning after intensive training (S_3) were examined, which in general formed a comparison group (CG).
The study of the respiratory system was performed for 2 minutes with an ultrasonic spirometer, which is the part of the device spiroarteriocardiorhythmograph (SACR).
The parameters of the respiratory variability (RV) were determined: TP_R, $(l/min)^2$ – total power of the variability spectrum, VLF_R, $(l/min)^2$ – power in the very low frequency range, LF_R, $(l/min)^2$ – power in the low frequency range and HF_R, $(l/min)^2$ – power in the high frequency range, which, according to heart rate variability, are associated with the activity of different parts of the autonomic nervous system.
It was shown that among 202 surveyed athletes in 10 according to the heart rate variability in the dynamics of recovery after intense exercise there was an overstrain of autonomic regulation of the cardiovascular system by sympathetic type.
These athletes formed an observation group (OG).

Results:
Having analyzed the changes in the indicators of RV in OG in comparison with CG, it should be noted that at S_1 in OG there were higher values of TP_R, $(l/min)^2$ – 625 (269; 740) against 328 (210; 538), $p<0.05$; VLF_R, $(l/min)^2$ – 4.0 (3.6; 4.8) against 2.0 (1.0; 3.6), $p<0.05$ and HF_R, $(l/min)^2$ – 548 (231; 610) against 243 (149; 441), $p<0.05$. It showed bigger regulatory exertion of external breathing in OG. At S_2, all differences between OG and CG were leveled and equalized for average values. This reflects the characteristic regulatory changes of spontaneous respiration under the influence of intense physical activity.
At S_3 the indicator TP_R $(l/min)^2$ in OG decreased significantly in comparison with S_1 and S_2 – 392 (320; 600), $p<0.05$, however it was higher, than in CG – 303 (180; 458), $p<0.05$. Such differences were noted due to more significant predominance of LF_R, $(l/min)^2$ in OG – 56.5 (5.3; 108.2) versus 24.7 (6.8; 84.6) at S_2 and 13.0 (7.8; 62.4) at S_1, and also against S_3 in CG – 13.7 (6.5; 70.6), $p<0.05$. The indicator HF_R $(l/min)^2$, which did not differ from CG in S_3, was substantially lower than in S_1, which showed a significant decrease in high-frequency regulatory effects on spontaneous respiration.

Conclusions:
The dynamics of changes in the respiratory variability by short measurements of athletes with overstrains of the cardiovascular system by the sympathetic type suggests that the regulatory effects on spontaneous respiration determine the overstrain development of autonomic regulation of the cardiovascular system. This is confirmed by significant differences between low-frequency and high-frequency regulatory effects on spontaneous respiration.

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