DOCTORAL THESIS

The effect of ventilatory muscle loading on heavy intermittent exercise sustainability

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The Effect of Ventilatory Muscle Loading on Heavy Intermittent Exercise Sustainability

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Abstract

This study was designed to investigate the reserve of individuals' tolerances of global ventilatory muscle (VM) fatigue, sensation of breathlessness and metabolic stress for sustaining heavy intermittent exercise at exhaustion. The reserve of tolerances was identified by examining the effect of modest inspiratory resistive load-induced augmentation of VM work on global VM strength, intensity of breathlessness and metabolic stress level during the exercise and their contributions to the VM load-induced change in the exercise sustainability (Ex_{sus}). Seven males (21.6 $\pm$1.0 years) performed 12-sec exercise at 160% maximum aerobic power output intermittently with passive recovery at 18-sec intervals under normal and loaded (VML) breathing conditions until exhaustion. In the VML trial, VM work at exhaustion was increased 200.4 $\pm$31.4% from control. Global VM strength was maintained in most subjects and a reduction of 31.7 $\pm$6.6% was found in control Ex_{sus}. It was also found that the slope of time course for the rating of perceived magnitude of breathing effort (RPMBE/Time), which reflected the individuals' intensity of breathlessness, was increased by 164.8 $\pm$32.2% over control while the RPMBE at exhaustion was higher (144.4 $\pm$21.8%) than the value at the iso-time point of the control trial. Plasma ammonia and uric acid accumulations, which were indicative of metabolic stress level, increased 168.1 $\pm$28.0% and 251.7 $\pm$57.4%, respectively, with no change in total $\dot{V}O_2$ when the control exercise was repeated with identical VML exercise duration. Furthermore, the subjects' percent change in Ex_{sus} was correlated to their percent changes in RPMBE/Time (r = 0.81) and RPMBE (r = 0.97) but not to those in metabolite accumulations. In conclusion, the augmented metabolic stress might contribute to the impairment of Ex_{sus}. However, the VML-induced augmentation of the sensation of breathlessness was the dominant factor. Such findings implied that there was no substantial reserve of tolerance of sensation of breathlessness in comparison with that of global VM fatigue and metabolic stress in subjects exposed to heavy intermittent exercise at exhaustion.

Keywords: Inspiratory resistive loading, sensation of breathlessness, metabolic stress, global ventilatory muscle fatigue

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