ALTERATIONS OF NEUROMUSCULAR FUNCTION AFTER A 5000-m TRACK RUNNING
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Introduction: Studies dedicated to long-distance running have shown that alteration in peripheral processes (i.e. neuromuscular propagation, excitation-contraction coupling, myofibrillar activity) are likely to contribute to strength loss, even if central fatigue is probably the main cause. However, there is a paucity of data regarding mechanisms (peripheral and central origin) involved in alteration of neuromuscular function after short-term running exercises. The aim of this study was therefore to characterize neuromuscular fatigue in plantar flexor muscles after a 5000-m track running.

Methods: Before and immediately after a 5000-m self-paced running exercise (mean performance: \( \sim 17 \) min 30 s) performed on a 200-m indoor track, maximal percutaneous electrical stimulations (model DS-7, Digitimer Stimulator, UK) were applied to the tibial nerve of 11 trained triathletes. To examine potential impairment in central drive, changes in soleus EMG activity normalized to M-wave amplitude (RMS/M) as well as muscle activation (VA) were quantified during maximal voluntary contraction (MVC) of plantar flexor muscles. Motoneuron pool excitability was measured by the soleus maximal Hoffman reflex, which was expressed as a ratio (H/M ratio) of the maximal electrically stimulated muscle action potential (M-wave). Peripheral fatigue was assessed by examining the characteristics of the M-wave (i.e. amplitude) of the soleus muscle (MP30, Biopac, CA) and the twitch contractile properties (i.e. peak twitch, twitch contraction time, half relaxation time). The torque and EMG data were recorded (2000 Hz) with commercially available software (Acknowledge 3.6.7, Biopac, CA).

Results: MVC declined (107.5 \( \pm \) 41.3 vs. 77.7 \( \pm \) 27.2 N.m, \( P < 0.001; -27\% \)) after the run and this was accompanied by an impairment of central activation, as attested by decline in VA (92.7 \( \pm \) 15.8 vs. 85.6 \( \pm \) 19.0\%, \( P < 0.05 \)) and RMS/M (\( P < 0.05 \)). Significant reduction in the H/M ratio (at rest: 56.2 \( \pm \) 14.2 vs. 32.4 \( \pm \) 19.1\%, \( P < 0.01 \); during MVC: 51.9 \( \pm \) 20.0 vs. 35.4 \( \pm \) 16.9\%, \( P < 0.05 \) ) occurred with fatigue. Following exercise, the single twitch was characterized by lower peak torque (-16\%; \( P < 0.001 \)) as well as shorter contraction (-19\%; \( P < 0.001 \)) and half-relaxation (-24\%; \( P < 0.001 \)) times. In the fatigued state, amplitude of the M-wave (9.6 \( \pm \) 13.2 vs. 8.2 \( \pm \) 3.1 mV, \( P < 0.05; -14\% \)) was significantly reduced.

Discussion/Conclusions: A 5000-m run resulted in fatigue attributable to both peripheral and central factors. At the peripheral level, alterations in muscle action potential transmission and excitation-contraction coupling properties are probable mechanisms contributing to the impairment of the neuromuscular function. The most obvious alteration in central nervous function might come from a modulation of spinal loop properties. This result emphasizes the possible role of the peripheral reflex pathways as a possible origin of the reduction in central efferent neural command.

Keywords: Running, Electromyography, Fatigue

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