Abstract

Title: Physiological responses on standardized climbing task in sport climbers

Purpose: To determine the effect of height, wall angle, climbing speed and climbing ability on physiological responses in sport climbers.

Methods: The study was divided into three parts. 75 sport climbers (36 female and 39 male) completed differing tests on climbing wall and motorized climbing ergometer. Perceived exertion was assessed on a scale suggested by Borg. Indirect calorimetry, venous blood samples and near-infrared spectroscopy were used to assess physiological response, hormonal response and muscle oxygen saturation, respectively.

Results: Perceived exertions were higher when climbing to height as opposes to climbing low to the ground on the treadwall (+5,3%; P = 0,013; η_p^2 = 0,149) (Study 1A). The physiological response was higher on the climbing wall as opposed to the treadwall: $\dot{V}O_2$ (+6%; P = 0,03; η_p^2 = 0,22), SF (+4%; P = 0,04; η_p^2 = 0,20), $\dot{V}E$ (+9%; P = 0,01; η_p^2 = 0,30) a EC (+16%; P < 0,001; η_p^2 = 0,48). There was an interaction for climbing ability and post-climbing catecholamine concentration (P < 0,01, η_p^2 = 0,28) (Study 1B). With increasing climbing speed greater differences were found for $\dot{V}O_2$ (P < 0,001, η_p^2 = 0,923) than for StO_2 (P < 0,001, η_p^2 = 0,448). Between-subject effect suggest that localized muscle oxygenation (StO_2, P = 0,001, η_p^2 = 0,296, ΔStO_2, P = 0,017, η_p^2 = 0,177) rather than systemic oxygen response $\dot{V}O_2$ (P = 0,093, η_p^2 = 0,151) distinguished the ability groups during steady state

climbing task (Study 2). Muscle oxygen breakpoint (MOB) was identifiable during incremental climbing test to exhaustion (Study 3).

Conclusion: Climbers are exposed to greater mental and metabolic stress during climbing high above the ground and the load is perceived as more demanding compared to climbing low above the ground. Climbing speed is the primary factor that affects the system $\dot{V}O_2$, the effect on local StO2 is conditioned by the performance level of the climber. On the other hand, increasing the difficulty with the slope of the climbing wall leads to a sharp decrease in StO_2, systemic $\dot{V}O_2$ does not reach the values typical for climbing at higher speeds. Local oxygen consumption at submaximal exercise is a sensitive indicator capable to distinguish climbing ability level, and near-infrared spectroscopy can be used to detect local metabolic zones.

Keywords: energy cost, oxygen uptake, heart rate, near-infrared spectroscopy