

人の熱放散反応を改善する可能性がある温度以外への入力

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The Possible Role of Nonthermal Factors in Improving the Heat Loss Response in Humans

by

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ABSTRACT

Nonthermal factors for control of heat loss during exercise are suggested to be one of the mechanisms that improve the heat loss response in humans with physical training. The purpose of this study was to investigate the relationship between the magnitude of the nonthermal factors and the heat loss response. Eight healthy male subjects participated in this study. They performed an isometric handgrip (IH) exercise for 60 sec at four different intensities (15, 30, 45, and 60% of maximal voluntary contraction – MVC) at an ambient temperature of 35°C and

a relative humidity of 50%. Esophageal temperature and mean skin temperature did not change with the rise in exercise intensity and were similar at all exercise intensities, while the heart rate (HR), rating of perceived effort (RPE), and mean arterial pressure (MAP) all increased with intensity. The sweating rate (SR) on the chest, and the right and left forearm and palm increased with the rise in intensity, although the pattern of the change in SR on the palm differed from that on the other body sites. The SR on the chest and forearm were significantly above the pre-exercise level when the exercise intensity was 30% MVC or more, while the change in SR on the palm was significantly increased at 45% MVC or more. The skin blood flow (SkBF) and cutaneous vascular conductance (CVC) on the chest and left forearm increased with exercise intensity, although the differences in CVC with exercise intensity were not marked. Furthermore, the SkBF and CVC at both these sites did not change significantly from the level at 15% MVC. The results indicate that nonthermal factors cause the changes in the heat loss response with a rise in IH exercise. These responses were induced at intensities of 30% MVC or more, although the heat loss response was greater with a rise in the magnitude of the nonthermal factors.

要 旨

運動に伴う身体トレーニングが熱放散反応を改善する仕組みとして、体温などの要因以外に非温熱性要因の入力も関係している可能性がある。本研究ではその入力の大きさと熱放散反応の変化との関係を検討した。被験者は健康な男子学生8名であり、環境温35℃、相対湿度50%の環境制御室内で最大等尺性筋収縮力(MVC)の15、30、45および60%の強度のアイソメトリックハンドグリップ(IH)運動を60秒間実施した。IH運動強度の増加とともに、心拍数、自覚的運動強度および平均血圧は増加したが、食道温および平均皮膚温はいずれの運動中も一定の値を示した。胸部、左右前腕部および手掌部の発汗量(SR)は強度の変化とともに増加したが、その増加の仕方は手掌部SRと他の部位のSRでは異なっていた。胸部と前腕部SRでは30%MVC以上の運動強度で手掌部SRでは45%MVC以上の運動強度で、それぞれ顕著な増加を示した。胸部および左前腕部の

皮膚血流量(SkBF)と皮膚血管コンダクタンス(CVC)は運動強度の変化とともに増加したが、CVCの増加は運動強度間で顕著な差は認められなかった。また、いずれもSRと同様に15%MVCでは顕著な増加を示さなかった。以上のことより、IH運動中に起こる熱放散反応は主に非温熱性要因が関与していると考えられる。非温熱性要因の大きさとともに熱放散反応も増大するが、顕著な熱放散反応を引き起こすためには30%MVC以上の強度の運動が必要であると考えられる。