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The production of sweat as measured by galvanic skin conductance, epidermal hydration and regional sweat rate

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Introduction

Galvanic skin conductance (GSC) increases prior to sweat reaching the skin surface [1], indicating pre-secretory sweat gland activity. Sweat travels through the duct and penetrates the stratum corneum (SC) causing epidermal hydration (HYD). Boucsein [2] claimed that SC hydrates first before sweat is released onto the skin surface. GSC is influenced by sweat within the glands, HYD and sweat on the skin surface [3]. The aim of this experiment is to determine the extent to which these contribute to the value of GSC.

Methods

Eight males (183 ± 4 cm, 80.1 ± 9.6 kg, 26 ± 4 y, 54.9 ± 3.5 mL·kg⁻¹·min⁻¹) volunteered in a protocol that aimed to slowly increase sweat production. Regional sweat rate (RSR) using absorbent pad technique [4], HYD (Moisture Meter) and change in GSC (Δ GSC) (biopac) were measured at the scapula, chest, arm and thigh. Participants were exposed to 10 minutes rest in a neutral room (23.4 ± 0.5°C, 50.0 ± 4.7% RH), followed by 60 minutes of heat exposure (30.1 ± 1.0°C, 30.0 ± 4.7% RH). Heat exposure comprised of 10 minutes rest and 50 minutes incremental exercise (30, 50 and 70% $\dot{V}O_{2max}$) on a treadmill.

Results

Increases in Δ GSC (0.49 ± 0.54 to 1.12 ± 0.97 μ S, $p < 0.05$) and HYD (4.11 ± 4.8 to 9.9 ± 10.8 AU) occurred with heat exposure, prior to an increase in RSR at all locations. A ceiling effect was observed in HYD, after which Δ GSC and RSR significantly increased ($p < 0.05$). Significant correlations were observed between Δ GSC and RSR ($r^2 > 0.80$, $p < 0.05$) during heat exposure but interestingly areas of high RSR did not correspond with the highest Δ GSC or HYD.

Discussion

Conflicting Boucsein's claim, it was found that during epidermal hydration, sweat is released slowly onto the skin surface, indicating that the epidermis does not have to be maximally hydrated for the appearance of surface sweat. However, the epidermis appears to have a maximal hydration level, after which RSR markedly increase. Upon maximal hydration, Δ GSC is predominately influenced by surface sweat. Gerrett (unpublished data) found that only the sweat that is in direct contact with the electrode influences Δ GSC.

References

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