Non-thermal mechanisms may modulate novel high-amplitude oscillations in skin blood flow

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We have recently described the presence of high-amplitude oscillations in thigh skin blood flow (SkBF) during whole body heating[1] (40°C), and we believe this phenomenon has not previously been reported. These oscillations (~0.4 Hz) spanned ~700-800 ms, and were comprised of high-amplitude peaks (~1500 AU) arising from a stable baseline (~200 AU). However, they where not present under basal conditions (28°C). We hypothesised that alterations in skin and core temperature were contributing to these oscillations, with results from animal experiments[2] indicating a dominant role for elevated skin temperature. We report here additional evidence, which is consistent with an important role of changes in transmural pressure.

Forearm SkBF was measured in ten males (29.4 yr (SD 9.9), 184.1 cm (SD 8.0), 80.35 kg (SD 11.34): during semi-recumbent rest at 25°C (50% R.H.). Using laser-Doppler flowmetry (20 Hz; TSI Laserflo BPM2, Vasamedics Inc., U.S.A.), SkBF (arbitrary units; AU) was determined over a 5-min period . Oesophageal (T_{es}), mean skin temperature (9 sites: meanT_{sk}), skin temperature at the site of SkBF measurement (T_{loc}), and cardiac frequency (f_c) were measured (0.2Hz). Data are means ± SE.

At rest, T_{es} averaged 37.0°C ± 0.1, meanT_{sk}= 32.5 ± 0.2, T_{loc} = 32.5 ± 0.3, f_c= 67.7 ± 4.1 b•min^{-1}, and SkBF was 292.6 ± 27.8 AU. The high-amplitude oscillations in SkBF, were present in all subjects and had an amplitude of 560.9 ± 59.6 AU, extending from a stable baseline flow (110.2 ± 19.2 AU). These oscillations occurred at 0.59 ± 0.04 Hz and each spanned 741.5 ± 17.3 ms, and are similar to those seen under hyperthermic conditions.

These results are consistent with the possibility that non-thermal mechanisms may induce these oscillations. We suggest that mechanisms contributing to the high-amplitude oscillations are consistent with a collapsible tube model of the conducting vessels, in which combinations of internal pressure, vessel tone and external pressure give rise to self-excited oscillations in flow. Differences in intravascular hydrostatic pressure, associated with the dependency of the test limb (thigh) in the previous experiments may explain the absence of oscillations. We are currently exploring ways to modify transmural pressure as a means to test this hypothesis.

(1) Haley C.D., Zeyl, A., Taylor, N.A.S., and Jenkins, A.B. (2004). Novel, high-amplitude blood-flow oscillations in vasodilating human skin. Journal Thermal Biology. In press.

(2) Haley C.D., Gordon, C.J., Taylor, N.A.S., and Jenkins, A.B. (2004). Investigating high-amplitude oscillations in rat tail skin blood flow during core heating and cooling. Journal Thermal Biology. In press.