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Tissue oxygen supply determined by Microvascular Oxygen Saturation (SO₂), Blood Flow (BF) and subcutaneous Tissue pO₂ (PsqO₂) during whole Body Heating and Normobaric Hyperoxia in healthy Volunteers

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Objectives: To compare microvascular oxygen saturation (SO₂), blood flow (BF) and subcutaneous oxygen partial pressure (PsqO₂) measured by tissue spectrophotometry, laser Doppler flowmetry and subcutaneous pO₂ electrode as parameters for tissue oxygen supply during whole body heating and normobaric hyperoxia in healthy volunteers.

Methods: In six healthy volunteers (age 25 ± 3, 1 male, 5 female) a fiber optic probe for measurement of SO₂ and one probe for measurement of BF was attached to the forearm with a tape. Subsequently a silastic tube was placed subcutaneously close to the other probes and a Clark-type electrode was inserted for measurement of PsqO₂. At first body temperature was increased by whole body warming with a warming blanket up to 37°C local skin temperature and SO₂, BF and PsqO₂ was measured in five minute intervals for an hour. After a resting period of ten minutes volunteers started breathing 100% oxygen through a mask and SO₂, BF and PsqO₂ were measured each five minutes for 15 minutes.

Results: Linear regression analysis showed a significant correlation (p<0.005) for changes of SO₂, BF and PsqO₂ during whole body heating (r=0.72 to 93). No correlation was found between SO₂ and PsqO₂ during administration of 100% oxygen. Whereas PsqO₂ increased (to 2.06 +/- 1.00 of baseline value), SO₂ was not altered (to 1.04 +/- 0.07 of baseline value) and BF decreased (to 0.79 +/- 0.19 of baseline value).

Conclusions: During hyperthermia oxygen delivery to tissue is increased resulting in increased SO₂, BF and PsqO₂. During normobaric hyperoxia decrease in BF and stable SO₂ indicates stable oxygen delivery to tissue, whereas increase of PsqO₂ indicates increased oxygen delivery. Reasons for the discrepancy between SO₂ and PsqO₂ might be, that capillary-venous oxygen saturation, reflected by SO₂, is not measurably increased, as total oxygen delivery to tissue during normobaric hyperoxia is not increased (BF decreases and low amount of physically dissolved oxygen), whereas PsqO₂ is increased, as it is biased by disproportionately high arterial pO₂.