Convective and diffusive O₂ transport components of peak oxygen uptake following long-duration spaceflight

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Spaceflight reduces aerobic capacity and may be linked with maladaptations in the O₂ transport pathway. The aim was to 1) evaluate the cardiorespiratory adaptations following 6 months aboard the International Space Station and 2) model the contributions of convective (Qₐₒ₂) and peripheral diffusive (DO₂) components of O₂ transport to changes in peak O₂ uptake (VO₂PEAK).

To date, 1 male astronaut (XX yrs) completed an incremental exercise test to measure VO₂PEAK prior to and 2 days post-flight. Cardiac output (Q) was measured at three submaximal work rates via carbon dioxide rebreathing. The Q:VO₂ relationship was extrapolated to VO₂PEAK to determine QPEAK. Hemoglobin concentration was measured at rest via a venous blood sample.

These measurements were used to model the changes in QO₂ and DO₂ using Fick’s principle of mass conservation and Law of Diffusion as established by Wagner and colleagues (Annu. Rev. Physiol 58: 21-50, 1996 and J. Appl. Physiol. 73: 1067-1076, 1992). VO₂PEAK decreased post-flight from 3.72 to 3.45 l min⁻¹, but QPEAK increased from 24.5 to 27.7 l min⁻¹. The decrease in VO₂PEAK post-flight was associated with a 21.2% decrease in DO₂, an 18.6% decrease in O₂ extraction, but a 3.4% increase in QO₂. These preliminary data suggest that long-duration spaceflight reduces peripheral diffusing capacity and that it largely contributes to the post-flight decrease in aerobic capacity.