Convective and diffusive O_2 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 O_2 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 ($\dot{Q}O_2$) and peripheral diffusive (DO_2) components of O_2 transport to changes in peak O_2 uptake ($\dot{V}O_{2PEAK}$). To date, 1 male astronaut (XX yrs) completed an incremental exercise test to measure $\dot{V}O_{2PEAK}$ prior to and 2 days post-flight. Cardiac output ($\dot{Q}$) was measured at three submaximal work rates via carbon dioxide rebreathing. The $\dot{Q}$:$\dot{V}O_2$ relationship was extrapolated to $\dot{V}O_{2PEAK}$ to determine $\dot{Q}_{PEAK}$. Hemoglobin concentration was measured at rest via a venous blood sample. These measurements were used to model the changes in $\dot{Q}O_2$ and DO_2 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). $\dot{V}O_{2PEAK}$ decreased post-flight from 3.72 to 3.45 l min^{-1}, but $\dot{Q}_{PEAK}$ increased from 24.5 to 27.7 l min^{-1}. The decrease in $\dot{V}O_{2PEAK}$ post-flight was associated with a 21.2% decrease in DO_2, an 18.6% decrease in O_2 extraction, but a 3.4% increase in $\dot{Q}O_2$. 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.