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Human Physiology in Space (2)

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EFFECT AND RECOVERY OF LONG-DURATION SPACEFLIGHT ON THE VENTRICLES OF THE ASTRONAUT'S BRAIN.

Abstract

Recent reports on the effect of spaceflight on the brain have shown an enlargement of the brain ventricular volume early after return from space. However, a detailed quantification and a description of its time course and possible reversibility has not yet been investigated. In our prospective study, we scanned 11 cosmonauts, with magnetic resonance imaging (MRI) methods before launch to the ISS and shortly after return to Earth. In 7 of these cosmonauts, an additional measurement was acquired 7 months after return to Earth. In addition, 11 control subjects were scanned twice with a similar time interval as between the preflight and early postflight scans of the cosmonauts. T1 weighted anatomical MRI scans were acquired for each subject and timepoint and were processed to obtain CSF volumes of different regions-of-interest (ROI's). These included the lateral ventricles (left and right combined), the third ventricle and the fourth ventricle. The sum of these three compartments was also calculated and used for further analyses. A linear mixed model was used to investigate the changes in ventricular volume across time. The interaction effect was also investigated using a 2x2 ANOVA of group (cosmonauts and controls) and timepoint (preflight and postflight). Results show that after spaceflight the lateral ventricles increased in volume by 13.3% 1.9% (se) and the third ventricle by 10.1% 1.1%, which was highly significant. The fourth ventricle, however, did not significantly change in volume over time in cosmonauts, though there was a significant interaction effect of group and time, driven by opposing changes in ventricular volume between cosmonauts and controls. At follow-up compared to the preflight measurement, a sustained increase in volume was noted for the lateral ventricles (7.7%1.6%) and for the third ventricle (4.7%1.3%), though compared to the early postflight measurement, a reduction in ventricular volume is clearly noted. These results highlight the extent of ventricular enlargement, which was previously noted without exact quantification. Additionally, our results highlight the reversibility of the postflight changes, but the process of normalisation seems to last a long time, as it is not yet complete at 7 months after return from space. The temporal course of normalisation and the relation of the current findings with clinical parameters remain to be determined in future studies.