Challenges of Life Support/Medical Support for Human Missions (8)
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KEYNOTE: SEEMINGLY DIFFERENT IMPACT OF SPACEFLIGHT ON NASA, ESA AND ROSCOSMOS SPACE CREW REGARDING THE PERIVASCULAR SPACE

Abstract

Background: Recent studies demonstrated changes in multiple cerebrospinal fluid (CSF) compartments after long-duration spaceflight on the International Space Station (ISS), but whether these changes equally affect spaceflight crews of different space agencies and how they relate to the spaceflight-associated neuro-ocular syndrome (SANS) remain unclear. We assessed the spaceflight-associated alterations detectable in multiple CSF spaces of National Aeronautics and Space Administration (NASA) astronauts, Roscosmos (ROS) cosmonauts, and European Space Agency (ESA) astronauts, and investigated their relation to SANS. Methods: We performed a joint analysis of brain magnetic resonance imaging (MRI) scans acquired before and within the first two weeks after long-duration spaceflight on the ISS in NASA astronauts, ROS cosmonauts, and ESA astronauts. MRI data from NASA astronauts involved in missions of short duration in the Space Shuttle Program and controls on Earth were analyzed as well. Volume measures of the perivascular spaces (PVS), lateral ventricles (LV), and subarachnoid space at the vertex (VSA) were obtained and analyzed across time and groups. Findings: PVS volume increased after long-duration spaceflight, with significantly greater percent enlargements in NASA astronauts compared to ROS cosmonauts (25.5% and 12.4%, respectively, p=.006). Moreover, LV volumes increased and VSA volumes decreased after long-duration spaceflight in all space crews. PVS enlargement was positively correlated with upward brain shift (rs=0.33, p=.04). Further, mission duration was positively correlated with changes in PVS volume (rs=-0.32, p=.04) and negatively correlated with VSA volume changes (rs=-0.53, p¡.001). Both pre- and post-flight PVS volumes were significantly higher in NASA astronauts who developed SANS compared with NASA astronauts who did not. Additionally, the NASA astronauts who developed SANS had a significantly larger percentage increase in PVS than the ROS group (p=.02). Interpretation: Long-duration missions to the ISS are associated with PVS volume increases in space crews, while not equally affecting NASA astronauts and ROS cosmonauts, which could be related to several factors including differences in countermeasures and/or training protocols. Furthermore, the amount of fluid in PVS is linked to SANS. Further investigation of the mechanisms underlying these structural changes in PVS might provide insight into the pathophysiology and prevention of SANS as well as into the physiology of PVS and cerebral fluid drainage.