

Intracranial Fluid Redistribution During a Spaceflight Analog

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The neural correlates of spaceflight-induced sensorimotor impairments are unknown. Head down-tilt bed rest (HDBR) serves as a microgravity analog because it mimics the headward fluid shift and limb unloading of spaceflight. We investigated focal brain white matter (WM) changes and fluid shifts during 70 days of 6° HDBR in 16 subjects who were assessed pre (2x), during (3x), and post-HDBR (2x). Changes over time were compared to those in control subjects (n=12) assessed four times over 90 days. Diffusion MRI was used to assess WM microstructure and fluid shifts. Free-Water Imaging, derived from diffusion MRI, was used to quantify the distribution of intracranial extracellular free water (FW). Additionally, we tested whether WM and FW changes correlated with changes in functional mobility and balance measures. HDBR resulted in FW increases in fronto-temporal regions and decreases in posterior-parietal regions that largely recovered by two weeks post-HDBR. WM microstructure was unaffected by HDBR. FW decreased in the post-central gyrus and precuneus. We previously reported that gray matter increases in these regions were associated with less HDBR-induced balance impairment, suggesting adaptive structural neuroplasticity. Future studies are warranted to determine causality and underlying mechanisms.

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