LONG DURATION HEAD DOWN TILT BED REST AND SPACEFLIGHT EFFECTS ON NEUROCOGNITIVE PERFORMANCE: EXTENT, LONGEVITY AND NEURAL BASES

R. D. Seidler[1], A. P. Mulavara[2], V. Koppelmans[1], K. Cassady[1], P. Yuan[1], I. S. Kofman[2], Y. E. De Dios[2], R. F. Riascos-Castaneda[3], S. J. Wood[4], J. J. Bloomberg[5]

[1]University of Michigan, 401 Washtenaw Avenue, Ann Arbor MI 48109-2214, rseidler@umich.edu
[2] KBRWyle, Houston, TX
[3]UT Neuroradiology
[4]Azusa Pacific University, Asuza CA
[5]NASA Johnson Space Center

ABSTRACT

We have recently completed a long duration head down tilt bed rest (HDBR) study in which we performed structural and functional magnetic resonance brain imaging to identify the relationships between changes in neurocognitive function and neural structural alterations in a spaceflight analog environment. We are also collecting the same measures in crewmembers prior to and following a six month International Space Station mission. We will present data demonstrating that bed rest resulted in functional mobility and balance deterioration with recovery post-HDBR. We observed numerous changes in brain structure, function, and connectivity relative to a control group which were associated with pre to post bed rest changes in sensorimotor function. For example, gray matter volume (GMv) increased in posterior parietal areas and decreased in frontal regions. GMv increases largely overlapped with fluid decreases and vice versa. Larger increases in precentral gyrus (M1)/ postcentral gyrus (S1+2) GMv and fluid decreases were associated with smaller balance decrements. Vestibular activation in the bilateral insular cortex increased with bed rest and subsequently recovered. Larger increases in vestibular activation in multiple brain regions were associated with greater decrements in balance and mobility. We found connectivity increases between left M1 with right S1+2 and the superior parietal lobule, and right vestibular cortex with the cerebellum. Decreases were observed between right Lobule VIII with right S1+2 and the supramarginal gyrus, right posterior parietal cortex (PPC) with occipital regions, and the right superior posterior fissure with right Crus I and II. Connectivity strength between left M1 and right S1+2/superior parietal lobule increased the most in individuals that exhibited the least balance impairments. In sum, we observed HDBR-related changes in measures of brain structure, function, and network connectivity, which correlated with indices of sensorimotor function. Recovery was observed post HDBR but remained incomplete at 12 days post-HDBR. Preliminary findings from our parallel ongoing flight study will be compared and contrasted with bed rest results during this presentation.

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