FOCAL GRAY MATTER PLASTICITY AS A FUNCTION OF LONG DURATION BED REST: PRELIMINARY RESULTS

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Long duration spaceflight (i.e., 22 days or longer) has been associated with changes in sensorimotor systems, resulting in difficulties that astronauts experience with posture control, locomotion, and manual control. It is unknown whether and how spaceflight impacts sensorimotor brain structure and function, and whether such changes may potentially underlie behavioral effects. Long duration head down tilt bed rest has been used repeatedly as an exclusionary analog to study microgravity effects on the sensorimotor system [1]. Bed rest mimics microgravity in body unloading and bodily fluid shifts. We are currently testing sensorimotor function, brain structure, and brain function pre and post a 70-day bed rest period. We will acquire the same measures on NASA crewmembers starting in 2014. Here we present the results of the first eight bed rest subjects. Subjects were assessed at 12 and 7 days before-, at 7, 30, and ~70 days in-, and at 8 and 12 days post 70 days of bed rest at the NASA bed rest facility, UTMB, Galveston, TX, USA. At each time point structural MRI scans (i.e., high resolution T1-weighted imaging and Diffusion Tensor Imaging (DTI)) were obtained using a 3T Siemens scanner. Focal changes over time in gray matter density were assessed using the voxel based morphometry 8 (VBM8) toolbox under SPM. Focal changes in white matter microstructural integrity were assessed using tract based spatial statistics (TBSS) as part of the FMRIB software library (FSL). TBSS registers all DTI scans to standard space. It subsequently creates a study specific white matter skeleton of the major white matter tracts. Non-parametric permutation based t-tests and ANOVA's were used for voxel-wise comparison of the skeletons. For both VBM and TBSS, comparison of the two pre bed rest measurements did not show significant differences. VBM analysis revealed decreased gray matter density in bilateral areas including the frontal medial cortex, the insular cortex and the caudate nucleus from pre to in bed rest. Over the same time period, there was an increase in gray matter density in the cerebellum, occipital, and parietal cortices. The majority of these changes did not recover from during to post bed rest. TBSS analyses will also be presented. Extended bed rest, which is an analog for microgravity, can result in gray matter changes and potentially in microstructural white matter changes in areas that are important for neuromotor behavior and cognition. These changes did not recover at two weeks post bed rest. These results have significant public health implications, and will also aid in interpretation of our future data obtained pre and post spaceflight.

Whether the effects of bed rest wear off at longer times post bed rest, and if they are associated with behavior are important questions that warrant further research.

REFERENCES [1] Reschke MF et al. (2009) Aviat Space Environ 9; 80(5, Suppl.):A1–10