Decreased intrinsic connectivity strength in the right parietal cortex after exposure to short-term microgravity

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Background: The effects of first-time exposure to short-term microgravity on the brain have not been investigated. Here, we tested changes in fMRI resting connectivity in a group of healthy controls that participated in a parabolic flight (PF).

Methods: 28 healthy volunteers (10 female, 18 male) were included in the study. Each subject participated in one flight (2-3 hours), which included 31 parabolic maneuvers at zero g. Each parabola started with a pull-up phase and ended with a pullout phase at 1.8g, both lasting about 20s. The duration of the zero g condition is about 21 sec. All subjects received scopolamine, an anti-emetic drug, to reduce motion sickness. Resting state volumes were acquired one day before the flight and right after the conclusion of the mission. To account for the scopolamine variance, 12 healthy non-PF volunteers (4 female, 8 male) were scanned without and 3h after scopolamine injection. A 2x2 repeated measures design checked for hypothesis-free (intrinsic connectivity contrast) changes in functional connectivity. All results were corrected for multiple comparisons at FWE p<0.05, cluster-level (two-sided).

Results: After the PF, subjects showed increased connectivity temporo-occipital cortex and decreased connectivity in right angular gyrus, precuneus, left supra-marginal and right inferior temporal gyrus; the scopolamine group showed only decreased connectivity in the pre-central gyrus. The interaction analysis revealed diminished connectivity in the right angular gyrus in the parabolic flight group (z=-0.58, 90%CI=0.32, as compared to the scopolamine group (z=0.57, 90%CI=0.49).

Conclusions: First-time exposure to short-term microgravity decreases connectivity in the right parietal cortex. This is a key region of the human vestibular cortex, which has been implicated in high-order multimodal integration, including spatial tasks such as world space and self-referential processing. Our results shed light on the neural substrates of vestibular function and are relevant for aerospace, such as for future interplanetary missions.