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HUMAN NEURAL STEM CELLS FLOWN ONTO SPACE PROLIFERATE MORE THAN GROUND CONTROL IN SPACE AND UPON RETURN TO EARTH: IMPLICATIONS FOR LONG-TERM SPACE TRAVEL

Abstract

Long-term travel and lengthy stays for astronauts in outer space are imminent. Neural stem cells (NSCs) are a key population in the central nervous system (CNS) because they maintain tissue integrity and function. They also possess the potential of generating the various cell types during development and adulthood in the CNS, in health and disease. We have previously reported that simulated microgravity (sim-G) increases cell proliferation. Here, using time-lapse microscopy we examined the behavior of space-flown human NSCs (SPC-NSCs) upon return, as they were adapting to Earth's gravity. NSCs proliferated seven times more while in space (SPC) when compared to cells grown on Earth. We also examined by continuous live imaging the behavior of space-flown NSCs. We found that after space flight, they continued proliferating at the same pace as 1G-cells. Cytokinesis length ranged from 15 to 19 hours in SPC-NSCs being equivalent to ground-control NSCs (GC-NSCs) which ranged from 16h to 19h. We also found two distinct subpopulations of NSCs, one of large NSCs and another one of small NSCs. The small cell population displayed a larger cell body than GC-NSCs, while large NSCs appeared smaller than GC-NSCs, a phenomenon we have also found in NSCs grown in simulated microgravity. Moreover, we discovered that upon return to Earth a subpopulation of NSCs and/or their progenies, exhibited abnormal features among which are phagocytosis, cell fusion, incomplete division, and cell death after space flight. The cause(s) that elicited enhanced proliferation, as well as the abnormal behaviors here described, have not yet been elucidated. Nonetheless, to understand what caused these kinds of behavior in SPC-flown NSCs, we are currently examining the secretome produced by NSCs during the 39.3 days they spent in space. Since longer space flights are imminent, understanding how NSCs responded to space, as well as how they behave upon returning to Earth, is of the essence to ensure that astronauts' health is protected during and after long-term space travel. Moreover, since the Moon and Mars have partial gravity, 16.1