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THE IMPLICATIONS OF MICROGRAVITY ON CELL MORPHOLOGY AND PROLIFERATION OF STEM CELL PROGENIES TOWARDS ASTRONAUT HEALTH

Abstract

It has been observed that microgravity (0G) induces apoptosis, alters the cytoskeleton and affects cell differentiation, proliferation, migration and adhesion differently depending on the cell type. However, its specific effects on neural cells have not been explored in depth. It is now known that astronauts tend to develop microgravity induced intracranial hypertension. This represents a detrimental health risk factor and a potential limitation to long-duration space missions. Astronauts have also reported perceptual and spatial disorientation, controlled by the neurovestibular system within the brain, due to prolonged acclimation to a microgravity environment. Our goal is to assess the effects of real microgravity on human neural stem cells (hNSC) and oligodendrocytes (OL). NSC are a type of stem cell located in specific regions of the brain and can be used to regenerate brain cells.

Therefore, they can serve as an adequate model for analyzing the influence of microgravity on the Central Nervous System (CNS). We used a 3D-clinostat robot (MHI) to examine the effects of simulated microgravity (sim-0G) on NSC. We also examined if NSC would commit to the OL phenotype while in sim-0G. OL are the cells that myelinate axons in the CNS. This study focused on culturing a NSC line in NSC medium or in OL specification medium to test if these cells would commit to OL phenotype in sim-0G. We determined that both NSC and derived OL survived and gave rise to more progenies during sim-0G exposure, but had a smaller average cell body diameter.

We find that sim-0G offers a novel platform to study the influences of microgravity on neural cells. Previously, this lab has determined that microgravity induces the proliferation of OL-progenitors. Our current observations using NSC in sim-0G have confirmed that NSC-progenitors seem to behave in a similar manner. Thus, we can say that increased neural cell proliferation might contribute to intracranial hypertension in astronauts, but the reduction on cell body size in sim-0G remains a perplexing finding. Sim-0G's apparent induction of increased stem cell proliferation is an intriguing discovery, for unraveling its biological mechanisms may not only prove vital to the immediate health of our pioneering space explorers, but also to those on our current planet in curing de-myelinating disorders, like multiple sclerosis.

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