Gene Lab for High Schools Internship Research

Title: Examining Impacts of Spaceflight-Induced Cell Cycle Dysregulation on Skin Health and Wound Healing in Mice with Metabolic Profiling of Igf2

Abstract:

From the moment when humans made their first venture into space, it has been noticed that spaceflight has many impacts on the human body, particularly related to skin health and wound healing. To identify roots to this problem, we investigated the OSD-254 “Transcriptional analysis of dorsal skin from mice flown on the RR-7 mission” dataset where we identified down-regulation of genes involved in cell cycle regulation (Cdk1, Ccnb1, Ccnb2 [p-value < 0.05, log2FC < -1.5]) in female C57BL/6J mus musculus. This trend is also reflected in homo sapiens, where according to literature, microgravity induces dysregulation in cell cycle genes in human cells (Verma et al., 2015). Additionally, cell cycle genes have been established to be keystone in cellular proliferation, where Cdk1, Ccnb1, and Ccnb2 have been found to be upregulated in various cancers. When upregulated, these genes drive rapid cell division, contributing to tumor growth and progression. These genes are well connected to cellular proliferation and development, specifically in their roles of regulating the G2/M transition phase of the cell cycle. In our investigation, we also found Igf2, which was upregulated in space, to be involved in many cell growth and proliferative processes along with these three regulatory genes. Through further analysis, we found their direct cellular interactions within the MAPK pathway. We then identified Igf2’s role in enhancing skin health (skin thickness/differentiated cell concentration) and wound healing (Ward et al., 2003) as well its role in metabolic pathways. This led us to focus on identifying unique metabolic profiles characterized by Igf2 expression in microgravity conditions. By designing an experiment utilizing immunofluorescence (IF), AO/PI flow cytometry assays, histological assessments, metabolomic assays, and numerous other potential procedures to examine impacts of cell cycle gene dysregulation and Igf2 expression on mice skin health/metabolomic characteristics, we aim to understand underlying mechanisms of skin health and wound healing in microgravity. This knowledge will open doors to tailor solutions for microgravity impacts on skin health whilst identifying potential metabolic side effects.