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CHARACTERIZING THE EFFECTS OF SIMULATED MICROGRAVITY ON HUMAN NATURAL KILLER CELLS

Abstract

Immune dysregulation has been reported in astronauts as a result of spaceflight. Microgravity is a major factor that may have significant impact on immune cells. Natural Killer (NK) cells are important components of innate immunity, as they kill both virus-infected and malignant cells. However, the cellular and molecular mechanisms for spaceflight-associated immune dysfunction remain largely unclear. Given the limitations of conducting research in space, microgravity can be modelled on Earth through rotating cell culture in a "rotary cell culture system" at a slow, constant velocity on a horizontal axis. This introduces laminar flow into the culture vessel which randomizes the gravity vector, thereby modelling microgravity. As NK cells play an important role in immune function, this study aims to characterize the mechanistic basis of changes in NK cell function and metabolism as a result of simulated microgravity exposure. Specifically, this study is focused on quantifying NK cell cytotoxicity with and without exposure to simulated microgravity, by using the gold-standard chromium release assay. Additionally, metabolism in immune cells has been shown to be linked to their functionality. As such, rates of mitochondrial respiration and glycolysis are also being evaluated, in addition to secretion of cytolytic components including perforin and granzyme. Lastly, potential changes in cytoskeletal morphology and granule polarization, a critical process in mediating cytotoxicity, will be evaluated through immunofluorescence microscopy. NK cells are an important cell type to study in this context, given that viral reactivation is seen as a result of spaceflight, and increased radiation dosage in space increases risk for cancer development in astronauts. This research also has the potential to provide insights into the understanding of immune dysregulation on Earth.