IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Radiation Fields, Effects and Risks in Human Space Missions (5)

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ADAPTIVE HEPATIC GENE EXPRESSION PATTERNS IN MICE IN RESPONSE TO SIMULATED OR SPACE RADIATION EXPOSURE.

Abstract

The liver, as a central organ in metabolism, maintaining energy balance, and detoxification, is a key study subject in the context of spaceflight conditions, where understanding its response becomes crucial. Research focusing on the hepatic transcriptional response to spaceflight conditions or simulated radiation is justified due to its potential to reveal how the latter may affect metabolic homeostasis. Additionally, a detailed understanding of the transcriptional landscape of the liver after organismal exposure to radiation contributes to efforts aimed at developing intervention strategies to preserve astronaut health during prolonged space missions.

This study investigates hepatic expression patterns in mice exposed to simulated ionizing radiation on Earth and those subjected to spaceflight radiation, with a focus on identifying shared differentially expressed genes. Leveraging data from two NASA GeneLab transcriptomic studies, namely OSD-294 and OSD-379, we conducted a comprehensive analysis to explore the molecular responses of liver tissue to radiation exposure.

We uncovered a set of 26 genes that were differentially expressed both in the liver of mice exposed to simulated ionizing radiation on Earth and those subjected to spaceflight radiation. These 26 genes exhibited the same behavior in both studies: 14 of them increased their expression while the other 12 decreased. This shared expression pattern suggests specific molecular responses in the liver to radiation exposure. We identified an overrepresentation of genes involved in energy metabolism processes and those associated with circadian rhythms, hinting at a potential relationship between radiation exposure and impaired regulation of both metabolic processes and circadian rhythms in the liver.

Our study identifies a set of genes that potentially represent an adaptive pattern to radiation conditions. These findings contribute to our understanding of the hepatic molecular response to ionizing radiation, both in simulated Earth conditions and the unique environment of spaceflight. Furthermore, the similar results obtained under both spaceflight conditions and simulated radiation on Earth support the relevance of ground-based experiments in replicating phenomena occurring in space. Further research on how altered regulation of the expression of these genes may impact liver homeostasis is required. Moreover, since our findings may hold true for other tissues, additional transcriptional analyses using NASA's public data are guaranteed to unravel the influence of radiation exposure on the transcriptional profile of astronauts during spaceflight.