Simulated space radiation and weightlessness: vascular-bone coupling mechanisms to preserve skeletal health

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INTRODUCTION

Spaceflight, bone and oxidative stress

- Astronauts may develop bone loss in space as a result of environmental challenges, such as exposure to both weightlessness and ionizing radiation.
- Oxidative stress results from an imbalance between production of free radicals and the ability of cells to counteract their harmful effects at the molecular level.

Endogenous ROS/RNS signaling for adaptive responses

HYPOTHESES

Weightlessness and radiation together cause oxidative stress, adversely affecting both bone and the blood vessels that feed muscle and bone.

METHODS

Animals: Adult (4 mo old at start), male C56Bl/6J mice

-Hindlimb unloading by tail traction to simulate weightlessness

-Irradiation with either ¹³⁷Cs, Protons, or ⁵⁶Fe

Experimental design

RESULTS

Late effects of HZE, but not transient Hu, on vasodilation (via NO signaling mechanism) at 6 to 7 months post-treatment

PURPOSE OF THE STUDIES

To define the mechanisms and risks of bone loss in space and to help develop effective ways to prevent that bone loss.

PUBLISHED FINDINGS FROM THE FINAL GRANT YEAR

- This last year, published papers from our group describe experimental findings with mice testing various aspects of our hypothesis¹−³, and reviews of ionizing radiation⁴ and simulated weightlessness⁵.


CONCLUSION

Radiation exposure and simulated weightlessness cause persistent antioxidant responses in marrow, decrements in bone microarchitecture and altered vasodilation properties of associated vasculature.

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