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 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

RESULTS

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

CONCLUSION

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

Published findings from the final grant year

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


PURPOSE OF THE STUDIES

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