Advancing Translational Space Research Through Biospecimen Sharing: Amplifying the Impact of Ground-Based Studies

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Background

- ✓ Biospecimen Sharing Programs (BSPs) have been organized by NASA Ames Research Center (ARC) since the 1960s with the goal of maximizing utilization and scientific return from rare, complex, and costly spaceflight experiments (Ronca, French & Smith, 2016)
- ✓ Otherwise unused biological specimens from primary Space Biology experiments are harvested and banked for secondary analyses
- ✓ Here we report an expansion of the Ames BSP to NASA Human Research Program (HRP) Human Health & Countermeasures (HHC)-funded ground-based studies
- ✓ Sharing of biospecimens derived from a long duration (90-day) rat head-down tilt (or Hindlimb Unloading [HLU] study) presently underway at UC Davis (PI: C.A. Fuller) and funded by HRP/HHC
- ✓ NASA BSP efforts are significantly broadening the range of health in Space and on Earth

UC Davis - NASA Collaboration

- ✓ Primary HHC study involves a long-duration head-down-tilt of rats utilizing brain and eyes to test hypotheses relevant to Visual Impairment/Intracranial Pressure (VI/IP)
- ✓ Subjects are young (3-mo-old) male and female rats and old (9-mo-old) male rats
- ✓ Over 5,060 biospecimens that would otherwise not have been utilized tissues preserved from this single experiment

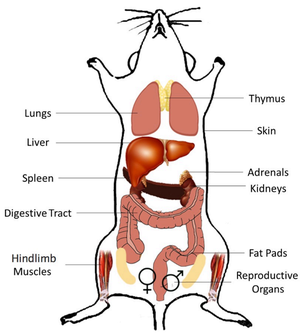


Figure 1. Available tissues

- ✓ Spine, tail, hindlimb bones, calvaria, and heart distributed to selected BSP PIs: Bloomfield, Globus & Hargens
- ✓ Available tissues are: Lungs, spleen, liver, skin, reproductive organs, fat pads, 5 hindlimb muscles, digestive tract, thymus, adrenals, and kidneys (Figure 1).

Methods

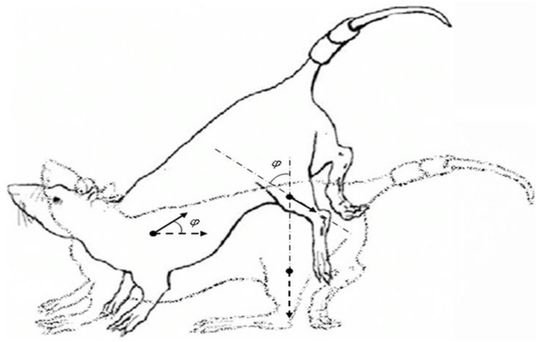
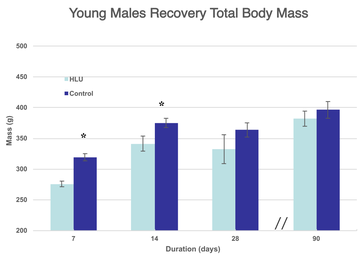
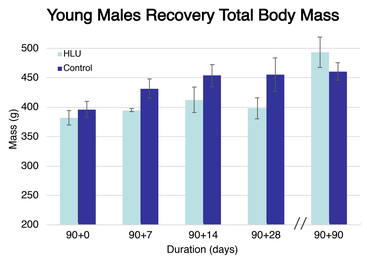


Figure 2. Depiction of HLU rat model. The 30° angle between the ground and vertebral column induces hindlimb disuse and a cephalic fluid shift, analogous to spaceflight conditions. Image credit: Ogneva et. al., 2013.

- ✓ Young (3-month old) male and female rats, and old (9-month old) male rats are either HLU or not unloaded for either 7, 14, 28, or 90 days.
- ✓ Additional groups are exposed to 90 days of unloading (or not unloaded) followed by either 7, 14, 28 days or 90 days of Recovery (normal loading).
- ✓ Tissues are harvested, weighed, and then preserved. For bilateral organs (lungs, adrenals, kidneys, hindlimb muscles, fat pads, reproductive organs), left side organs are preserved in RNA Later then snap frozen within 48hr while right side organs are immediately snap frozen. Unilateral organs are bisected and identically preserved.
- ✓ Here we present organ mass data from selected tissues available for analysis. Bilateral tissue masses were expressed total mass:tissue body mass ratio.

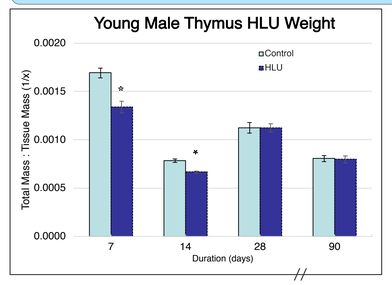


*Total body mass (g) of young male rats following 90-day HLU and Controls (*p<.05)*

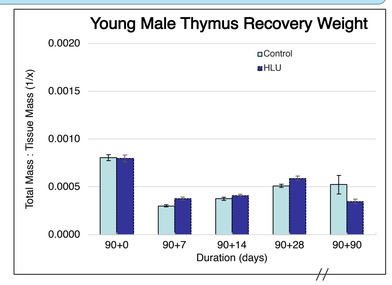


*Total body mass (g) of young male rats following HLU Recovery and Controls (*p<.05)*

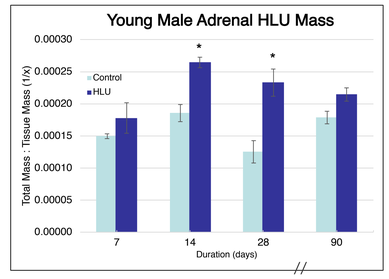
Results



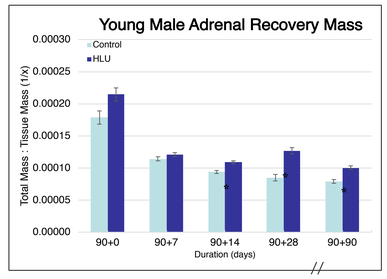
*Thymus weights (g) of young male rats following 90-day HLU and Controls (*p<.05)*



*Thymus weights (g) of young male rats following 90-day HLU Recovery and Controls (*p<.05)*



*Average right and left adrenal weights (g) of young male rats following 90-day HLU and Controls (*p<.05)*



*Average right and left thymus weights (g) of young male rats following 90-day HLU Recovery and Controls (*p<.05)*

Future Considerations

- ✓ Identify collaborators for remaining unused tissues
- ✓ Tissue collection to be completed August 2017
- ✓ Correlate results across tissues to identify common and disparate effects on organ systems following long-duration HLU and recovery

Acknowledgments

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References

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