RODENT HABITAT ON ISS: ADVANCES IN CAPABILTY FOR DETERMINING SPACEFLIGHT EFFECTS ON MAMMALIAN PHYSIOLOGY

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Rodent research is a valuable essential tool for advancing biomedical discoveries in life sciences on Earth and in space. The National Research Counsel's Decadal survey (1) emphasized the importance of expanding NASAs life sciences research to perform long duration, rodent experiments on the International Space Station (ISS). To accomplish this objective, new flight hardware, operations, and science capabilities were developed at NASA ARC to support commercial and government-sponsored research. The flight phases of two separate spaceflight missions (Rodent Research-1 and Rodent Research-2) have been completed and new capabilities are in development.

The first flight experiments carrying 20 mice were launched on Sept 21, 2014 in an unmanned Dragon Capsule, SpaceX4; Rodent Research-1 was dedicated to achieving both NASA validation and CASIS science objectives, while Rodent Reesearch-2 extended the period on orbit to 60 days. Groundbased control groups (housed in flight hardware or standard cages) were maintained in environmental chambers at Kennedy Space Center. Crewmembers previously trained in animal handling transferred mice from the Transporter into Habitats under simultaneous veterinary supervision by video streaming and were deemed healthy. Health and behavior of all mice on the ISS was monitored by video feed on a daily basis, and post-flight quantitative analyses of behavior were performed. The 10 mice from RR-1 Validation (16wk old, female C57Bl6/J) ambulated freely and actively throughout the Habitat, relying heavily on their forelimbs for locomotion. The first on-orbit dissections of mice were performed successfully, and high quality RNA (RIN values>9) and liver enzyme activities were obtained, validating the quality of sample recovery.

Post-flight sample analysis revealed that body weights of FLT animals did not differ from ground controls (GC) housed in the same hardware, or vivarium controls (VIV) housed in standard cages. Organ weights analyzed post-flight showed that there were no differences between FLT and GC groups in adrenal gland and spleen weights, whereas FLT thymus and liver weights exceeded those of GC. Minimal differences between the control groups (GC and VIV) were observed. In addition, Over 3,000 aliquots collected post-flight from the four groups of mice were deposited into the Ames Life Science Data Archives for the Biospecimen Sharing Program and Genelab project. New capabilities recently developed include DEXA scanning, grip strength tests and male mice.

In conclusion, new capability for long duration rodent habitation of group-housed rodents was developed and includes in-flight sample collection, thus avoiding the complication of reentry. Results obtained to date reveal the possibility of striking differences between the effects of short duration vs. long duration spaceflight. This Rodent Research system enables achievement of both basic science and translational research objectives to advance human exploration of space.

REFERENCE

[1] NRC Decadal Survey on Biological and Physical Sciences in Space, (2011) http://sites.nationalacademies.org/SSB/CompletedProjects/SSB_067720