Estrous Cyclicity of Mice During Simulated Weightlessness

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Presented at the 2017 meeting of American Society for Gravitational and Space Research
Motivation for studying estrous cyclicity in simulated weightlessness

• STS-131, STS-133, STS-135 revealed cessation of estrous cycle in female mice (Tash 2012 & Ronca 2014)

• Spaceflight leads to loss of corpora lutea and significantly reduced estrogen receptor mRNA levels in the uterus

Goals of this study

• Assess whether female endocrine signaling biomarkers are altered in simulated weightlessness via hindlimb unloading model in both reproductive and non-reproductive organs

Unpublished images from Tash
Experimental Design

Normally Loaded
n=10

Hindlimb Unloaded
n=10

Vivarium Control
n=10

Primary endpoints:
1. Did mice maintain/return to normal estrous cycling?
2. Were there structural changes to reproductive organs (ovaries, uterus, vaginal wall)?
Methods: Daily lavage and Imaging


Cora, Michelle C., Linda Kooistra, and Greg Travlos. "Vaginal cytology of the laboratory rat and mouse: review and criteria for the staging of the estrous cycle using stained vaginal smears." Toxicologic pathology 43.6 (2015): 776-793.
Methods: Cytology Analysis

• Translate qualitative date into an experiment timeline for each mouse defining Day 0 as start of treatment.

• Graph each animal’s estrous cycle in relation to other experiment landmarks

Hypothesis

• Hindlimb unloading will cause mice to arrest estrous cyclicity in the diestrous stage
Result: Pair-feeding/Cage effect observed
Result: Differences observed in HU reproductive organs and adrenals
Cytology Results

• Average cycle length of vivarium cage control animals was 4.7 days.
  • In line with reported literature\(^1,2\)
  • Suggests our technique did not impede normal cycling

• Normal cycling did not present in many animals during the acclimation to HU cages, or even throughout remainder of experiment.

• Some occurrences of cycling did return to HU cage mice.

• Infection-like symptoms resulted in missing data in HU mice.

Conclusions

• Cage effect/Pair Feeding effect present

• Validated model for observing estrous stage in VIV control

• Longer acclimation period may allow control cage animals to return to normal estrous cyclicity

• Longer HU period may allow HU animals to acclimate and return to normal estrous cyclicity
Thanks to those who contributed

NASA Ames Research Center
- Joshua Alwood
- Catherine Choi
- Parker Dubee
- Ayana Kishibuchi
- Eric Moyer
- Kotaro Okada
- Megan Pendleton
- April Ronca
- Ryan Scott
- Pantelis Solomides
- Brad Staten
- Yuli Talyansky
- Nicholas Thomas

Kansas UMC
- Lane Christenson
- Joseph Tash

This research was supported by NASA Space Biology Grant NNX15AB48G