IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medical Care for Humans in Space (3)

Author: Dr. Junichi Tajino
Kyoto University, Japan, tajino.junichi.6c@kyoto-u.ac.jp

Dr. Akira Ito
Kyoto University, Japan, ito.akira.4m@kyoto-u.ac.jp
Dr. Momoko Tanima
United States, momoko.tanima@nih.gov
Dr. Shoki Yamaguchi
Japan, shoki.yamaguchi@iuhw.ac.jp
Dr. Hirotaka Iijima
Keio University, Japan, iijima.hirotaka.4m@yt.sd.keio.ac.jp
Dr. Wataru Kiyan
Kyoto University, Japan, kiyan.wataru.32c@kyoto-u.jp
Dr. Tomoki Aoyama
Kyoto University, Japan, aoyama.tomoki.4e@kyoto-u.ac.jp
Dr. Hiroshi Kuroki
Kyoto University, Japan, kuroki.hiroshi.6s@kyoto-u.ac.jp

ARTIFICIAL GRAVITY WITH CENTRIFUGE AND OPTIMAL DOSE OF THE INTERVENTION TO COUNTERACT GAIT ALTERATION IN RATS EXPOSED TO SIMULATED MICROGRAVITY

Abstract

Introduction/Purpose Microgravity could affect many aspects of physiological system such as musculoskeletal features and autonomic regulations. We have previously found that microgravity environment disturbs walking motion in rats and the distortion could be attenuated by hypergravity intervention (twice of usual gravity for one hour a day) using centrifuge. Despite this benefit, the optimal dose of the gravitation is still unclear. The purpose of this study was to explore the range of effectiveness (intensity and duration) and the optimal use of hypergravity intervention.

Methodology Male Wistar rats were distributed into 6 groups according to intensity and duration of the gravitational intervention. They were unloaded by their tail for 2 weeks (unloading period) followed by another 2-week free rearing period (recovery period). During the unloading period, each group was subjected to distinct gravitation as follows: 1) continuously unloaded (UL); 2) reloaded for 1 hour a day (UL+1G); 3) centrifuged at 2G for 1 hour a day (UL+2G); 4) centrifuged at 1.5G for 80 minutes (UL+1.5G80mins); 5) centrifuged at 2.5G for 48 minutes (UL+2.5G48mins); and 6) reared freely throughout the experiment (Ctrl). Muscle weight of hindlimb extensors and kinematics properties of their walking motion were evaluated using 3 dimensional motion capture apparatus.

Results Recoveries of muscle weights were not significantly different across the groups (p ¿ 0.05). The UL group showed significant narrower and forward shifted oscillation of the hindlimb. Also, their knee and ankle joint at stance phase were significantly extended (p ¡ 0.05, respectively). Conversely, those of UL+2G and UL+1.5G were closer to Ctrl whereas those in UL+2.5G were still agitated.

Discussion/Conclusion Despite of little influence on muscle weight recovery, the intermittent gravitation using centrifuge could attenuate the alteration of rats' walking and this effect had Hertz-like curve shaped range. 2G and 1.5G interventions affected similarly and the most preferable within the parame-

ters we tested this time, whereas 2.5G intervention was less preferable. This findings suggest existence of optimal range of gravitation and might be helpful to figure out the breakeven point to compromise between physiological need and on board regulation of space crafts.