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EXAMINATION OF MOLECULAR MECHANISMS ON VASCULAR FORMATION AND STRESS RESPONSE IN ZEBRAFISH BY DIFFERENT MICROGRAVITY ENVIRONMENTS

Abstract

It has been proved that the presence of humans in space requires meticulous mission design and critical understanding of physiological parameters. Space is a hostile environment that has caused numerous health hazards in astronauts, including alterations in vascularization system and high rates of muscle atrophy. Therefore, understanding the molecular pathways mediating space-induced alterations on human physiology is a necessity in making future missions a success. The goal of this study is to use zebrafish (Danio rerio) embryos as a unique model, which has genomic similarities to humans, to study molecular mechanisms of simulated and real microgravity effect on vascularization system and stress response. To simulate microgravity, we used a two-dimensional clinorotation device to expose zebrafish embryos at 1-day postembryonic fertilization and lasting for four days. Changes of 38 genes expression was measured by q-PCR. Thus, we used a unique zebrafish strain labelled with fluorescent protein allowing to image vascularization system using state of the art confocal microscopy. Our preliminary results indicate that only a small proportion of genes are affected by early simulation of microgravity. Our next goal is to confirm our findings by exposing zebrafish embryos to microgravity during suborbital flight. Our project entitled Muscular characterization in Microgravity Universal Spacelab (McXIMUS) is a joint research collaboration between the Embry- Riddle Aeronautical University (ERAU) and the University of Texas Health Science Center in San Antonio (UTHSCSA) to fly a suborbital payload aboard Blue Origin's New Sheppard vehicle this Spring, 2019. To ensure the safe environment for zebrafish embryos during the suborbital flight, we designed a NanoLab to guarantee stable thermal conditions inside the payload. Our team has established proper procedures and validation checks to maximize the outcome of this novel scientific experiment. To the best of our knowledge, this is a first time when Danio rerio will be flown on suborbital flight mission to assess microgravity induced alterations on vascularization system and stress. Data obtained from this experiment will give insights into molecular pathways mediating vascular system and stress response and will assist in mapping out the strategies aimed to minimize the antagonizing effect of space travel. A comparative analysis of the pool of genes affected by different types of microgravity platforms and flight stressors (temperature, accelerations, and vibrations) across flight, ground and lab controls will be provided. Thus, this study has a potential to lay foundation for orbital experiments.