Paper ID: 32119
student

IAA/IAF SPACE LIFE SCIENCES SYMPOSIUM (A1)
Human Physiology in Space (2)

Author: Mr. Charles Laing
German Aerospace Center (DLR), Germany, charles.laing@dlr.de

G-LEVEL INDEPENDENT RADIUS ALTERATIONS AFFECT CARDIOVASCULAR RESPONSES TO CENTRIFUGATION

Abstract

Exposure to microgravity causes a head-ward fluid shift that current spaceflight countermeasures fail to fully ameliorate. Artificial gravity (AG) through short-arm human centrifugation (SAHC) has been proposed as a possible countermeasure. Whilst the responses to increasing g-levels are well characterized , the effects of a shift in rotational axis position (RAP), independent of g-level, are not known. We hypothesized that a shift in RAP to in-body rotation (IBR) at heart-level, with comparable g-level at the feet, would have a beneficial effect on g-tolerance through supported cerebral perfusion from head-ward arterial pressure increases. To test our hypothesis we performed a study with twenty (10 male; 10 female) healthy participants (mean +/- SE; age: 26.2 +/- 0.9 yrs and BMI: 22.9 +/- 0.4 kg.m-2) who underwent passive short-arm centrifugation, in which profiles were randomized, for periods of 10 min five times per day on two separate days, two months apart. Each centrifuge profile consisted of one of three centers of rotation (either above the head – P1; apex of the head – P2 or IBR at heart-level – P3) at one of three different g-levels (either 1.0 +Gz – G1; 1.7 +Gz – G2; or 2.4 +Gz at the feet – G3). Cerebral perfusion (cerebral near-infrared spectroscopy for tissue saturation index, cTSI), central volume loss (strain gauge plethysmography for calf circumference, CC) and cardiovascular response for heart rate (HR) were all continuously measured. G-tolerance to each position was obtained by recording the number of participant centrifuge runs with pre-syncopal symptoms (PSS). In the last minute at 2.4 gz, ΔCC increases were attenuated from P1 (5.02 0.24 mm) to P3 (2.72 +/- 0.13 mm, $p < 0.05$) and ΔHR from P1 (41 +/- 2 bpm) to P3 (9 +/- 1 bpm, $p < 0.05$). cTSI decreases were attenuated from P1 (-4.14 +/- 0.31 The present data demonstrate that RAP has an influencing factor on cardiovascular response similar to well characterized g-level effects. Specifically, a RAP shift towards the heart being comparable to reducing g-level. Thus, future centrifuge studies would benefit from considering RAP in addition to g-level.