Ocular Outcomes Comparison Between 14- and 70-day Head-down Tilt Bed Rest

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INTRODUCTION: Ophthalmological changes, including optic disc edema with optic nerve sheath distension, posterior globe flattening with hyperopic shift, choroidal folds and cotton wool spots have been detected in some astronauts involved in long-duration spaceflights.[1] It is hypothesized that elevated intracranial pressure resulting from microgravity-induced cephalad fluid shifts may be responsible for most of these findings. Head-down tilt bed rest (HTDBR) is a ground-based microgravity analog which also produces cephalad fluid shifts. It is conceivable that prolonged HDTBR exposure may induce ocular changes similar to those experienced in microgravity. Therefore, the purpose of the present study was to compare structural and functional ocular outcomes between 14- and 70-day HDTBR in healthy human subjects. It is hypothesized that 70-d HDTBR induced ocular changes of greater magnitude as compared to 14-d HDTBR.

METHODS: Two HDTBR studies were conducted at the NASA Flight Analogs Research Unit, located at The University of Texas Medical Branch at Galveston, TX. Identical NASA standard screening procedures and BR conditions (e.g., strict sleep-wake cycle, standardized diet, continuous video monitoring) were implemented in both studies. Participants spent 14 and/or 70 consecutive days in a 6° HDT position and did not engage in exercise. Subjects received weekly ocular examinations before, during, and after HDTBR. Ocular testing included: distance and near best-corrected visual acuity (BCVA), cycloplegic refraction, intraocular pressure (IOP) measurement, color vision, red dot test, modified Amsler grid test, confrontational visual field, color fundus photography and Spectral-domain OCT scans of the macula and the optic disc. Pre/post HDTBR differences between the two studies will be evaluated for BCVA, spherical equivalent, IOP, retinal nerve fiber layer (RNFL) thickness and macular OCT parameters.

RESULTS: 16 (12 males and 4 females) and 6 (5 males and 1 female) subjects participated in the 14 and 70-day HDTBR studies, respectively. One subject participated in both studies. The demographic and ophthalmological characteristics of the 14-day HDTBR study have been presented elsewhere.[2] In the 70-day study, subjects age averaged 39.5 ± 7.8 years; pre- and post-HDTBR Goldmann IOP were, on average, 15.4 and 14.6 mmHg in the right eye, and 15.3 and 14.4 mmHg in the left eye, respectively; pre- and post-HDTBR Spectralis OCT (Heidelberg Engineering, GmbH, Heidelberg, Germany) average RNFL thickness were 103.8 and 106 µm in the right eye, and 103 and 104.3 µm in the left eye, respectively. In both studies, color vision, red dot test, modified Amsler grid test and confrontational visual field were within normal limits at all time points; no changes were detected on stereoscopic color optic disc photography. For the above outcomes, preliminary results of the pre/post HDTBR differences between the two studies will be presented at the 2015 Human Research Program Investigators' Workshop.

CONCLUSIONS: Although 14-day HDTBR did not seem to induce clinically relevant ocular changes,[2] a systematic evaluation and comparison with the 70-day HDTBR study results will elucidate whether the magnitude of ocular structural and functional changes is affected by the time spent in the recumbent position. Further research will also address the effects of integrated resistance and aerobic training during HDTBR on the ocular outcomes.

REFERENCES:

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