OPTIC NERVE SHEATH DIAMETER: TRANSLATING A TERRESTRIAL FOCUSED TECHNIQUE INTO A CLINICAL MONITORING TOOL FOR SPACEFLIGHT

Sara Mason¹, Millennia Foy², Ashot Sargsyan², Kathleen Garcia², Mary L. Wear², Deepak Bedi³, Randy Ernst³, Mary Van Baalen⁴

¹MEI Technologies, ²Wyle Science, Technology and Engineering Group, ³University of Texas MD Anderson Cancer Center, ⁴NASA Johnson Space Center

Introduction

Ultrasonography is increasingly used to quickly measure optic nerve sheath diameter (ONSD) when increased intracranial pressure (ICP) is suspected [1]. NASA Space and Clinical Operations Division has been using ground and on-orbit ultrasound since 2009 as a proxy for ICP in non-acute monitoring for space medicine purposes. In the terrestrial emergency room population, an ONSD greater than 0.59 cm is considered highly predictive of elevated intracranial pressure [1]. However, this cut-off limit is not applicable to the spaceflight setting since over 50% of US Operating Segment (USOS) astronauts have an ONSD > 0.60 cm even before launch. Crew Surgeon clinical decision-making is complicated by the fact that many astronauts have history of previous spaceflights. Our data characterize the distribution of baseline ONSD in the astronaut corps, its longitudinal trends in long-duration spaceflight, and the predictive power of this measure related to increased ICP outcomes.

Results

Within the astronaut cohort, we have determined that ultrasound measurement of ONSD using a standardized method has high inter-rater reliability. Terrestrial values for ONSD have limited generalizability to the astronaut population due to significant differences in the setting, health status, population characteristics, and measurement fidelity. This necessitated creation of population-specific distribution curves.

Figure 1. First ground measurement.

Figure 2. Inflight averages vs. time.

Figure 3. Preflight ONSD vs. disc edema.

Discussion

1. A cohort-specific distribution curve of the ONSD values was successfully created, thus providing a reference framework for clinical use of ONSD.
2. Astronauts who developed disc edema started out with larger preflight ONSD values (difference of 0.09; 95%CI: 0.06, 0.13; p<0.001).
3. Inflight ONSD appears to moderately increase (difference of 0.05; 95%CI: 0.01, 0.10; p<0.0001).
4. More data are necessary to assess the clinical significance of trends within an individual astronaut.

Conclusions

Future Work

Optic nerve sheath diameter is just one of the many features of the eye and orbit assessed with ultrasound; other features include globe length, disc elevation, and posterior globe flattening. A broader analysis is underway to examine the value of these anatomical and functional criteria for clinical management, as well as to elucidate the intricate mechanisms in the pathogenesis of VIIP phenomena.

Reference