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TRANSCRIPT

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Bits from "Bullets and Brains": Houston, We Have a (Health) Problem

Dr. Wilner:
You're listening to Book Club on ReachMD. I'm Dr. Andrew Wilner, and today I'll be reviewing one of the more than 100 essays from my book, Bullets and Brains.

Today, I'd like to update an essay I published on July 22, 2012, the title, Microgravity: A New Risk Factor for Idiopathic Intracranial Hypertension. In this chapter, I highlighted a paper published in the Journal of Radiology by Cramer et al. that demonstrated ocular abnormalities with 3 Tesla MRI in almost all of 27 astronauts who had significant microgravity exposure. All but 1 had a central area of T2 hyperintensity in their optic nerves; 7 had posterior globe flattening; 4 had optic nerve protrusion; 4 had optic nerve sheath diameter distention in association with optic nerve sheath kinking; and 3 had moderate concavity of the pituitary dome with posterior stalk deviation. It was hypothesized that these abnormalities might be related to increased intracranial pressure, but there was no clear explanation.

For today's podcast, I investigated whether there have been any updates on these observations. Indeed, as of 2018, more than 40 astronauts have been affected with a variety of neuro-ocular disorders. I read a 109-page evidence report published in 2017 by NASA entitled, The Risk of Space Flight-Associated Neuro-ocular Syndrome, or SANS, S-A-N-S. The first case of ocular abnormalities

was discovered in 2005, postflight, with the presence of optic disc edema and a cotton wool spot. As of 2016, 24 long-duration crew had inflight or postflight visual acuity and ocular anatomical changes that included choroidal folds, cotton wool spot, globe flattening, hyperopic shifts, and optic disc edema. This syndrome was originally termed Visual Impairment and Intracranial Pressure Syndrome, but the terminology has now changed to Space Flight-Associated Neuro-ocular Syndrome, or SANS. As many as 60% of Space Station astronauts who stay in microgravity conditions for a long duration report visual changes. Changes in vision have had practical ramifications in that many astronauts have had to alter their reading glasses prescription inflight. Space Station astronauts are now provided with adjustable glasses for that purpose.

In 2010, NASA standardized medical monitoring for the syndrome with ocular surveillance that includes 3 Tesla MRIs, special NASA astronaut protocol, visual-field perimetry, cycloplegic refraction, optical coherence tomography, or OCT, and other tests. It is known that under microgravity conditions there is a cephalad fluid shift resulting in cerebral venous congestion. Brain MRI findings reported in the New England Journal of Medicine in 2017 included narrowing of the central sulcus, upward shift of the brain, and narrowing of CSF spaces at the vertex. However, the duration and clinical significance of these changes are not yet known.

The explanation of the SANS syndrome is still under investigation. While the ocular findings resemble those from idiopathic intracranial hypertension, the astronauts did not complain of typical associated symptoms, such as headache or pulsatile tinnitus, and sometimes the findings were unilateral, which would be unusual for idiopathic intracranial hypertension.

Astronauts face well-known health hazards, such as radiation exposure from galactic cosmic rays and solar proton events, as well as muscle and bone loss due to microgravity. In addition, it appears that long-duration microgravity exposure affects not only the visual system, but the position of the brain in the skull. Intracranial pressure may also be elevated. Importantly, it is unclear to what extent these changes are reversible. As astronauts prepare for even longer space journeys, such as a voyage to Mars, NASA is actively investigating the impact of microgravity on human physiology and searching for strategies to mitigate its adverse effects.

For more information on my book, Bullets and Brains, and to access other episodes of this series, visit ReachMD.com/BookClub where you can be Part of the Knowledge. For ReachMD, I'm Dr. Andrew Wilner. Thanks for listening.