AJNR

Comments on ''Prolonged Microgravity Affects Human Brain Structure and Function''

J.J. Bevelacqua, J. Welsh and S.M.J. Mortazavi

AJNR Am J Neuroradiol 2020, 41 (2) E7
doi: https://doi.org/10.3174/ajnr.A6387
http://www.ajnr.org/content/41/2/E7

Comments on "Prolonged Microgravity Affects Human Brain Structure and Function"

This letter addresses the article, "Prolonged Microgravity Affects Human Brain Structure and Function."[1] To investigate whether brain structural changes (which can be observed after long-term space missions) are associated with alterations in motor or cognitive function, Roberts et al[1] retrospectively analyzed brain MR images of National Aeronautics and Space Administration astronauts to quantify pre- to postflight alterations in brain structure. They showed that brain structural changes were linked to changes in cognitive and motor test scores as well as the development of spaceflight-associated neuro-optic syndrome. However, due to the small sample size and number of comparisons, they suggested that their findings should be interpreted with cautioun.

Although this article has certain strengths, it has at least 1 major shortcoming that stems from ignoring the key point that in long-duration deep space missions, astronauts are exposed to multiple stressors ranging from psychological stress due to the confined environment to ionizing radiation and gravitational changes. It is not well-understood whether these stressors impact the central nervous system only individually or in combination (ie, synergistically). However, what we are fully aware of is the key role of space radiation on human brain function, according to Parihar et al,[2] "The Mars mission will result in an inevitable exposure to cosmic radiation that has been shown to cause cognitive impairments in rodent models, and possibly in astronauts engaged in deep space travel." Cucinotta et al[3] have also confirmed galactic cosmic ray (GCR)-induced alterations in astronauts' cognitive function, "Galactic cosmic rays may alter astronauts, cognition during space missions." Cucinotta et al also reported that exposure to GCRs can be associated with increased risk of CNS disorders, "GCR[s] may increase central nervous system risks including Alzheimer disease." Most important, Krukowski et al[4] reported that novel pharmaceutical agents are being explored for their ability to protect memory function in rodents exposed to simulated cosmic radiation, "Now neuroscientists have identified a potential treatment for the brain damage caused by cosmic rays, a drug that prevents memory impairment in mice exposed to simulated space radiation." In summary, this omission has possibly affected the validity of the findings of the study conducted by Roberts et al.[1]

http://dx.doi.org/10.3174/ajnr.A6387

Disclosures: James Welsh—*UNRELATED*: *Grant*: I have a Small Business Innovation Research grant from the National Institutes of Health, but it is related to proton radiography and proton beam CT scanning; *Consulting Fee or Honorarium*: I am an advisor to TAE Life Sciences for boron neutron capture therapy.* *Membership*: Coqui Pharma, *Comments*: I have received no financial remuneration; *Employment*: Department of Veterans Affairs, *Comments*: This is my primary employer; *Patents (Planned, Pending or Issued)*: I hold a patent for a method to reduce adverse effects of reirradiation by adjusting the effective dose rate. So far, I have received no financial benefit; *Royalties*: Prometheus Books, *Comments*: I am the author of *Sharks Get Cancer, Mole Rats Don't: How Animals Might Hold the Key to Cancer Immunity*. This was published in 2016. *Money paid to the institution.

REFERENCES

1. Roberts DR, Brown TR, Nietert PJ, et al. **Prolonged microgravity affects human brain structure and function.** *AJNR Am J Neuroradiol* 2019;40:1878–85 CrossRef Medline
2. Parihar VK, Allen BD, Caressi C, et al. **Cosmic radiation exposure and persistent cognitive dysfunction.** *Sci Rep* 2016;6:34774 CrossRef Medline
3. Cucinotta FA, Alp M, Sulzman FM, et al. **Space radiation risks to the central nervous system.** *Life Sciences in Space Research* 2014;2:54–69 CrossRef
4. Krukowski K, Feng X, Paladini MS, et al. **Temporary microglia-depletion after cosmic radiation modifies phagocytic activity and prevents cognitive deficits.** *Sci Rep* 2018;8:7857 CrossRef Medline

J.J. Bevelacqua
Bevelacqua Resources
Richland, Washington

J. Welsh
Department of Radiation Oncology
Edward Hines Jr VA Hospital
Hines, Illinois

S.M.J. Mortazavi
Diagnostic Imaging Department
Fox Chase Cancer Center
Philadelphia, Pennsylvania
Medical Physics Department
School of Medicine
Shiraz, Iran