



The increased protein tau in blood after SCUBA diving can be related to distal arterial bubbles

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Dear Editor,

A comment to the study: Rosén A. et al. Protein tau concentration in blood increases after SCUBA diving: an observational study. *Eur J Appl Physiol* 2022; 122: 993–1005. In their interesting recent study, Rosen et al. (2022) determined tau protein as a marker of brain injury following an immersed hyperbaric exposure. In the search for the cause of the injury they excluded oxygen toxicity and reported no relationship to venous gas emboli (VGE). They conclude “The physiological mechanism that causes tau levels to increase, after presumed neuronal stress without manifest injury to the CNS has not been identified”. Impaired cognitive performance in divers was the drive for this research and the take-up message is to further explore tau as a marker for brain injury in diving.

We suggested a mechanism for distal arterial bubble formation (Arieli and Marmur 2017). In the bifurcating arterial tree, the vessel’s wall becomes thinner and wall surface to the volume of the vessel increases. Both of these enhance nitrogen diffusion from the surrounding tissue into the blood. A local reduction in the perfusion would leave more time for nitrogen diffusion. When a nanobubble forms at an active hydrophobic site (AHS) located in a distal artery, it will develop into a decompression bubble which may, in turn, block the artery. Expansion of bubbles downstream the arterial tree was suggested to explain the microvascular insult and the focal highly localized punctate lesions in the white matter of experienced divers as well as a deterioration in the neuropsychometric performance which was found in experienced divers. It was also suggested to explain the

increased risk in DCI, in spinal decompression illness, as compared to the brain. Distal arterial bubble formation was also suggested as a main cause of taravana and vestibular DCI (Arieli 2019) and also the cause for neurological disorders in breath-hold diver who dive repeatedly (Arieli 2021).

It is well possible that the increased tau after diving is due to formation of distal arterial bubbles which eventually evolve into the lesions in the white matter and could be the cause of impaired cognition. There is almost no “oxygen window” in the arterial blood. Therefore a distal arterial bubble, which is not large enough to block perfusion, would stay at the AHS for long time. In the following dive, it would expand to block perfusion and cause further damage. This can explain the increased tau after the second dive in the study of Rosen et al. (2022). The reported higher tau values in repeated deep open sea diving as compared to the values reported by Rosen et al. (2022; 42 msw, 10-min hyperbaric chamber), substantiate the suggestion of distal arterial bubble formation, i.e., larger decompression stress and repeated diving.

Author contributions Ran Arieli is the only author of this letter to the Editor.

Declaration

Conflict of interest There is no conflict of interest.

References

- Arieli R (2019) Taravana, vestibular decompression illness, and autochthonous distal arterial bubbles. *Respir Physiol Neurobiol* 259:119–121. <https://doi.org/10.1016/j.resp.2018.08.010>
- Arieli R (2021) Diving-related disorders in breath-hold divers could be explained with the distal arterial bubble hypothesis. *Div Hyperb Med* 51:382–383
- Arieli R, Marmur A (2017) A biophysical vascular bubble model for devising decompression procedures. *Physiol Rep* 5:e13191. <https://doi.org/10.14814/phy2.13191>
- Rosén A, Gennser M, Oscarsson N, Kvarnström A, Sandström G, Seeman-Lodding H, Simrén J, Zetterberg H (2022) Protein tau

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concentration in blood increases after SCUBA diving: an observational study. *Eur J Appl Physiol* 122:993–1005. <https://doi.org/10.1007/s00421-022-04892-9>

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