

Author Response: Posture-Dependent Collapse of the Optic Nerve Subarachnoid Space: A Combined MRI and Modeling Study

We thank Killer et al. for their interest in our paper “Posture-dependent collapse of the optic nerve subarachnoid space: A combined MRI and modeling study.”¹ We agree with the authors that the microstructures within the optic nerve subarachnoid space (ONSAS) may affect the ONSAS pressure, and we included this as a limitation in the original article.¹ These potential effects need to be further investigated and we are currently working on implementing such effects into our model using porous media modeling. However, there is evidence supporting the notion that a sufficient decrease in the cerebrospinal fluid pressure can break the communication between the cranial subarachnoid space and the ONSAS. For example, animal studies have shown that when the cerebrospinal fluid pressure in the cranium is artificially decreased, there is a breakpoint where the communication (correlation) between the ONSAS pressure and the cranial subarachnoid space pressure (intracranial pressure) vanishes,^{2,3} with the pressures showing a similar behaviour as that predicted by our model (where the intracranial pressure is instead decreased by a change in posture). Whether this pressure breakpoint is really reached in the upright posture (in vivo), as our model predicts, remains to be fully determined. High-resolution imaging in the upright posture could be a possible way forward to further investigate this suggested mechanism.

We also want to take the opportunity to emphasize that although our model is a 0D model, the ONSAS does not collapse everywhere because the ONSAS (and the ONSAS flow resistance) was divided into 13 segments along the optic nerve, based on magnetic resonance imaging, and collapse only occurred in the model at one posterior region of the ONSAS. Thus, there still is a significant volume of cerebrospinal fluid within the “noncollapsed” parts of the ONSAS, including the region closest to the eye (thus the modeled ONSAS volume and area was not zero in the upright posture).

Finally, we agree that compartmentalization may be the appropriate terminology when describing a major obstruc-

tion of the fluid dynamic communication along the ONSAS, and we will use this terminology going forward. However, we also want to stress that a compartmentalization owing to collapse does not have to mean a total occlusion, only that the resistance to flow is large enough to decouple the two pressures on either side of the collapse.

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