

# Cerebral Tissue Oxygenation Saturation Does Not Equate With Cerebral Oxygen Availability

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Dear Editor,

We read with great interest the nice paper of Hasler et al. [1]. The main result of this study is that in COPD patients without hypoxemia, breathing oxygen-enriched air improves exercise performance. In addition, using near-infrared spectroscopy, the authors reported a higher cerebral tissue oxygen saturation (CTO) in the breathing oxygen-enriched air condition during exercise. This was interpreted as an increased oxygen availability to the brain. We have some major concerns regarding this interpretation. CTO as measured by NIRS provides an estimation of oxygen saturation in the brain tissue, as did pulse oximetry at the finger or the ear [2]. Therefore, it absolutely does not reflect the amount of oxygen availability to the brain, which depends not only on oxygen saturation variations but also on the amount of hemoglobin and of cerebral blood flow. Yet in humans, any increase in blood oxygen tension (PaO<sub>2</sub>) leads in turn to a reduction of cerebral blood flow due to the cerebrovascular reactivity mechanism (e.g., [3]). This mechanism, which is thought to ensure cerebral homeostasis [4], acts to maintain the amount of oxygen availability in the brain (the exact opposite mechanism is also observed during hypoxia through a cerebral blood flow increase). Cere-

brovascular O<sub>2</sub> reactivity has also been confirmed in patients with COPD a few years ago [5]. Using a design close to the study of Hasler et al. [1], Vogiatzis et al. [5] recorded both cerebral blood flow and CTO in desaturating COPD patients during exercise while breathing air or 100% oxygen. They also calculated cerebral oxygen availability as the product of cerebral blood flow and arterial oxygen content (CaO<sub>2</sub>, of which CTO is a component, together with PaO<sub>2</sub> and hemoglobin concentration). While CTO was higher under oxygen supplementation, as it was in the study of Hasler et al. [1], the authors also reported a reduced cerebral blood flow in this condition. Consequently, the cerebral oxygen availability was reported as equivalent with or without oxygen supplementation, despite the increased CTO and CaO<sub>2</sub>. These results definitely show that considering that any increase in CTO reflects an increased oxygen availability to brain, without having controlled the cerebral blood flow, is a misleading interpretation. While we believe that this limitation should have been acknowledged in the paper of Hasler et al. [1], this does not impact the quality of the method and of the study and the other conclusions of the paper.

## Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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## Author Contributions

F.A. wrote the first draft of the manuscript. A.V. and N.H. commented on the manuscript. All authors approved the final version of the manuscript.

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