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Presentation Abstract

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Title:	Two-photon microscopic measurement of distribution and cerebral metabolic rate of oxygen in cortical tissue
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Abstract: The ability to measure oxygen partial pressure (pO_2) with high temporal and spatial resolution in three dimensions is crucial for understanding oxygen delivery and consumption in normal and diseased brain. Until now, the lack of technologies for direct 3D mapping of oxygen availability in the brain has been a major limiting factor in investigations of oxygen metabolism. This limitation was overcome by recent development of the two-photon-enhanced phosphorescent nanoprobe, which allows for direct high-resolution mapping of cortical tissue and intravascular pO_2.

We applied this new technology to obtain for the first time extensive pO_2 maps in rat's cortical tissue. Measurement through a sealed cranial window reveals steep pO_2 gradients around both pial and descending arterioles. In contrast, pO_2 maps around ascending venules and capillaries indicate significant heterogeneity of the tissue oxygen concentration in venous and capillary compartments. Most importantly, high density tissue pO_2 maps

allow for the first time calculation of the cerebral metabolic rate of oxygen ($CMRO_2$) based on tissue pO_2 gradients with unprecedented spatial resolution. The calculation was performed using pO_2 gradients around arterioles based on the Krogh's model.
The developed methodology enables high-resolution depth resolved mapping of cortical tissue pO_2 and assessment of $CMRO_2$ that will provide critical insight into the metabolism and function of the normal brain as well as into various neurological conditions and stroke. Furthermore, this methodology can be directly applied in other areas, such as cancer and heart failure, where accurate non-invasive determination of pO2 is the key to understanding physiological function. The synergism of two-photon phosphorescent measurements of pO_2 with other two-photon microscopy tools for imaging of neuronal, vascular and metabolic activity opens the door to a more integrative approach for addressing critical questions regarding the order of pathological events in the progression of disease and promises to provide an objective way for screening of potential therapies

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