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Presentation Abstract

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Presentation Title: Spatial gradient of vasodilation kinetics in the mouse somatosensory cortex

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Authors: **P. TIAN**[1,6], H. UHLIROVA[2], Q. CHENG[1], K. L. WELDY[1], P. A. SAISAN[1], K. NIZAR[1], T. C. STEED[1], V. B. SRIDHAR[3], G. A. SILVA[4], A. M. DALE[5], *A. DEVOR[5,7];
[1]Neurosciences, [2]Radiology, [3]Bioengineering, [4]Bioengineering & Opthalmology, [5]Neurosciences & Radiology, Univ. of California San Diego, LA JOLLA, CA; [6]John Carroll Univ., University Heights, OH; [7]MGH, Harvard Med. Sch., Charlestown, MA

Abstract: Neuroglial activation is accompanied by release of vasoactive mediators that dilate and constrict the surrounding arterioles and capillaries. In our recent study (1) using *in vivo* 2-photon imaging of single blood vessels in the rat primary somatosensory cortex (SI), we demonstrated a spatial gradient of dilation onset and peak times consistent with "upstream" propagation of vasodilation towards the cortical surface along the diving arterioles. In Tian et al. PNAS 2010, the measurements were performed down to ~500 μm (the upper boundary of layer IV in the rat SI) and the deepest locations exhibited the fastest dilation.
In the present study, we translated this experimental paradigm to the mouse SI in order to reach cortical layers IV and V. The main advantages of using mice for 2-photon vascular imaging, as opposed to rats, are: (1) a thinner cortex, allowing imaging of deeper layers for the same penetration depth; and (2) weaker scattering of light in the cortical tissue, allowing deeper 2-photon imaging. First, we reproduced our findings from the rat SI within a comparable range of cortical depths. Then, we extended imaging down to a depth of over 700 μm; 700 μm corresponds to mid-layer V in the mouse SI. Our results show that the onset of dilation along individual

arterioles decreased with depth throughout the entire range. Further, using a combination of direct microinjections of glutamate and 2-photon imaging, we provide evidence that local neurovascular coupling mechanisms are present in upper layers, including layer I. We conclude that propagation from deeper layers within vascular walls is not the only mechanism behind dilation in the upper layers. Rather, both local and propagated signaling is present in the upper layers, while local neurovascular communication has slower kinetics. While further investigation is needed to address the mechanisms behind the timing differences of local neurovascular coupling across layers, our current data suggest that this mechanism is not immediately related to the level of metabolic activity. This is because the earliest dilation was detected in layer V, whereas the highest metabolism is known to occur in layer IV. The observed gradients of dilation onsets are in agreement with a recent high-resolution fMRI study in humans (2), suggesting evolutional conservation of this phenomenon.

1. Tian P*, et al.* (2010) *Proc Natl Acad Sci U S A* 107(34):15246-15251.
2. Siero JC, Petridou N, Hoogduin H, Luijten PR, & Ramsey NF (2011) *J Cereb Blood Flow Metab* 31(10):1999-2008.

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