

319.07 / U15 - Vasoconstriction induced by cortical inhibition reduces cerebral blood flow and hemoglobin oxygenation

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Presenter at Poster

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Poster

Authors

***M. DESJARDINS**^{1,2}, **K. KILIÇ**³, **C. MATEO**⁴, **P. SAISAN**³, **C. L. G. FERRI**³, **Q. CHENG**³, **K. WELDY**³, **D. KLEINFELD**^{4,5,6}, **A. DALE**^{2,3}, **A. DEVOR**^{3,2,7}; ²Radiology, ³Neurosciences, ⁴Physics, ⁵Section of Neurobio., ⁶Electrical and Computer Engin., ¹UCSD, La Jolla, CA; ⁷Martinos Ctr. for Biomed. Imaging, Massachusetts Gen. Hosp. / Harvard Med. Sch., Charlestown, MA

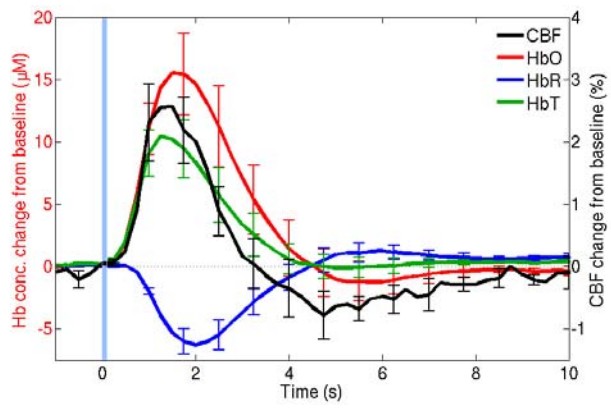
Disclosures

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Abstract

Positive Blood Oxygen Level Dependent (BOLD) functional magnetic resonance imaging (fMRI) signal arises in response to neural activity when an increase in cerebral blood flow (CBF) overcompensates for the competing increase in cerebral metabolic rate of oxygen (CMRO₂), causing a decrease in deoxyhemoglobin concentration ([HbR]). Yet, the origin of the negative BOLD (nBOLD) signal, arising under certain conditions, is still debated. Using optogenetics and two-photon microscopy *in vivo*, we have previously shown that inhibitory activity elicits a biphasic arteriolar response with a dilation followed by a constriction phase [1]. Arteriolar dilation and constriction lead to increase and decrease in CBF, respectively. However, accompanying changes in blood oxygenation also depend on CMRO₂ and thus remain unknown. To address this question, we performed simultaneous measurements of intrinsic optical signals (IOS) and laser speckle contrast (LSC) in response to optogenetic stimulation of inhibitory neurons through thinned skull over the somatosensory cortex of awake, head-fixed VGAT-ChR2(H134R)-EYFP mice. IOS provide measurements of oxy- ([HbO]), deoxy- and total ([HbT] = [HbO]+[HbR]) hemoglobin concentrations. LSC is inversely proportional to CBF. The measured ROI- and group-averaged timecourses of [HbO], [HbR], [HbT] and CBF responses (Fig. 1) show that activation of inhibitory neurons elicits a biphasic hemodynamic response. During the initial CBF increase, [HbO] increases while [HbR] decreases; during the following CBF decrease, [HbO] decreases and [HbR] increases. Therefore, the vasoconstriction phase elicited by neuronal inhibition causes a decrease in both blood flow and oxygenation, which would be reflected as nBOLD in fMRI. [1] Uhlirova H et al. SfN abstr 2014 #352.10. Fig. 1: Average timecourses +/- s.e.m. (N=3, 720 trials total, each trial was a single 100 ms, ~6 mW pulse of 450 nm).

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