Neurometabolic & Neurovascular Couplings Underlying Quantitative BOLD

Functional magnetic resonance imaging (fMRI) with blood-oxygenation level dependent (BOLD) contrast is an important tool for neuroscience. But interest in quantitative fMRI emerged out of awareness that oxidative, not glycolysis, energetics supports brain function. Relationships between BOLD signal and the underlying neurophysiological parameters have been elucidated to allow determination of dynamic and laminar changes in cerebral metabolic rate of oxygen consumption (CMR_{O2}) by "calibrated fMRI," which require multi-modal high-resolution measurements of BOLD signal along with cerebral blood flow (CBF) and volume (CBV). But how do CMR_{O2} changes, steady-state or transient, derived from calibrated fMRI compare with neural activity recordings of local field potential (LFP) and/or multi-unit activity (MUA)? I will discuss recent findings, primarily from animal studies, which allow high magnetic fields studies for superior BOLD sensitivity as well as multi-modal CBV and CBF measurements in conjunction with LFP and MUA recordings. I will also discuss pros and cons of various "calibrated fMRI" methods (e.g., absolute R_2' mapping vs. CO_2/O_2 gas challenges) and their implications for CMR_{O2} quantification.