Magnetic Resonance Imaging of Cerebral Physiology — A Multimodal Approach.

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Most functional MRI (fMRI) studies rely on the blood-oxygen-level dependent (BOLD) signal to image regions in the brain that respond to task-specific neural activation. While the BOLD method has played a key role in mapping brain function under healthy conditions, translation of the BOLD data into clinically useful outcomes has been ineffectual. The lack of physiological specificity and the fact that the BOLD signal is dependent on baseline conditions largely account for the limited success of BOLD fMRI in clinical research. In recent years, there has been a surge in the development of new fMRI modalities that provide a direct and absolute measurement of physiological correlates of brain function, such as cerebral blood flow (CBF) and cerebral blood volume (CBV). Multimodal imaging has become increasingly important because no single imaging approach has the capacity to provide a comprehensive assessment of brain function. Furthermore, multimodal techniques combine anatomical with functional information to identify mechanism-based processes in the brain that are affected by aging and/or disease. One of the main challenges we face is to develop the methodology that integrates fMRI data with other physiological data, such as EEG and TMS, for developing earlier markers of disease and for reliable tracking of disease progression and therapy.