ASL Applications: Clinical, Pharma, Cognitive Neuroscience, etc.

Perfusion Imaging: ASL, DCE & DSC

Saturday, 20 April 2013

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Target audience: *Anyone interested in functional imaging and its applications*

Objective: *– Get an idea of what ASL measures and how is used in clinic practice, in clinical research, and in cognitive neuroscience*

Highlights

- *Microvascular perfusion is a key physiological parameter and perfusion disorders are common sources of medical morbidity and mortality*
- *Perfusion also reflects alternations in tissue function caused by functional activation, pharmacological actions, or disease states*
- *In the brain, ASL is a biomarker of regional brain function that is noninvasive, quantitative, and suitable for basic, research, and clinical applications*

Abstract

Perfusion provides oxygen and nutrients to tissues at the microsvascular level and is closely linked to tissue function. Disorders of perfusion are major sources of medical morbidity and mortality, and perfusion is altered in other types of pathologies as well. ASL allows noninvasive perfusion quantification with MRI, and ASL implementations are available for most scanner platforms. Although ASL MRI can be carried out in any organ, most studies to date have focused on the brain. In brain, regional microvascular function reflects regional brain function and can be used to quantify neural activity as a function of genotype, phenotype, and cognitive, disease, or pharmacological state. In tumors, microvascular function appears indicative of tumor grade and the response to antiangiogenesis therapies. CBF and related parameters are useful in characterizing cerebrovascular disease and in differentiating it from other conditions. Vessel selective ASL can also be used to obtain noninvasive angiography or to visualize the perfusion distribution of specific arteries. Specific patterns of CBF change are observed in Alzheimer's disease.

In basic neuroscience, ASL provides a measure of brain function that differs from BOLD contrast in its ability to measure resting or low frequency fluctuations in neural activity that are reflective of states and traits as well as task activation. The microvascular localization of the ASL signal is also associated with greater spatial and temporal resolution for mapping brain activity changes, though in practice the low SNR of most ASL methods makes this benefit difficult to realize. The utility of ASL in mapping connectivity networks is in the process of being elucidated. In clinical research, ASL provides a biomarker of neural activity that can be used to follow disease progression or responses to therapies. This is of particular interest in Pharma research, where biomarkers may reduce the sample sizes and hence cost of early phase studies. Because ASL directly quantifies a biological parameter, it should be particularly suitable to monitoring brain function in the context of multisite and/or longitudinal studies, though this is only beginning to be validated.

This brief presentation will cover common clinical and research applications of ASL MRI through examples.