An MRI Approach to the Quantification in vivo of Cerebral Blood Volume at High Resolution

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Recent literature suggests that Alzheimer's Disease (AD) may be initiated by a neurovascular mechanism that precedes neurodegenerative observations. Despite the potential great importance of observing the neurovasculature of AD patients, current in vivo vascular imaging techniques suffer from poor spatial resolution and accuracy. In this project, a non-invasive high-resolution in vivo MRI methodology and mathematical model were developed to quantify a crucial vascular parameter for evaluating blood vessels: cerebral blood volume (CBV). It is hypothesized that the change in the first order derivative of the signal decay between pre- and post-contrast images, $\Delta S'$, is linearly proportional to the concentration of the drug (mass of drug per volume of tissue), and therefore to CBV (assuming a homogeneous distribution of the drug). The model was applied to rodent imaging data to obtain CBV maps. The vascular architecture depicted matched the predicted architecture of a rodent brain. Indeed, coronal slices show areas of increased estimated CBV in series of voxels orthogonal to the axial surface of the brain, which is in accordance with previous rat histology data. A direct comparison with in vitro histology from the same rodent will be undertaken to validate the linear relationship between $\Delta S'$ and CBV. The novel methodology developed could be instrumental to the validation of the vascular hypothesis of AD and in the diagnosis of AD.

Awards Won:

Second Award of $2,000

University of Arizona: Tuition Scholarship Award