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Age-related Reductions of Cerebral Blood Flow and White Matter Integrity by High-Field Perfusion and Diffusion MRI

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Background: While neuroimaging findings of decreased cerebral blood flow (CBF) in healthy aging have been inconsistent, age-related degradation of white matter has been reported using diffusion tensor imaging (DTI). In order to identify imaging features which distinguish healthy aging from neurodegenerative diseases, such as Alzheimer's disease (AD), it is important to fully characterize age related changes. Objectives: 1) To determine the regional pattern of age-related CBF reduction; 2) To determine the regional variation of age-related DTI alterations; 3) To identify correlations between cortical CBF reduction and subcortical DTI alterations. Methods: Fifty-one cognitively normal (by neuropsychological testing) subjects(29 male, 22 female; Age 22-76 yrs) had structural MRI and DTI at 4 Tesla and a subgroup of 38 subjects had also perfusion MRI using arterial spin labeling (ASL). The effect of age on CBF was tested using Statistical Parametric Mapping (SPM). Fractional anisotropy (FA) of DTI was used to characterize white matter in the corpus callosum (CC) and in the cingulum fibers. Results: Age-related CBF reductions were found in bilateral anterior cingulate and parietal regions as well as in left superior temporal and posterior cingulate ($p<0.001$). Age-related FA reductions occurred primarily in the anterior CC ($p < 0.0006$) and posterior cingulum ($p = 0.01$). CBF reductions in the parietal cortex and FA reductions in the posterior cingulum were correlated. Discussion: Together, CBF and DTI findings indicate substantial involvement of parietal brain regions in healthy aging, similar to what is seen in AD. This would make it difficult to distinguish between healthy aging and early AD based on MRI. However, it is possible that the MRI alterations could indicate presymptomatic AD. Prospective studies on healthy subjects are necessary to determine the extent to which these MRI findings are markers of early AD.

Keywords : Cerebral Blood Flow, Arterial Spin Labeling, Diffusion Tensor Imaging