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Improved Arterial Spin Labeling Perfusion Method to Measure White Matter Perfusion at a 4 Tesla MRI

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Purposes: Measurement of cerebral blood flow (CBF) in white matter (WM) has been a major challenge due to a poor signal-to-noise (SNR) ratio and a long arterial transit time in WM. Therefore, technical improvements of better SNR and greater independence from transit time can play a significant role. The purpose of this work was that a pulsed arterial spin labeling (ASL) method is developed to achieve multislice WM CBF imaging at a high field magnetic resonance imaging (MRI). Methods: In the proposed ASL method, stationary spins in an imaging plane are kept at equilibrium to avoid noise due to T1 relaxation, while blood water is labeled using in-plane double inversion. The proposed method was tested on five subjects and compared with existing ASL MRI methods at a 1.5 Tesla MRI to show improvement and was tested on additional 7 subjects using echo-planar imaging (EPI) and Turbo-Flash (TFL) acquisitions using various post-labeling delay times to test feasibility to measure WM CBF at a 4 Tesla MRI. WM and gray matter (GM) CBF maps were obtained and analyzed within the statistical parametric mapping (SPM) tool. Results: CBF measurements with the proposed method were less confounded by magnetization transfer effects and less dependent on blood velocity than the existing methods studied at the 1.5T MRI. Furthermore, the proposed method yielded excellent gray/white contrast of CBF maps. The ratios of GM to WM CBF were consistently higher on TFL (average 1.61) than on EPI (average 1.45) at the 4T MRI. Furthermore, TFL acquisitions achieved more stable CBF measurements than EPI in various brain regions. Conclusion: The proposed ASL method improved CBF imag-ing at 1.5T and 4.0T and accomplished to measure CBF of WM at 4T. Therefore, the proposed method should improve accuracy in measuring regional CBF.

Keywords : Cerebral Perfusion, Magnetic Resonance Imaging, Arterial Spin Labeling