Oral PO-1

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Cerebral Perfusion with Arterial Spin Labeled MRI: Reliability and Clinical Applications in Alzheimer's Disease and Mild Cognitive Impairment

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목적 : Arterial spin labeled (ASL) MRI is a fast, repeatable, and noninvasive technique that uses endogenous arterial blood water as a tracer to measure regional perfusion on conventional MR scanners. Efficiency of ASL to tag blood water is one factor besides physiological and instrumental fluctuations that can limit the reliability of brain perfusion studies. Given the coupling between metabolism and perfusion in the cortex, ASL-MRI may detect similar functional changes to PET and SPECT while offering several advantages over these modalities. The objectives of this study were: 1) to measure perfusion reliability in healthy human brain and 2) to determine group differences in cerebral perfusion on Alzheimer's disease (AD), mild cognitive impairment (MCI), and cognitively normal (CN).

대상 및 방법 : For the reliability study, the three pulsed ASL tagging methods, EPISTAR [1], PICORE [2], and DIPLOMA [3], were scanned to measure test-retest reliability and reproducibility on thirteen healthy volunteers (mean age 4514 years, 4 men and 9 women) within two hours. Reliability of each pulsed ASL method was determined by comparing between to within subject variation of perfusion in terms of an intra-class correlation coefficient (ICC). Perfusion measures that were tested included a) overall mean perfusion, b) perfusion of gray matter, and c) perfusion of white matter. For group comparisons, twenty AD subjects, 18 MCI, and 23 CN subjects were studied with DIPLOMA ASL-MRI [3]. In addition to perfusion-weighted imaging, volumetric T1-weighted was acquired for tissue segmentation and normalization into a standardized space using SPM99 (Statistical Parametric Mapping, http://www.fil.ion.ucl.ac.uk/spm/). Perfusion images were co-registered to T1-weighted images, corrected for partial volume effect (PVE) using information from the T1-weighted image to determine the tissue content of perfusion voxels, and normalized to a disease specific template. Voxel-based analyses of group perfusion differences, with and without corrections for PVE, were performed using SPM'99. Both studies were performed on a 1.5T MR system (Siemens Vision).

결과 : Reliability of mean whole brain perfusion was best with DIPLOMA, achieving an ICC of 0.81, followed by PICORE with 0.78 and EPISTAR with 0.78 for ICC. Similarly, results of gray matter and white matter perfusion showed better reliability with DIPLOMA than with EPISTAR or PICORE. Furthermore, reliability of perfusion was usually higher for gray matter than for white matter. The AD group showed significant (cluster-level corrected $p < 0.05$) regional hypoperfusion in the right inferior parietal cortex extending into the bilateral posterior cingulate gyri ($P < 0.001$), bilateral superior and middle frontal gyri ($P < 0.001$), and left inferior parietal lobe ($P < .007$) when compared with controls even after accounting for PVE. With a more liberal voxel-level threshold of $P < 0.01$, the MCI group showed significant regional hypoperfusion relative to the CN group in the inferior right parietal lobe ($P < 0.046$), similar to the region of greatest significance in the AD group.

결론 : DIPLOMA ASL-MRI should provide superior power in detecting differences of perfusion between subjects and groups than EPISTAR or PICORE ASL-MRI. ASL-MRI measures regional hypoperfusion in AD in similar brain regions to those seen in FDG-PET and HMPAO-SPECT studies on similar populations and this hypoperfusion persists after accounting for underlying cortical gray matter atrophy. ASL-MRI, coregistered with structural MR, is a useful tool for the functional characterization of AD and may be useful for early detection of this disease.

References: 1) Edelman, R.R. and Q. Chen, Magn Reson Med, 1998. **40**(6): p. 800-5; 2) Wong, E.C., et. al. Magn Reson Med, 1998. **39**(5): p. 702-8; 3) Jahng, G.H., et al. Magn Reson Med, 2003. **49**(2): p. 307-14.