

Perfusion Weighted Magnetic Resonance Imaging in Alzheimer's Disease and Mild Cognitive Impairment: Initial Experience

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Background: Alzheimer's disease (AD) is associated with several vascular risk factors pointing to a microvascular insufficiency of gray and white matter in AD pathogenesis [1, 2]. Cerebral perfusion measurements in AD with PET and SPECT show hypoperfusion in: Hippocampus, temporo-parietal and frontal cortices [3, 4]. We hypothesize that perfusion weighted (PW) MRI with subsequent coregistration can serve as a tool for delineating microvascular perfusion abnormalities across AD patients and thus better characterize disease progression.

Objectives: To study regional perfusion abnormalities with PW-MRI in AD and mild cognitive impairment (MCI) patients compared with controls.

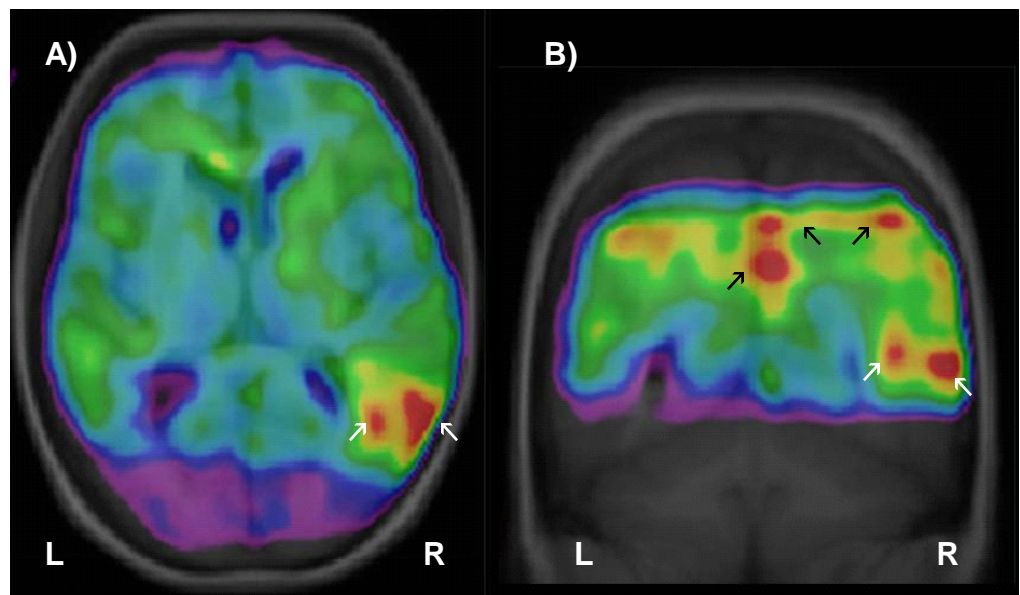
Methods: Patients (n=8) clinically suspected of mild to moderate AD or MCI (using ICD-10 and DSM-IV Criteria) and healthy age-matched controls (n=13) were studied with PW-MRI on a 1.5 T GE scanner. Following an axial T1, SE EPI was performed during i.v. bolus injection (5 ml/sec) of 0.2 mmol/kg gadobutrol (Gadovist® 1.0 M, Schering) immediately followed by 20 ml saline. Twelve axial slices were imaged at a spatial resolution of 1.6x1.6x6mm and mean transit time (MTT) maps calculated [5]. 3D-T1 and PWI maps were coregistered to Talairach space [6]. After blurring (FWHM 8 mm) to avoid effects of atrophy, a voxel by voxel t-test was performed to identify areas with significant MTT differences between patient and control group.

Results: PW-MRI was technically feasible in this patient group. Patients' MTT was **higher** ($p < 0.04$) than controls' in following areas: Right, medial, parietal gray matter and right posterior, temporal white and gray matter (Fig. 1).

Fig. 1.

Resulting t-test color map. Red areas represent regions with prolonged MTT in patient group ($p < 0.04$).

- A) Axial slice shows MTT prolongation in watershed area in posterior, white, and gray matter of right, temporal lobe.
- B) Coronal slice through red watershed area in A (white arrows). Black arrows point out other regions with significant MTT prolongation in right, parietal, gray matter of the medial brain surface.



Discussion: Our finding of prolonged MTT indicates low perfusion pressure in accordance with PET findings of low CBF and the high incidence of watershed infarcts known from post mortem AD studies. Group averages of functional MRI maps following coregistration provide a powerful tool to study diffuse disease markers. By combining perfusion measurements (MTT, CBV and CBF) with indicators of tissue microstructural damage (by DTI) we hope to further address the vascular and neurodegenerative pathogenesis of AD and MCI.

References: [1] de la Torre, JC: *Neurosci.Behav.Rev.* 18:397-401, 1994; [2] Brown, WR: *Ann.NYAcad.Sci.* 903:39-45, 2000; [3] Friedland, RP: *JCAT* 7:590-98, 1983; [4] Waldemar, G: *Cerebrovasc.BrainMetab.Rev.* 7:89-130, 1995; [5] Østergaard, L: *MRM* 36:715-25, 726-36, 1996; [6] Collins, DL: *JCAT* 18(2):192-205, 1994