MULTIPLE MRI MEASURES IN THE CHARACTERIZATION OF PATIENTS WITH EARLY ALZHEIMER DISEASE OR MILD COGNITIVE IMPAIRMENT - RELATIVE SPARING OF THE OCCIPITAL LOBES

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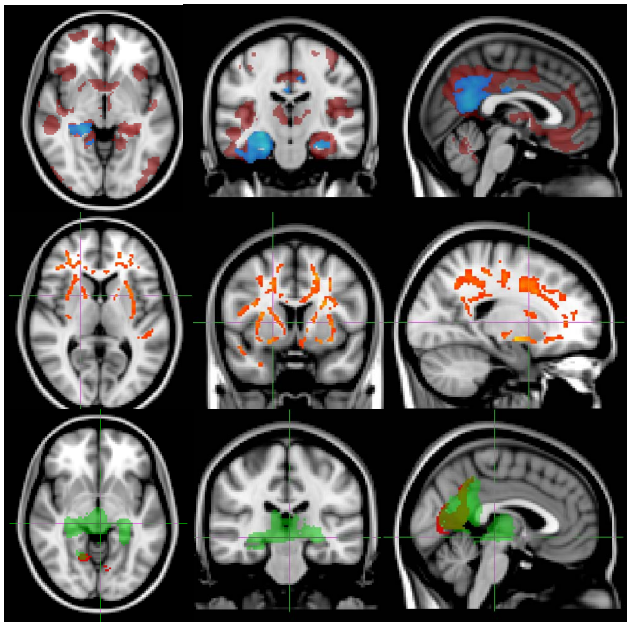
Background: In patients with degenerative mild cognitive impairment (dMCI) and Alzheimer's disease (AD) clinical MRI can exclude alternative pathologies. In addition, modern imaging techniques can characterise patients with dMCI and AD by providing specific morphological and pathophysiological information. As brain regions are affected differentially at different stages of AD, these techniques may also help to stage AD and thus allow for an estimate of the prognosis. Global or local measures of brain atrophy and in particular the rate of atrophy during the disease may be useful biomarkers. We employed further MR markers in combination with atrophy analyses, namely DTI, ASL perfusion imaging and MR-spectroscopy. Such a wide array of MR methods should by itself and in combination with clinical and laboratory findings increase the diagnostic accuracy of MCI and AD. The goal of the present study was to establish the feasibility and usefulness of a complex MRI protocol in a monocentric study.

Methods: All subjects received a comprehensive neuropsychological and clinical assessment and underwent an extensive MRI protocol (n=204, 121m 83f, mean age 72 years 50-89 years, healthy elderly (n=61), subjects with dMCI (n=65) and early Alzheimer disease (AD) (n=78). A 60 minutes MRI protocol was developed on a 3T Allegra head only MR system. It includes structural, diffusion, ASL perfusion MRI, and MR spectroscopy. Analysis: Structural and diffusion MRI data - FSLVBM (Voxel-Based Morphometry using FSL tools, to test for differences across groups in grey matter density, as imaged by structural MRI) and TBSS (Tract-Based Spatial Statistics, part of FSL, to test for differences in white matter microstructure across groups, as imaged by diffusion MRI). Inference was carried out using permutation testing, using TFCE (Threshold-Free Cluster Enhancement) thresholding, correcting for multiple comparisons. The perfusion measurements are modelled with FLAME Bayesian hierarchical modelling and are thresholded using GRF at $Z>2.3$, $p<0.05$ (corrected).



grey matter density (VGM):
MCI > AD (blue)
CON > AD (red)

mean diffusivity (TBSS):
CON > AD

perfusion (FLAME Bayesian):
CON > AD (green)
MCI > AD (red)

Results: Comparison of controls vs AD showed stronger differences in all modalities mainly involving brain regions commonly affected pathologically (MTL, precuneus, thalamus). Differences between dMCI patients and AD patients were less pronounced. The occipital lobes were largely spared by changes in diffusivity, grey matter density or perfusion changes.

Discussion: This study demonstrates the feasibility of the complex MR protocol that can serve to exclude alternative pathology and investigate specific pathological features of MCI and AD. The difference between NC subjects and patients (AD, MCI) were more pronounced than the difference between MCI subjects and AD patients on global and grey matter atrophy measures, white matter diffusivity measures, and brain perfusion results. This implies, that MCI patients may suffer from a neurodegenerative process distinct from normal ageing. Furthermore, the changes seen in patients demonstrate that the occipital lobes seem relatively less affected on perfusion analysis and in regard to white matter changes. This confirms the pathological observation of relative sparing of the occipital lobes in AD.