Reduced Mid Parietal NAA and Creatine Marks Conversion from Mild Cognitive Impairment to Alzheimers's Disease

U. Pilatus[1], C. Lais[2], A. du Mesnil de Rochmont[3], F. E. Zanella[3], H. Lanfermann[3], T. Kratzsch[2], and J. Pantel[2]

[1]Institut für Neuroradiologie, Klinikum der JW Goethe-Universität, Frankfurt, Germany, [2]Klinik für Psychiatrie, Klinikum der JW Goethe-Universität, Germany, [3]Institut für Neuroradiologie, Klinikum der JW Goethe-Universität, Germany

Introduction

Magnetic resonance spectroscopy provides non-invasively information on the concentration of cerebral metabolites. Changes of these metabolites can be used as markers for neurodegenerative diseases like Alzheimer's disease (AD). While it is widely accepted that the MRS detectable neuronal marker N-acetylasparte (NAA) is decreased in mild to moderate AD, the potential of MRS in detecting metabolic changes at the beginning of the disease is still under discussion. The purpose of the presented work was to develop and evaluate a short robust MRS examen which can identify metabolic changes occurring at the onset of clinical manifestation of AD. The posterior cingulate has been discussed as an area which may show initial changes in AD and also allows acquiring of high quality single voxel MRS spectra within a reasonable time (< 5 min). Therefore, we choose to study MRS-spectra from mid-parietal grey matter in a longitudinal study on a cohort of patients with mild cognitive impairment (MCI) and an age matched control (AMC) group.

Methods

Twelve healthy volunteers (mean age 68, range 60 – 76) and 15 patients (mean age 73, range 62 – 82) were examined twice within a period of 12 to 24 month. Patients were classified as suffering from mild cognitive deficits at the first visit (MMSE: mean 26.4, range 20 -30). All imaging and single voxel ^{1}HMRS studies were performed using a clinical 1.5 Tesla scanner. Metabolite spectra were acquired using the PRESS localization sequence (TE 22 ms, TR 3000 ms, 64 to 128 acquisitions). Spectra were analysed using LCModel and metabolites were quantified as absolute concentrations corrected for partial volume by determining the CSF-fraction in the VOI from T_2 decay of the water signal. The CSF fraction also serves as gross indicator for brain atrophy in the VOI thereby providing an additional parameter which may of diagnostic use.

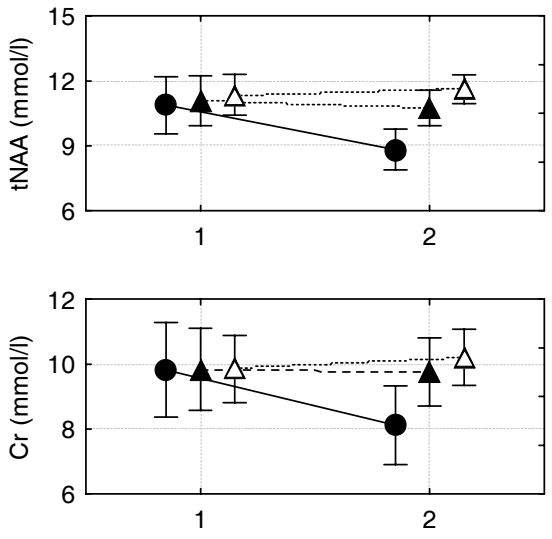
Results

In the first visit mean MMSE score for patients ranged between 20 and 30 while in the second visit the range was from 14 to 28. Volunteers scored high in both examina. Six patients had a decrease in score of more than 2. These patients were classified as converter (MCI_{conv}) in contrast to stable MCI (MCI_{stable}). MMSE scores and respective tNAA concentrations for both visits are plotted in Fig.1 indicating the correlation between cognitive performance and tNAA concentration. At the initial visit, the most significant difference between both groups was the partial volume of brain tissue. However, no changes of this parameter were observed comparing the first and second visit, while tNAA and Cr were siginificantly decreased for MCI_{conv} (Fig.2).

Discussion

Our results suggest that conversion from MCI to AD can be observed from MRS by a decrease in tNAA in parietal gray matter. This is in accordance with other publications (Ackl et al., 2005; Adalsteinsson et al, 2000; Chao et al, 2005; Kantarci et al., 2000), but some of this studies had detected changes just by measuring tNAA/Cr ratio. We feel, that quantification in terms of absolute concentrations is superior in obtaining reliable data. This requires the determination of the CSF fraction in mid parietal grey, which just takes additional 90 s but provides valuable additional information on brain atrophy.

Fig.2: tNAA and Cr concentration changes between first (1) and second (2) vist. MCI_{conv}: closed circle, MCI_{stable}: closed triangle, AMC: open triangle.



.Fig.1: MMSE score versus tNAA. Closed symbols represent second visit.