Deformation-Based-Morphometry shows widespread reversible atrophy in detoxifying alcoholics

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Introduction

Morphologic alterations in alcohol dependent patients have previously been found (partly) reversible with abstinence (1-3). This study focuses on volumetric brain alterations in alcoholics at the beginning of withdrawal (T1) and after three months of abstinence (T2). We evaluated differences between measure from T1 and T2 in respect to whole brain white and gray matter (WM, GM) and CSF as well as localized morphologic changes analyzed with Deformation Based Morphometry (DBM(4)). The investigations are part of a longitudinal study of metabolic changes and their time course in alcoholics before and during withdrawal. This study was supported by the Deutsche Forschungsgemeinschaft (DFG).

Methods

All MRI studies were performed on a 1.5 T Siemens Vision system. Structural T1-weighted 3D mprage datasets with a resolution of 1 mm³ were obtained from 21 male patients and 11 male healthy controls at T1 and T2. 11 of these patients had been completely abstinent after 3 months whereas 10 patients continued to drink alcohol. The postprocessing of the images was performed using Matlab and SPM99. Two volumetric evaluations were carried out. First: the images were automatically segmented into WM, GM and CSF. For inter-subject comparison the ratio of each of the three measures to the sum of all three was used, e.g. CSF/(CSF+WM+GM). Second: We used DBM based on SPM 99. DBM analyzes the nonlinear normalization procedure itself and looks for differences in the normalization parameters rather than normalizing the data and taking a look at the differences that are left. The method is especially useful for longitudinal volume comparisons.

Results

In a paired t-test the whole brain WM content increased significantly ($p < 0.02$), whereas CSF showed a trend for a decrease ($p = 0.06$) after 3 months in abstinent alcoholics. No significant changes were observed for whole brain GM. Relapsing patients showed no significant changes in any of the measures.

The DBM analysis revealed significant volume changes of the inner and outer CSF spaces in the abstinent patients and no changes in relapsed patients. The most prominent significant GM and WM tissue increase was observed in described regions within the parietal and occipital lobe and a significant increase of predominantly WM in the frontal lobe as well as a significant increase of GM in the cingulate, all areas according to the Talairach Daemon (5). The figures show areas of significant volume change. Fig1: CSF spaces in A) abstinent patients, B) relapsed patients and Fig 2: Areas of significant WM and GM increase in abstinent patients at T2.

Figure 1:

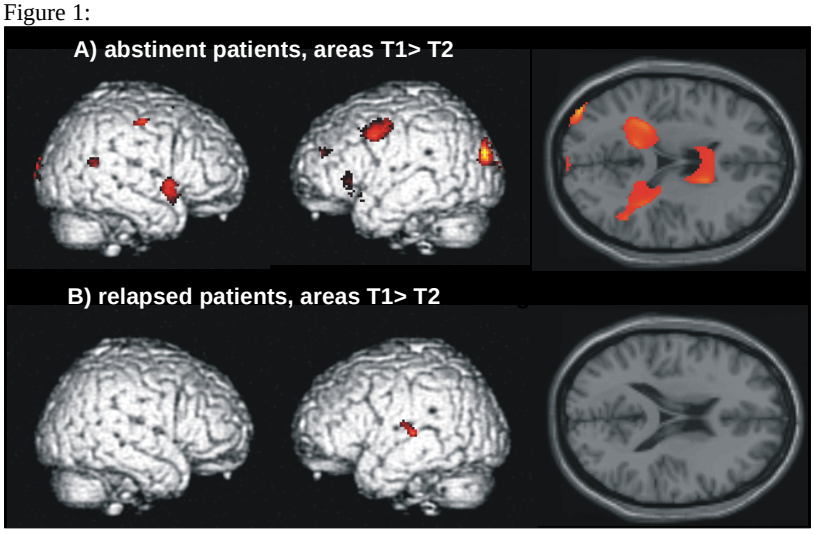
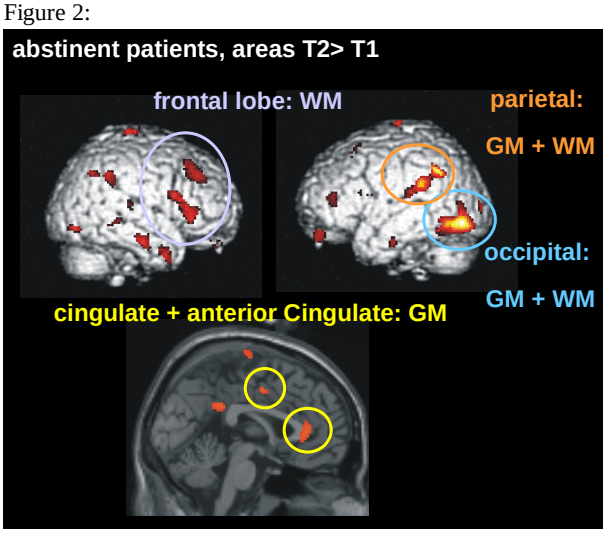


Figure 2:



Discussion

Our findings corroborate previous findings of reversible atrophy in alcoholic patients. The changes are rather widespread throughout the brain. In the whole brain segmentation analysis increasing WM was the most prominent finding in 3 months abstinent patients in accordance with Agartz et al. (3). But DBM also showed significant decreases of inner and outer CSF spaces and a GM increase in certain brain structures in addition to widespread WM increases consistent with other volumetric studies (1,2).

References:

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