Rise in frontal white matter choline is correlated with reversing atrophy in detoxifying alcoholic patients

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Introduction

Spectroscopic and morphologic alterations in alcohol dependent patients have previously been found (partly) reversible with abstinence (1-4). This study focuses on metabolic and volumetric brain alterations in alcoholics at the beginning of withdrawal and after three months of abstinence. We hypothesized that the observed increase of choline-containing compounds (Ch) in abstinent patients (1) is correlated with increased white and gray matter (WM; GM) and a decreased amount of CSF. The investigations are part of a longitudinal study of metabolic changes and their time course in alcoholics before and during withdrawal supported by the Deutsche Forschungsgemeinschaft (DFG).

Methods

All MRI and MRS studies were performed on a 1.5 T Siemens Vision system.

MRS: Two axial planes of ^{1}H Multislice SI data were collected using a single spin-echo multislice sequence (TE 135 ms/TR 1500 ms). The first ^{1}H MRSI plane was positioned through the cerebellum and pons using anatomical landmarks for reproducible slice positioning and the second slice superior to the lateral ventricles including frontal lobe gray and white matter and anterior cingulate gyrus. Data from two time points of 15 patients are presented. 16 healthy controls were also scanned twice 3 months apart for comparison. Seven of the patients had been completely abstinent whereas eight patients continued to drink alcohol. With use of an automated image coregistration and segmentation program (5) all MRSI voxels were corrected for the CSF content as well as the individual point spread function. For evaluation of the repeated study of the same subject both data sets were visualized at the same time for selection of voxels from identical positions.

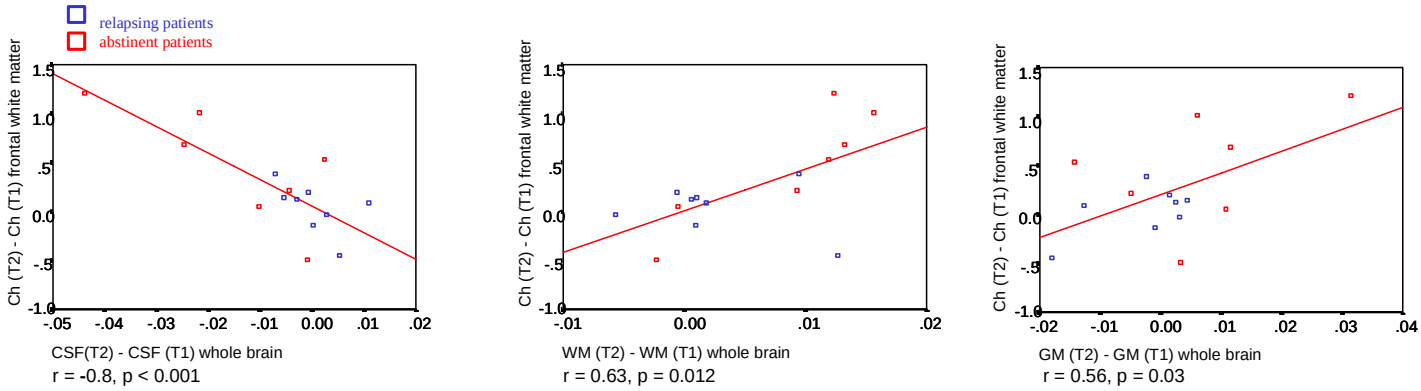
MRI: For each subject a structural T1-weighted 3D-dataset with a resolution of 1 mm³ was obtained. The postprocessing of the images was performed using Matlab and SPM99. The images were automatically segmented into WM, GM and CSF. For inter-subject comparison the ratio of each of the three measures to the sum of all three was used, e.g. CSF/(CSF+WM+GM). Pearson two-tailed correlations were evaluated for the differences of the Ch measures at T2 (3 months after withdrawal) and T1 (beginning of withdrawal) in 3 frontal and 3 cerebellar brain regions with the volumetric changes of WM, GM and CSF, respectively.

Results

We found significant correlations of volumetric brain changes with frontal lobe WM Ch changes after 3 months of detoxification.

The differences between T1 and T2 were significant for the patients compared to controls, but as expected – in a post hoc analysis (Tukey's honestly significant difference) only the abstinent patients showed significantly larger differences of the volumetric and spectroscopic measures compared to healthy controls.

The figure shows the correlation between frontal lobe WM Ch and CSF, WM and GM changes in patients.



Discussion

Our results give evidence that the observed increases in frontal WM Ch reflect the changes in membrane lipid composition, metabolism, and rigidity and an increased cerebral metabolism underlying the reversing atrophy in abstinent alcoholics.

References:

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