POSITIVE CORRELATION BETWEEN ABSOLUTE CHOLINE CONCENTRATION WITH ALCOHOL CONSUMPTION IN THE FRONTAL WHITE MATTER OF SOCIAL DRINKERS

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Introduction

It has been previously shown that in alcohol dependent patients after detoxification the choline containing compounds signal (Cho) (and its ratio to creatine (Cr)) is below-normal and increases with duration of abstinence [1-3]. In a ^{1}H MRSI study at 1.5 T of light social drinkers we observed a significant positive correlation between alcohol consumption during the last 90 days and Cho/Cr in frontal WM and in the anterior cingulate gyrus [4]. With the current study we wanted to replicate the correlation at a 3 T MR scanner and also wanted to examine whether the correlation is caused by a correlation between Cho concentration and alcohol consumption or if it might be an effect of altered relaxation times since the initial MRSI study was heavily T1 and T2 weighted (TR = 1.5 s, TE = 135 ms). The correlation between alcohol consumption of social drinkers and absolute metabolite concentration are realized with data quantification in QUEST and an accurate registration of the last two weeks of alcohol consumption prior to the MRS acquisition.

Methods

In vivo proton spectroscopy has been performed on 14 healthy volunteers aged between 22 and 54 years, mean age: 38.2 ± 9 years (6 male / 8 female). Volunteers had been asked to record for two weeks their drinking behaviour as accurate as possible differentiated into alcohol, caffeine and others. Mean alcohol consumption was 12.6 ± 9 g/day (min: 0 g, max: 29.7 g). Mean caffeine consumption was 0.3 ± 0.2 g/day (min: 0 g/day; max: 0.61 g/day). All MR measurements were performed on a 3 T Siemens TRIO with a 12-channel head coil (Siemens Medical Solutions, Erlangen, Germany). A set of sagittal and transverse scout MR images was first obtained to determine patient position. Based on the scout images a 10x40x10 mm³ single voxel was positioned in the frontal white matter. Reduced water suppression localized spectra were performed with a PRESS sequence using following parameters: TE = 30 ms, TR = 6000 ms, BW = 2400 Hz, 2048 data points and averages = 40. In addition six fully relaxed unsuppressed water spectra were acquired with TR = 10 s and different TE (30, 80, 276, 552, 1000 and 1500 ms) to estimate the absolute water signal at TE = 0. This was used to correct data for different coil loadings and possible coil inhomogeneities. The correction factor includes the absolute water signal in vitro divided to the absolute water signal acquired in vivo and was applied to each metabolite value. Different water concentrations in the phantoms (1.0) and in white matter (0.71) were accounted for. For absolute quantification QUEST from the jMRUI 3 [5] software was used with a basis set of phantom spectra (NAA, Cr, Cho, GABA, Glu, Gln, mI) which were acquired identical to the in vivo spectra at TE = 30 ms and TR = 6000 ms and the "subtract" approach for background handling. The different metabolite relaxation times in vitro and in vivo were accounted for as we measured the same voxel with varying TE = 30, 80, 200, 300, 420 ms and TR = 6000 ms for T2 quantification and varying TR = 1500, 2000, 2500, 3000, 4000, 5000 and 6000 ms for T1 quantification in vitro. T1 and T2 relaxation times from the same voxel location in vivo were taken from [6]. Data were also corrected for partial volume effect by segmenting a T1-weighted MPRAGE including chemical shift displacement for different metabolites although CSF content was less than 1 % [7]. Segmentation confirmed white matter content of about 95 % in the voxel.

Results

We could corroborate a significant positive correlation (spearman) between Cho in the frontal white matter and alcohol consumption of the last two weeks (R = 0.823, p = 0.000). A trend in the same direction is found for the Cr value (R = 0.519, p = 0.057) but did not reach significance (Figure 1). No significance was found for the NAA concentration or correlations between any metabolite with caffeine.

Discussion

With this study we expanded our previous study by determining the absolute concentration of Cho using short TE and long TR at 3 T. We could corroborate an increase of Cho with alcohol consumption in social drinkers using QUEST for absolute quantification. The trend for an increase in Cr with alcohol consumption that has not been observed in the 1.5 T data might be a hint that Cr relaxation times rather than Cho relaxation is influenced by alcohol in the brain. We will further investigate whether Cho and Cr relaxation times might be influenced by alcohol consumption. Relaxation times will be the target of further MRS studies on the influence of alcohol on the brain.

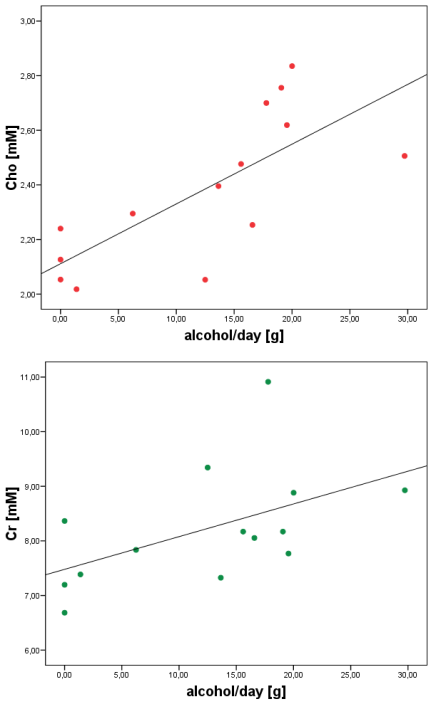

Figure 1: Absolute concentration of frontal white matter Cho (top; R = 0.823 p = 0.000) and Cr (bottom; R = 0.519, p = 0.057) as a function of alcohol consumption per day.

References

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