Occipital lobe metabolic aberrations in alcohol dependents: An in-vivo proton magnetic resonance spectroscopy study

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Target audience

Researchers working in the field of drug abuse and imaging.

Introduction

Chronic use of alcohol is associated with neuropsychological deficits, altered brain metabolism and extensive brain shrinkage as shown by various neuroimaging studies. Besides deficits in higher order cognitive functions, alcoholics also show a deficit in the processing of basic sensory information of visual stimulation. Occipital lobe is responsible for the processing of visual information.[1] An earlier in vivo proton MRS study carried out at our centre showed a significant increase in Cho/Cr ratio ($p<0.015$) in occipital lobe in the alcoholic group.[2] However, the sensitivity and resolution of the spectra increases with the increase in magnetic field strength. Therefore, to get a better insight of metabolic alterations associated with visual information processing deficits in alcohol dependents, we carried out similar study at higher field strength of 3 T to look for the additional metabolic changes, if any.

Material and Methods: To investigate the susceptibility of occipital lobe to alcohol-associated metabolic changes, image guided, single voxel, proton magnetic resonance spectroscopy (MRS) was carried out on alcohol dependents (n=25) and healthy non alcoholic controls (n=22) matched for age, sex and education. The study was carried out using 3T whole body MR system (Magnetom Skyra, Siemens, Germany) with a 32 channel head coil. The parameters used were TE=30ms, TR=3300ms, Voxel size=10*10*10 and averages=256. LC model was used for data processing. Relative concentrations of N-acetylaspartate (NAA), choline-containing compounds (Cho), myo-inositol (Ins), combined glutamate-glutamine (Glx) and creatine plus phosphocreatine (Cr) were measured. To explore the neuropsychological status, PGIBBD (PGI-Battery of Brain Dysfunction test (an Indian version of Wechsler Scale) was performed on these subjects on the day of examination.[3] The subjects were abstained from alcohol at the time of study with an abstinent period of more than a week. The results were reported as ratios relative to creatinine at p values (≤ 0.05).

Results and discussion: PGIBBD results showed that alcohol dependents were significantly impaired on the tasks of visual retention and visual perception as compared to controls as assessed by the Dysfunction rating score(DRS) (p value ≤ 0.001)(Table 1). Proton MRS results have shown alcohol-associated significant reductions in NAA/Cr and Glx/Cr ratios whereas there was a significant increase in Cho/Cr and Ins/Cr ratios (p value ≤ 0.05)(Table 2).Reductions in NAA levels might be attributed to neuronal loss while reductions in Glx levels might reflect perturbation of Glu-Gln system in alcohol dependents which could represent a neuroprotective adaptation.[4] Elevations in Inositol may reflect astrocyte proliferation as well as an osmotic response to cell shrinkage whereas a significant increase in choline ratios indicate altered cell membrane metabolism. All these metabolic alterations may probably be associated with the alterations in the cognitive abilities associated with visual processing in alcohol dependents.

Conclusion: The neuronal compromise that these metabolic changes reflect may contribute to the visual processing deficits in alcohol dependents. Our study thus shows a possible relationship between altered metabolism and function in the occipital lobe of alcohol dependents.

References:

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Dysfunction Rating Score assessed by PGIBBD(DRS)		
Subtest	Alcohol dependents (Mean ±S.D.)	Controls (Mean ±S.D.)
Visual retention	1.833 ±1.504	0.2 ±.77
Visual recognition	1.277 ±1.263	0.29 ±.84
Spatial processing	1 ±1.309	0.17±.22
Mental rotation	1.4 ±1.217	0

Table 1: DRS scores of alcohol dependents and controls (p value≤0.05)

Metabolite ratios	Alcohol dependents (Mean ±S.D.)	Controls (Mean ±S.D.)
NAA/Cr	1.180±0.132	1.520±0.091
Cho/Cr	0.301±0.047	0.227±0.038
mI/Cr	0.966±0.136	0.687±0.130
Glx/Cr	0.875±0245	1.267±.235

Table 2: Results of in vivo MRS studies on occipital lobe of alcohol dependents and controls (p value≤0.05)