Dual Voxel Two-dimensional MR Spectroscopy of Hepatic Encephalopathy and Correlation with Neuropsychological abnormalities

M. A. Thomas[1], V. Elderkin-Thompson[2], N. Rajakumar[1], S. Liu[1], G. Verma[1], A. Huda[3], S. Han[4], and R. K. Gupta[1]

[1]Radiological Sciences, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [2]Psychiatry, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [3]Medical Physics, California State University-Fresno, Fresno, CA, United States, [4]Division of Digetive Diseases, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States

Introduction: The association between the changes in MRI and MR spectroscopic (MRS) variables in HE, and cognition has been a major topic of interest (1-3). Both one-dimensional (1D) and two-dimensional (2D) MR Spectroscopic data (MRS) have shown decreased myo-inositol (mI) and choline (Ch), and increased glutamate/glutamine (Glx) in the selected regions of HE patients (3,4). A major goal of this study was to investigate the nature of association between the neurochemical changes in the prefrontal and occipital white matter regions using 2D L-COSY, and to correlate with the neuropsychological (NP) scores. The hypothesis was that the bio-chemical levels in the frontal and occipital locations will have differential correlations with selected cognitive scores.

Methods: Twenty minimal HE patients (mean age of 50 years) awaiting liver transplantation_and sixteen healthy volunteers (mean age of 49.5 years) were investigated. A 1.5T MRI/MRS scanner (Siemens Medical Systems, Erlangen, Germany) with a body coil "transmit" and a 2-loop coil phased array "receive" assembly was used. **2D MRS**: One of the two surface coils was placed directly on the forehead and the other facing the occipital cortex of the subjects. A 27-ml voxel was placed on two locations: the right prefrontal dorsolateral white/gray and the left visuo-occipital white/gray matter. Spectra were recorded with the following parameters (3,4): TE=30ms, TR=2s and total scans=768. 2D L-COSY spectra were processed using Felix-2000 (MSI, San Diego, CA). The volumes under the diagonal and cross peaks in the 2D COSY spectra from both locations, and their respective ratios with respect to that under the creatine diagonal peak were calculated (4,5). **NP**: All the subjects also participated in a neuropsychological test battery on the same day of MRS and MRI. The z-scores and t-scores were calculated from the neuropsychological test battery. The Pearson correlation was performed using the SPSS software.

Results and Discussion: 2D MRS data showed significant decline of the following metabolite ratios: Ch_d, mICh, PE and mI. There was a significant increase of Glx in both locations. Findings of correlation of NP scores with biochemical changes are summarized in Table 1 and 2. MMSE represents the mini-mental status examination. Neuropsychological tests of visuo-motor ability, i.e. Trails B, correlated with multiple metabolitie ratios recorded in HE patients. The strongest pattern of associations was with the metabolites such as NAA_d, mICh, Glx, and mI in the prefrontal voxel. Tests of executive function, i.e., working memory and verbal memory did not show a pattern of significant results with any metabolites.

Table 1. Correlation of metabolite ratios calculated from the prefrontal 2D COSY spectra and NP scores

Neuropsychological Test	Ch_d	NAA_d	mICh	Glx	mI	PCh	PE
MMSE	0.344	0.694	0.524	0.624*	0.559	0.177	-0.027
T Trails A (Heaton)	0.526*	0.159	0.124	0.269	0.339	0.581	0.156
T Trails B (Heaton)	0.346	0.641*	0.533*	0.598*	0.696**	0.279	-0.113
T peg dominant (Heaton)	-0.73**	-0.482	-0.408	-0.627*	-0.659*	-0.616*	0.07
T peg nondominant (Heaton)	0.474	0.737**	0.534*	0.757**	0.796**	0.375	-0.09
T Digit Symbol (WAIS IIIA)	0.262	0.760**	0.738**	0.607*	0.697**	0.263	-0.083
T Digit span (WAIS IIIA)	0.488	0.063	-0.024	0.26	0.208	0.174	0.518

***p<0.05, **p<0.005**

Table 2. Correlation of metabolite ratios calculated from the occipital 2D COSY spectra and NP scores

Neuropsychological Test	Ch_d	NAA_d	mICh	Glx	mI	PCh	PE
MMSE	0.285	0.629*	0.212	0.448	0.466	-0.124	-0.254
T Trails A (Heaton)	0.467	0.364	0.323	0.385	0.499	0.596*	0.226
T Trails B (Heaton)	0.353	0.619*	0.461	0.568*	0.658*	0.183	-0.099
T peg dominant (Heaton)	-0.283	-0.230	-0.462	-0.172	-0.252	-0.308	-0.168
T peg nondominant (Heaton)	0.266	0.479	0.069	0.429	0.513*	0.101	-0.379
T Digit Symbol (WAIS IIIA)	0.463	0.515*	0.455	0.741**	0.635*	0.531*	0.205
T Digit span (WAIS III Adj)	-0.321	-0.167	-0.595*	-0.363	-0.305	-0.601	-0.435

***p<0.05, **p<0.005**

Conclusion: Our pilot findings demonstrate that there are different types of correlation of metabolite levels and NP scores in the frontal and occipital region. This study also suggests the ability of 2D COSY to differentiate anatomically distinct neurochemical markers in HE related to neuro-anatomical specific cognitive abilities.

References:

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