2D MR Spectroscopic Characterization of NAA, Glutamate and Glutathione in Human Brain *in vivo*

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Introduction

The J-coupled proton metabolites which have well separated multiplets have been identified by one-dimensional spectral-editing techniques. A major drawback is that only one metabolite can be identified at a time. Successful attempts in editing GABA and glutamate using whole body MRI/MRS scanners have been presented by other researchers (1,2). A technique based on subtraction methods is very sensitive to motion artifacts and leads to subtraction errors. A single-shot based multiple-quantum filtered MR spectroscopic sequences have also been implemented on a whole body scanner, but a severe loss of signal associated with various coherence transfer pathways makes it less attractive to human applications (3). The primary goals of this project was to implement and evaluate a localized 2D correlated spectroscopic sequence (L-COSY) on a whole body MRI scanner, and to record the L-COSY spectra in the frontal and occipital gray matter of healthy human brains.

Materials and Methods

Nine healthy volunteers (29-45yo) participated in this study. The study was approved by the institutional review board. A GE Horizon1.5T MRI/MRS scanner with echo-speed gradients and a body coil transmit with a 3" surface coil receive was used. A voxel size of 18-36 ml was localized by the L-COSY sequence, which was used simultaneously for both voxel localization and coherence transfer for the 2D spectra. The 2D raw matrix was acquired with 1024 complex points along the first dimension and 40 points along the 2nd dimension (TR=2s and TE=35ms). The total duration for one 2D spectra was typically 20 minutes long. The raw data was processed on a Silicon graphics workstation.

Results and Discussions

The 2D L-COSY spectra shown in Fig. 1 was recorded in the frontal gray matter of a 29yo healthy volunteer (18ml).

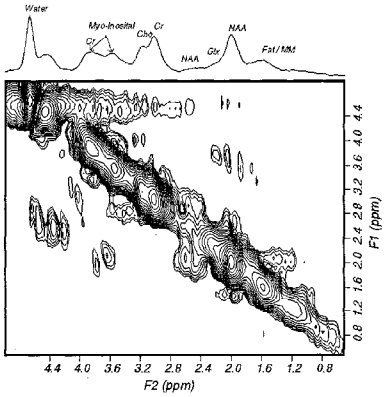

Figure 1: Prefrontal gray matter L-COSY spectrum recorded in a 29 yo healthy volunteer (3x3x2ml)

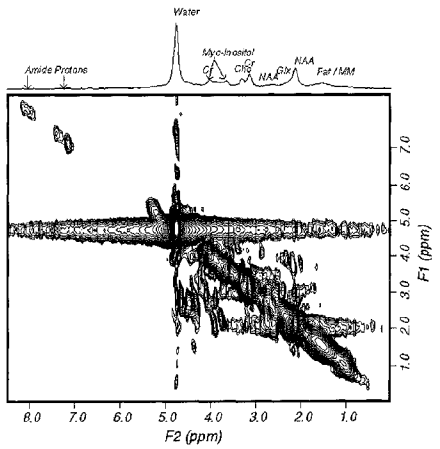

Figure 2: Occipital white/gray matter L-COSY spectrum recorded in a 32yo healthy volunteer (3x4x3ml)

Fig. 2 was recorded in the occipital gray/white matter region of a 32 yo healthy volunteers (36ml). The total duration for each 2D spectrum was approximately 20 minutes. The 2D cross peaks due to NAA, glutamate/glutamine (Glx), myo-inositol, GABA, glutathione and aspartate have been identified. These findings were evident in all the 2D L-COSY spectra recorded in nine healthly controls. When the voxel size doubled in the occipital region, there were diagonal peaks due to the amide protons of NAA and Glx.

Conclusions

A two-dimensional chemical shift correlated MR spectroscopic (L-COSY) sequence integrated into a new volume localization technique has been successfully implemented for the whole body MR Spectroscopy. The 2D cross peaks excited by the proposed 2D sequence were asymmetric with respect to the diagonal peaks. Results from the experimental and theoretical findings will be presented.

References

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