Metabolite Concentrations of Pons, Mendulla, Motor Cortex in Normal Human Brain Using 2D CSI

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INTRODUCTION

Human brain metabolites measured by water-suppressed proton MR spectroscopy imaging has been used to localize pathologically abnormal areas, monitor disease progression and therapeutic response. In making a clinical assessment, it is important to know the regional metabolite concentration in normal human brain. To date, there are many reports on the metabolite concentrations of frontal, parietal, occipital, temporal lobe and thalamus using proton MRS, and only a few studies are relevant to the brain stem area. In this abstract, we report the quantitative estimates of metabolite levels of pons, mendulla and motor cortex in normal human brain. The data may be helpful for the evaluation of the severity of diseases in these difficult assessible areas in studies of motor function, cortical epileptic focus and amyotrophic lateral sclerosis and others.

MATERIALS AND METHODS

Short echo (TR/TE=1500/30) PRESS was employed to acquire the in vivo proton MRS from pons, mendulla and motor cortex of 22 healthy adult volunteers. The number of volunteers involved in pons, mendulla and motor cortex studies are 12, 6, and 4 respectively, and average ages are 32±6, 39±11 and 33±5 respectively. 2D CSI was performed with a Siemens 1.5T Vision system. Acquisition employed FOV of 240x240 mm² with 16x16 phase encoding. For the pons and mendulla, voxel size of 10x10x20 mm³ and VOI of 30x30x20 mm³ were used. Positioning the single voxel in pons and mendulla for MRS studies are depicted in Fig. 1 & 2 respectively. For the motor cortex scan, voxel size of 15x15x10 mm³ and VOI of 60x60x10 mm³ were used. The position of VOI in cortical region is shown in Fig.3. The spectra of the four central voxels were then used to calculate the metabolite level in this motor cortex. The number of signal averages is 3 for pons and mendulla, and 2 for the motor cortex.

To objectively and automatically analyze the spectra, Provencher's LCModel (5) was employed. The absolute metabolite concentration were estimated from these LCModel outputs and the concentration is in millimolar (mM).

RESULTS AND DISCUSSIONS

Employing the LCMODEL iteration program, the metabolite concentrations of NAA+NAAG, Creatine(Cr), Choline(Cho), Glutamate(Glu)+Glutamine (Gln) and myo-inositol(Ins) are estimated and shown in table 1. The SDS of NAA+NAAG, Cr and Cho are less than 10%, and of Glu=Gln and Ins are less than 20% each. The ratio of metabolite concentration to Cr is also listed in table 1. The first important result is that the NAA+NAAG concentration of pons is much higher than that of mendulla, but Cr concentration of pons conversely, is lower than in mendulla, despite the fact that anatomically, pons and mendulla are adjacent to each other and both belonging to the brain stem. In most studies, concentration ratio rather than concentration was employed. Here, you can see that if one use only concentration ratio by assuming that Cr is insignificantly difference between pathological and normal tissues as most publication believed, the assumption would be certainly wrong. Clearly, being able to estimate the metabolite concentration would help us in correctly interpreting the MRS alternations.

Useful metabolites Glu=Gln and Ins are also obtained from the short TE MRS. Neurological disorders such as epilepsy, brain tumor and ALS frequently lead to abnormal distribution of Glu, Gln and Ins (4). So this control study can be useful reference for the monitoring of neurodegeneration and therapeutic response. It is interesting that NAA+NAAG and Cr level of motor cortex are in similar levels to that in mendulla, but the Cho and Ins level are lower and Glu=Gln is higher.

DISCUSSION AND CONCLUSION:

By using proton MRS, metabolite concentrations of pons, mendulla and motor cortex of healthy volunteers were obtained. Our results show the regional differences of metabolite levels in the human brain and can be used as control for the examination of neuronal diseases in relevant to these areas.

REFERENCES