Study of brain metabolite Change in amyotrophic lateral sclerosis using TE-Averaged PRESS

J. Han[1], and L. Ma[2]

[1]Neuroradiology, Huanhu Hospital, Tianjin, Tianjin, China, People's Republic of, [2]Radiology, PLA General Hospital, Beijing, China, People's Republic of

Background—Excitotoxicity of glutamate (Glu) may be an important pathogenesis of amyotrophic lateral sclerosis, some publications reported the Glu level elevated in the brain tissue, CSF and blood plasma [1, 2]. Magnetic resonance spectroscopy can gain quantitative measurements of Glu, glutamine (Gln), myoinositol (mI), choline (Cho), creatine (Cr), and N-acetylaspartate(NAA), and the differences between normal control and patients can help in ALS diagnosis while conventional MRI lack sensitivity and specificity. In typical spectrum, the Glu C4 protons (2.35ppm) are contaminated with NAA C3 protons, as well as Gln C3 and C4 protons. The co-resonant signals from the Glu and Gln C2 protons (3.75ppm) are partly obscured by mI. TE-Averaged Point Resolved Selective Spectroscopy can provide spectra with unobstructed signals optimized for quantitative analysis of brain glutamate [3]. Such MRS technique is used in this study to investigate the changes of metabolites, and the results may provide information in diagnosis of ALS.

Methods—15 patients (6 males and 9 females; age range 30-62 years, mean age 51.33±10.12 years) with definite or probable ALS (defined by the diagnostic criteria of El Escorial World Federation of Neurology) and 15 age and gender matched normal controls (7 males, 8 females, age range 37-60 years, mean age 49.47±7.37 years) were enrolled. All the participants had no other diseases or any recent medicine treatments. 1H-MRS was performed on a 3.0 T GE imaging system (GE Medical System, Milwaukee, Wisconsin, USA) with a standard head coil. T2-weighted MR images were acquired in axial, sagittal and coronal plane for localization of the spectra acquisition by using FSE sequence (TR=4000 ms, TE=102 ms, NEX=1, thickness=5mm, FOV=24cm×24cm, matrix=256×256). Single voxel TE-Averaged Point Resolved Selective Spectroscopy was used to get spectra. The TE value increased from 25ms to 115ms with increments of 5ms, total 18 times. TR=1500ms, FOV=24cm×24cm, NEX=4, voxel size=8 cc, scan time= 252sec. The regions of interest were primary motor cortex and posterior limb of the internal capsule. The spectrum data were acquired and analysised by SAGE (Spectroscopic Analysis, GE) software. The peak height of NAA, Cr, Glu and Glx (glutamate + glutamine) were acquired and NAA/Cr, Glu/Cr, Glx/Cr were calculated (**Fig1-3**), and *t*-test was used to compare differences between groups.

Results— The Glu peaks at 2.35ppm and Glx peaks at 3.75ppm were clearly separated (**Fig.3**).The primary motor cortex and posterior limb of the internal capsule of ALS patients had lower NAA/Cr (1.91±0.34 and 1.53±0.17) compared with normal subjects (2.23±0.33 and 1.66±0.07), the differences between groups were statistically significant (p=0.00 and p=0.01). ALS patients had higher Glu/Cr (0.34±0.05 and 0.29±0.06) and Glx/Cr (0.40±0.04 and 0.33±0.06), compared with normal subjects (0.30±0.03 and 0.25±0.04) and (0.32±0.05 and 0.26±0.03), the differences between groups were statistically significant (p=0.00 and p=0.00).

Discussions and Conclusions—In this study we have shown that TE-averaged PRESS at 3T can provide spectra optimized for quantitative measurements of Glu, Glx, NAA and Cr in ALS patients. Good baseline and sufficient resolution are achieved at relatively short effective-TE values. The Glu and Glx elevated in ALS patients than in controls, which implies excitotoxicity of Glx may have correlation with pathologic process of ALS. The decreased NAA implied neuronal loss.

Neuronal loss and Glx+Glu increase can be detected by using proton MRS in ALS patients. 1H-MRS is a useful tool in reflecting the characteristic changes of metabolite in ALS.

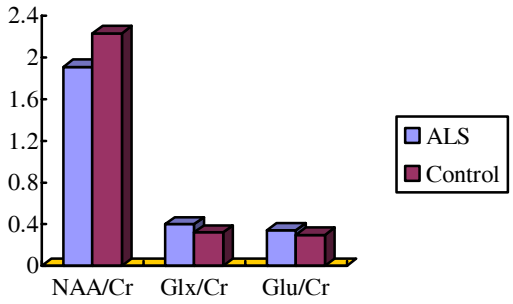

Figure 1. Ratios of metabolites in subcortex motor area in groups

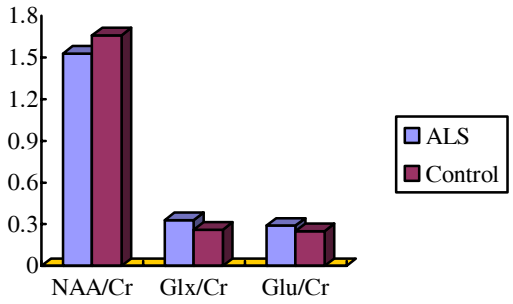

Figure 2. Ratios of metabolites in posterior limb of the internal capsule in groups

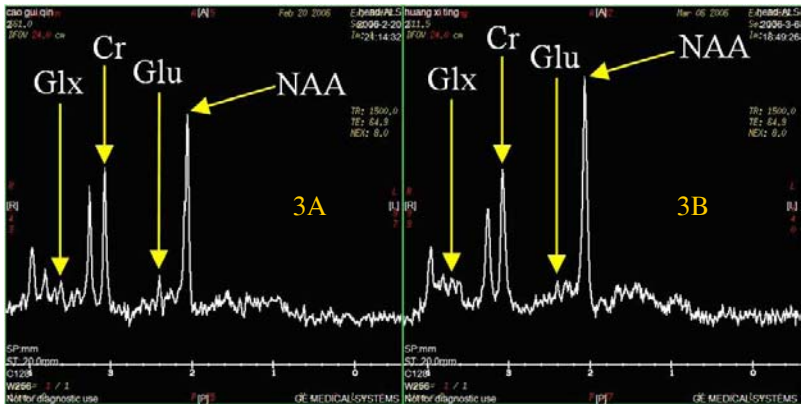

Figure 3. Spectrum indicating the position in ALS (3A) and control (3B)

Reference

1. Cams W, et al. Acta Neurol Scand, 1993, 88:51-5.
2. Plaitakis A, et al. Brain Res Bull. 1993, 30(3-4):381-6.
3. Ralph H, et al. Magn Reson Med., 2004, 51:435–40.