Lead Exposed Encephalopathy: Evaluation by 1H Spectroscopy of a 3T MR Scanner

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Introduction

The detrimental effects of lead poisoning have been well known since ancient times, but some of the most severe consequences of exposure to this metal have only been described recently. Lead affects the higher functions of the central nervous system and undermines brain growth, preventing the correct development of cognitive and behavioral functions. However, the conventional imaging can not show the changes in the brain parenchyma. In this study, we use proton magnetic resonance spectroscopy, a widespread accepted method for assessing neuronal viability, to the subclinical changes in the brain metabolites of the patient with lead exposure.

Material and Methods

Totally 21 patients with lead exposure and 18 normal volunteers are enrolled in this study. The MR imaging studies were performed using a 3.0-T scanner. A 2D MRS imaging (MRSI) sequence with PRESS volume pre-selection was used. Three regions (thickness 15 mm) were examined, which include left frontal lobe, left occipital lobe and left basal ganglia regions (Fig. 1). Spectra were acquired with TR 1500 ms, TE 144 ms, Matrix size of 16 x 16 over a FOV of 16 cm resulting a scan time of 6.4 min on each region. Spectral data sets were zero filled to 1024 points, multiplied by a 1.25-Hz Lorentzian function, and Fourier transformed in the time domain and in two spatial domains. The peak area ratio of Cho/Cr and NAA/Cr were calculated. The data of blood lead and bone lead levels were collected in the same day MRI performed. The bone lead levels at patella and tibia were examined using K-shell X-ray fluorescence.

Results

The distributions of gender, age, BMI and life habits, including smoking, drinking and betel nut, had no difference between the patients and volunteers. In the patients, there is significant increase in blood lead ($p<0.001$) and bone lead at patella ($p<0.001$) and tibia ($p<0.001$). All of the MRS data in the exposed group show lower in the ratios of choline/creatine and NAA/creatine than in the control group There are significant differences of the choline/creatine ratios at frontal gray matter ($P=0.002$), frontal white matter ($p=0.04$), occipital gray matter ($p<0.001$), occipital subcortical white matter ($p<0.001$) and occipital white matter ($p=0.006$). In the NAA/Cr ratios, there are significant differences at frontal gray matter ($P<0.001$), frontal subcortical white matter ($p=0.006$), frontal white matter ($p=0.049$), and occipital white matter ($p<0.001$).

Discussion

In this study, the patients with lead exposure had higher blood lead levels than that of the volunteers but the blood lead levels were within subclinical level (<40μg/dL). The significant difference of bone lead means long time exposure to lead. All of the MRS data in the exposed group show lower in the ratios of choline/creatine and NAA/creatine than that in the control group. Both gray matter and white matter have significant differences in the ratios of choline/Cr and NAA/Cr. And the significant differences are not only noted in the frontal lobes but also the occipital lobe. It means that the expose of lead may cause damage of neuron diffusely.

Conclusion

Proton MRS in 3.0T MR scanner can show the metabolic changes of the neurons in vivo in this study. The results show the brain damages of the patients with lead exposure. The proton MRS should be a good method in evaluation and follow-up in the patient group.

a. b. c.

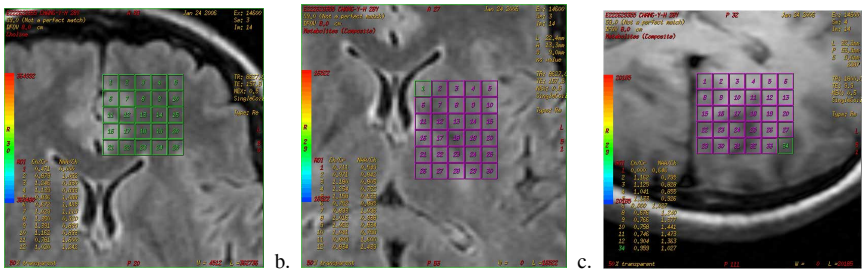

Fig. 1. The example of the placement of square regions of interest of 2D proton MRS in the left frontal lobe, left basal ganglion and left occipital lobe.

References:

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