PROTON MAGNETIC RESONANCE SPECTROSCOPY ALONG THE PYRAMIDAL TRACT OF PATIENTS WITH AMYOTROPHIC LATERAL SCLEROSIS

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Introduction

Amyotrophic lateral sclerosis (ALS) is a progressive neurodegenerative disease affecting motor neurons in the motor cortex, brainstem and spinal cord (pyramidal tract). Previous studies assessed ^{1}H spectra in different brain areas in patients with ALS [1, 2]. In this work, we have chosen to compare the spectra from different brain regions along the pyramidal tract, and to correlate the data to different clinical manifestations of the disease.

Methods

11 patients with clinically proven ALS (10 male, 1 female, all right-handed, aged 52.2±13.9) and 11 volunteers matched for age, sex and educational level (aged 53.3±14.0) underwent single-voxel ^{1}H-MRS examination of both left and right precentral gyri (3.4 ml), pons (5.2 ml), medulla oblongata (3.9 ml) and the occipital lobe (8 ml) in a 1.5T Siemens Symphony MR scanner (TE=135ms, TR=1500ms, 256 avgs, see **fig. 1**). By adjusting the first and second order shims, B_0 field homogeneity was established in all the voxels for water FWHM being at most 7 Hz. Spectra were evaluated using LC Model [3]. In order to avoid partial volume effects of CSF, only ratios of metabolites to tCre (*t* standing for *total*) and tCho were used for calculations. We compared them to the values of the healthy volunteers and evaluated their correlation to the patients' total ALSFRS score [4] and its subscores (bulbar, fine motorics, gross motorics and respiratory).

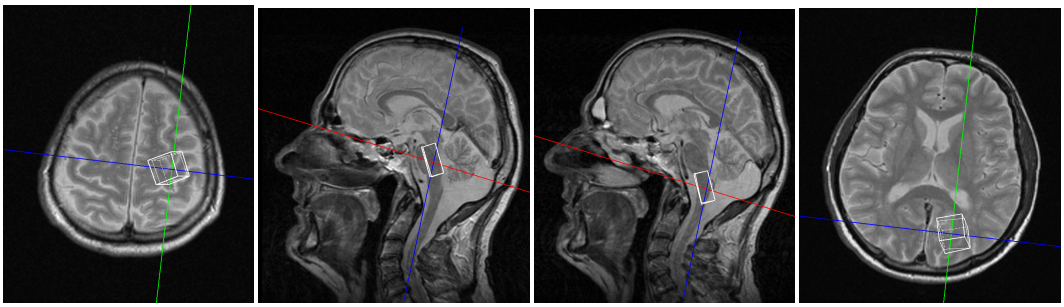

Fig. 1: Spatial localization of the SVS voxels in the precentral gyrus (left), pons, medulla oblongata and the occipital lobe.

Results

Between the patients and the volunteers, significant differences were found in the tNAA:tCre ratio for the right precentral gyrus (p=0.046) and the pons (p=0.046). The ratio of tNAA:tCho was signifycantly different in the medulla oblongata (p=0.021). Other metabolite ratios in other areas did not show significant differences. Occipital lobe, which was chosen as a control region outside the pyramidal tract, has shown no differences at all.

In the right precentral gyrus, very good correlations were found between tNAA:tCre and patients' ALSFRS score (ρ=0.92, p=0.0001,see **fig. 2**), fine motorics subscore (ρ=0.67, p=0.025) and gross motorics subscore (ρ=0.81, p=0.003).

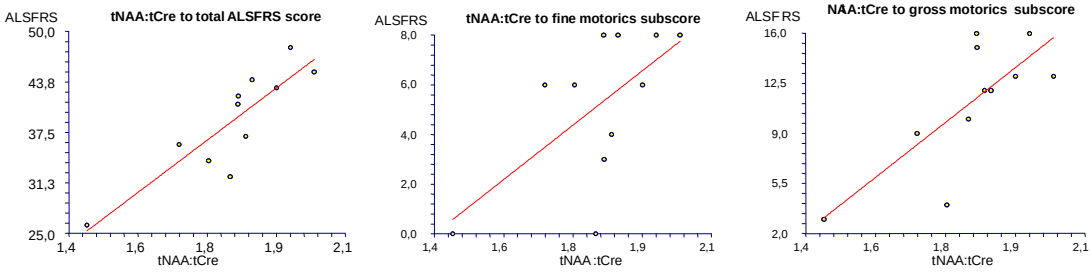

Fig. 2: tNAA:tCre in the right precentral gyrus correlated to patients' ALSFRS score (left), fine motorics subscore (middle) and gross motorics subscore (right)

Discussion

Our experiments compare MRS diagnostic values of different regions in the pyramidal tract and their relationship to the clinical manifestation of ALS. The data from our small group already show promising correlations to the patients' clinical score. Due to low prevalence of the disease, our set is quite small and we observe that statistical significance of further metabolite ratios in other voxels increases as more patients are measured. Therefore, we expect that with a larger patient group, even more interesting relationships would be observed.

[1] Neurology 1998;50(1):72-7
[2] Neurology 2004;62(10):1753-7
[3] NMR Biomed. 2001;14(4):260-4
[4] Arch Neurol 1996;53(2):141-7