Study of upper motor neuron involvement in motor neuron disease with DTI and MRS on 3.0T MRI scanner

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Synopsis

In this study, we investigate Motor Neuron Disease (MND) by various functional MR techniques including diffusion tensor imaging (DTI), which demonstrate the magnitude and orientation of the white matter anisotropic diffusion property, and Magnetic Resonance Spectroscopy (MRS), which reveals the chemical metabolism level of gray and white mater. The combination of Fractional anisotropy (FA) value, N-acetyl aspartate/Creatine (NAA/Cr) ratio and Choline / Creatine (Cho/Cr) ratio demonstrates good sensitivity in discriminating motor neuron disease.

Methods

Thirty patients with definite or probable MND and thirty age-sex matched controls without neurological disorders were studied. The patients group included 25 males and 5 females, with age range from 17 to 68 years (average 47.5 years). The normal control group included 25 males and 5 females, with age range from 20 to 68 (average 48.8 years). All MR image and spectroscopy study were performed on a 3.0T GE scanner with standard quadrature head coil. Diffusion Tensor image was scanned by EPI sequence with 15 direction, 1000s/mm^2 B value, 2 NEX, 3.5 mm thickness without spacing. 2D MRS were scanned with PRESS sequence with 144ms TE, 1000ms TR, focusing at cerebral peduncles and posterior limb of internal capsule.

Fractional anisotropy (FA) value, NAA/Cr ratio and Cho/Cr ratio were measured respectively in bilateral cerebral peduncles (CP) and the third quarter of posterior limb (PL) of the internal capsule (IC). For quantitative assessment, a 30 mm^2 ROI was equally used for measuring FA value. MRS ratios were acquired by Functool 2.6.3. Statistical analysis was performed by SPSS 12.

Results

The measured values of FA and NAA/Cr, Cho/Cr were shown in table 1. All of these three characters demonstrate significant difference between diagnostic patients group and control group ($p<0.05$), with a decrease of FA, decrease of NAA/Cr and/or increase of Cho/Cr. For individual analysis, among 30 patients, FA value discriminate 74 percent abnormity, MRS value discriminate 88 percent, and a combination of FA and MRS can increase the diagnosis to 94%.

Discussion

As a neurodegenetive disease, MND affects upper and lower motor neuron.By using DTI technique ,the decreased FA values in CP and PL of the IC in MND patients was consistent with the degenerative changes of UMN.2D MRS can be used to evaluate the metabolic changes.A combination of DTI and MRS study can highly increase the diagnosis accuracy in upper motor neuron involvement of MND.

Table 1: FA, NAA/Cr, Cho/Cr (mean ± SD) in control and patient group

		FA	NAA/Cr		Cho/Cr	
			<40 years	>40years	<40 years	>40years
CP	Control Group	0.76±0.04	1.77±0.15	1.65±0.16	1.13±0.08	1.12±0.08
	Patient Group	0.72±0.04	1.64±0.18	1.56+0.17	1.32±0.31	1.39±0.27
PL of IC	Control Group	0.73±0.04	1.75±0.18	1.64±0.19	1.03±0.10	1.01±0.09
	Patient Group	0.68±0.04	1.52±0.21	1.52±0.20	1.14±0.14	1.22±0.20