Diffusion Tensor MRI of the spinal cord in amyotrophic lateral sclerosis.

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Introduction.

Amyotrophic lateral sclerosis (ALS) is a neurodegenerative condition, associated to spinal cord damage[1]. Because the spinal cord contains important motor tracts, its degeneration may cause important locomotor disability. Diffusion-tensor (DT) MRI provides quantitative information about structural and orientational features of the central nervous system, and it is an invaluable tool for detecting disease-related subtle damage, undetected by conventional MRI. Aim of this study was to obtain mean diffusivity (MD) and fractional anisotropy (FA) histograms of the cervical cord from a group of ALS patients and healthy subjects, to find the extent of cord damage in these patients.

Methods.

Using a 1.5 T scanner**,** cervical cord DT MRI was performed using a single shot SE-EPI sequence with 12 non-collinear diffusion gradient directions. A sagittal T1-weighted 3D magnetization-prepared rapid acquisition gradient echo (MP-RAGE) of the spinal cord was also obtained from 14 patients with ALS (8 men and 6 women; mean age=54 years [range=27-72 years]) and 13 healthy controls (6 men and 7 women; mean age=44 years [range=20-62 years]). Mean disease duration for these patients was 3 years (SD=9 years) and their median disability score, measured with the ALS Functional Rating Score (ALSFRS) was 26.5 (SD=6). Diffusion tensor was calculated for each voxel of spinal cord[2], and MD and FA were derived from it. Cord MD and FA histograms were produced and the cross-sectional cord area was measured[3]. Univariate correlations among histogram-derived metrics, cord cross-sectional area and clinical parameters were assessed by using the Spearman Rank correlation coefficient.

Results.

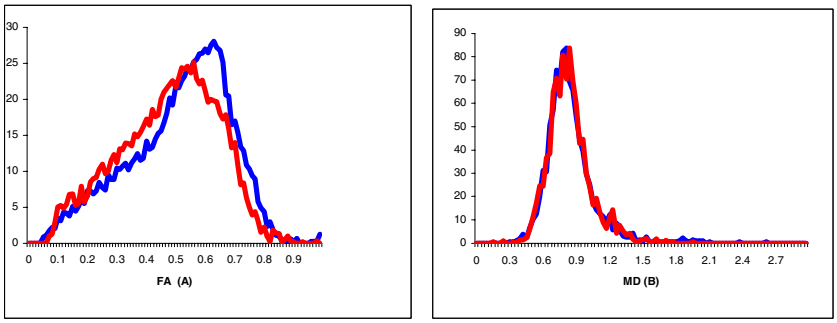
Cervical cord histogram-derived metrics from ALS and controls are reported in the Table.

	ALS patients	Healthy subjects
Average MD (SD)	0.89 (0.06)	0.88 (0.12)
MD Peak height (SD)	111 (21)	115 (23)
Average FA (SD)	0.48 (0.04)	0.52 (0.03)
FA peak height (SD)	45.5 (8)	46.5 (7)
Cord cross-sectional area	68.4 (9)	78.2 (6)

MD and FA histogram-derived measures from ALS patients and from healthy control subjects. Average MD in units of mm^2s^{-1} x 10^{-3}; MD and FA peak heights expressed in %0; average FA in percentage (%).

Compared to controls, ALS patients had significantly lower average FA (p=0.021). No significant differences were found for MD histogram-derived metrics between the two groups (Figure). Cord cross-sectional area was found to be significantly reduced in ALS patients in comparison with the healthy controls (p=0.005). A significant correlation was found between average FA and cord cross-sectional area (r=-0.52, p=0.05), whereas no significant correlations were found between ALSFRS score and histogram-derived metrics.

Figure



Legend. Average FA (A) and MD (B) histograms of the cervical cord from healthy controls (blue line) and ALS patients (red line).

Conclusions.

This study shows that DTI-MRI of spinal cord is feasible in patients with ALS and allows to grade the extent of cord damage. The most likely pathological substrates of the diffusion and atrophy changes found are axonal loss (due to cortico-spinal tract degeneration) and reactive gliosis.

References.

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