CERVICAL CORD IS VULNERABLE TO AGING: A DIFFUSION-TENSOR MRI STUDY

P. Valsasina[1], F. Agosta[1], S. Sala[1], M. Laganà[2], B. Benedetti[1], L. Dall'Occhio[1], M. P. Sormani[1,3], and M. Filippi[1,2]

[1]Neuroimaging Research Unit, Department of Neurology, Scientific Institute and University Hospital San Raffaele, Milan, Italy, [2]MRI Research Group, Scientific Institute Fondazione Don Gnocchi, Milan, Italy, [3]Unit of Biostatistics, DISSAL, University of Genoa, Genoa, Italy

Introduction.

Several studies have shown that normal aging is accompanied by the development of white matter lesions, hyperintense on T2-weighted scans, and by changes in volumetry, magnetization transfer and diffusion-tensor (DT) MRI parameters of brain tissue[1,2]. On the contrary, no previous studies investigated age-related changes of aging spinal cord. Aim of this study was to investigate the influence of normal aging on volumetry and DT-MRI metrics of the cervical cord.

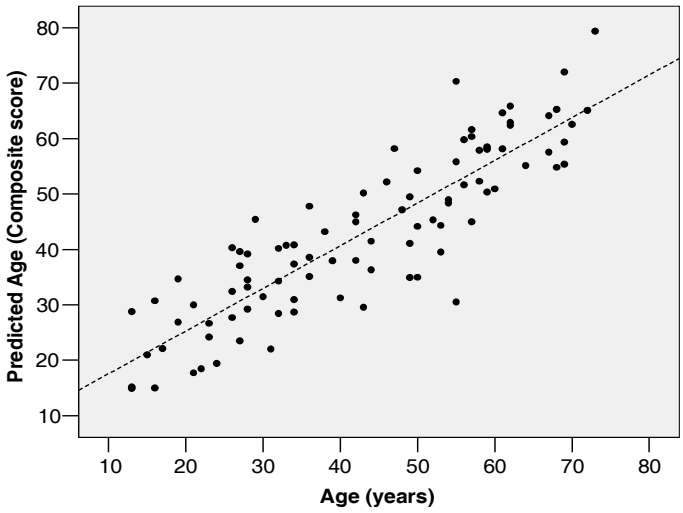
Methods.

We studied 96 healthy subjects (41 males and 55 females, mean age=43 years, age range=13-73 years). Using a 1.5 T scanner (Magnetom Avanto, Siemens, Erlangen, Germany), cervical cord and brain DT-MRI was acquired using a pulsed-gradient spin-echo single shot echo-planar sequence (PGSE-SS-EPI) (inter-echo spacing=0.77, TR=2900, TE=84), with diffusion-encoding gradients applied in 12 non collinear directions (b factor=900 s/mm^2). Eighteen, contiguous axial slices (4 mm slice thickness, matrix size=128x128, field of view [FOV]=240 mm^2) from the brain, and five, sagittal slices (4 mm slice thickness, matrix size=128x48, FOV=240x90 mm^2 from the cord were obtained. During each session, cervical cord and brain conventional T2-weighted and T1-weighted 3D magnetization-prepared rapid acquisition gradient echo (MP-RAGE) sequences were also acquired. Diffusion tensor was calculated for each voxel[3], and mean diffusivity (MD) and fractional anisotropy (FA) were derived. MD and FA histograms were produced from cord and brain tissues (grey [GM] and white [WM] matter). Cervical cord cross-sectional area[4] and normalized brain (NBV), global GM, cortical GM (cGM) and WM volumes[5] (Vs) were computed. Univariate correlations were assessed by using the Spearman Rank correlation coefficient. A multivariate linear regression model was used to establish which MRI variables were independent influenced by age.

Results.

No cord lesions were found in any subjects. Brain T2 LV was 1.97 ml (SD=4.6 ml). Cord FA was significantly associated to age (r=-0.69, p<0.001), whereas cord MD and cord area did not. Significant univariate correlations were also found between age and the following brain variables: T2 LV (r=0.49, p=0.004), NBV (r=-0.76, p<0.001), normalized cGMV (r=-0.83, p<0.001), GM (r=0.62, p<0.001) and WM (r=0.37, p<0.001) average MD, GM (r=-0.79, p<0.001) and WM (r=-0.40, p<0.001) MD histogram peak height. Cord and brain MRI metrics were only weakly correlated (r values=from -0.35 to 0.20, p values=from 0.001 to 0.03). A multivariate linear regression model retained cord FA, normalized cGM volume and brain GM MD histogram peak height as independent predictors of age (correlation coefficient=0.88, p<0.001), as shown in the Figure.

Figure: Scatterplot of the correlation between subject's age and the composite score derived from the multivariate model in the healthy individuals.



Conclusions.

Spinal cord DT-MRI was able to detect microstructural age-related changes in the cervical cord of healthy individuals. Such diffusivity changes are not likely a mere consequence of Wallerian degeneration. The combined use of brain and cord MRI metrics allows to monitor the extent of damage occurring in aging CNS tissues.

References.

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