Structural correlates of abnormalities of cervical cord functional MRI activity in patients with multiple sclerosis

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Purpose. Aim of this study was to investigate the association of cervical cord functional MRI (fMRI) activity with brain and cord structural damage in a large cohort of patients with multiple sclerosis (MS). Previous cervical cord fMRI studies have shown that MS patients have an enhanced cord activation [1,2]. Due to the small number of subjects, however, most of these studies failed to detect any correlation between cord activity and the extent of structural damage.

Methods. Cervical cord fMRI scans were acquired from 87 MS patients (39/48 males/females, mean age=48.3 years) and 22 controls (9/13 males/females, mean age=45.6 years). Subjects performed a sensory task, which consisted in a tactile stimulation of the palm of the right hand. Conventional, diffusion-tensor and 3D T1-weighted images of the cervical cord and brain were also acquired. Statistical maps of cord activity were produced using a general linear model. The presence of activity in all cord quadrants was assessed on single-subject activation maps. The mean cord intensity signal change was computed. Structural MRI analysis included the assessment of (i) cord lesion number and brain T2 lesion volume; (ii) brain and cord diffusivity abnormalities; (iii) brain and cervical cord atrophy. Between-group differences were assessed with the Mann-Withney test and the Pearsons' Chi-square test. The associations between cord fMRI activity and structural MRI variables were investigated with multiple regression and binary logistic models.

Results. Average cord fMRI activity was higher in MS patients (3.37%, SD=1.0) than in healthy controls (2.77%, SD=0.7) (p=0.03, corrected for cord area) (Figure 1). MS patients showed a higher frequency of fMRI activity than controls in the left anterior cord at different levels (p=range 0.01-0.03), and in the right posterior cord at C6/C7 (p=0.02). Cord fMRI activity was correlated with atrophy (r=-0.23; p=0.04) (Figure 2) and mean diffusivity (P value of binary logistic model=0.009) of brain grey matter. No correlation was found with any metric of cord damage.

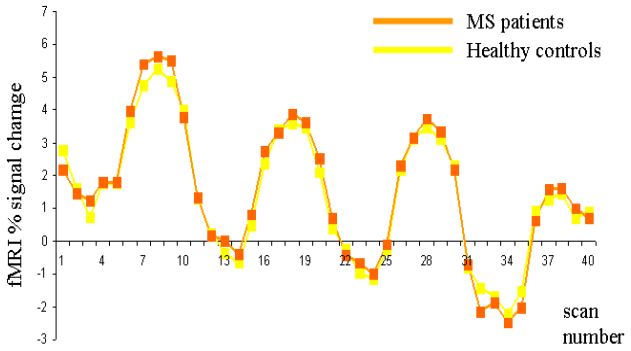

Figure 1. *Mean percent signal intensity change in the cervical spinal cord during a tactile stimulation of the palm of the right hand in healthy controls (yellow) and MS patients (orange).*

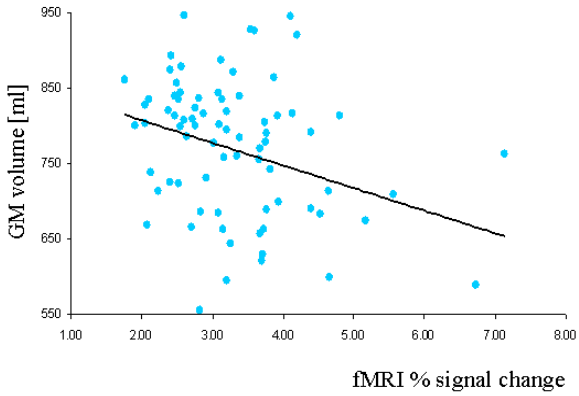

Figure 2. *Scatterplot of the correlation between cord fMRI activity and grey matter volume in our cohort of MS patients.*

Discussion and conclusions. Increased cord activity was observed in MS patients compared with controls. The correlation between cord over-recruitment and brain damage suggests that increased cord activity might be due an altered supraspinal modulation.

References

1. Valsasina P, et al. J Neurol Neurosurg Psychiatry 2010; 81:405-408.
2. Agosta F, et al. Radiology 2009; 253:209-215.