DOES CORTICAL ADAPTATION CHANGE WITH DISEASE EVOLUTION IN MS? A FUNCTIONAL MRI STUDY OF PATIENTS WITH DIFFERENT DISEASE PHENOTYPES.

M. A. Rocca[1], A. Falini[2], B. Colombo[3], A. Ghezzi[4], V. Martinelli[3], G. Scotti[2], G. Comi[3], M. Filippi[1]

[1]Neuroimaging Research Unit, Ospedale San Raffaele, Milan, Italy, [2]Dept. of Neuroradiology, Ospedale San Raffaele, Milan, Italy, [3]Dept. of Neurology, Ospedale San Raffaele, Milan, Italy, [4]Dept. of Neurology, Ospedale di Gallarate, Gallarate, Italy

Introduction

Recent fMRI studies have suggested that brain plasticity is one of the main factors, with the potential to limit the clinical impact of structural tissue damage in MS patients. In patients with clinically isolated syndromes (CIS) suggestive of MS, as well as in patients with established MS and a relapsing-remitting (RR) disease course, movement-associated cortical reorganization has been shown to involve the "classical" areas of the sensorimotor network, including the primary and the secondary sensorimotor cortices and the SMA.[1,2] On the contrary, similar studies of the motor system in patients with secondary progressive (SP)[3] and primary progressive (PP) MS[4,5] have shown an increased recruitment of several regions of a widespread network usually consider to function in sensorimotor and multimodal integration processing. One of the possible explanations for these findings might be that the mechanisms of cortical plasticity are different in the different phases of the disease. In order to test this hypothesis, we compared the movement-associated brain patterns of cortical activations in patients at different stages of the disease.

Patients and methods

fMRI scans during the performance of a simple motor task with the right, fully-normal, hand were obtained from 16 patients at presentation with CIS suggestive of MS, 14 patients with RRMS and no clinical disability, 16 patients with RRMS and mild clinical disability and 13 patients with SPMS. fMRI analysis was performed using statistical parametric mapping (SPM99).[6]

Results

Compared to RRMS patients with no clinical disability, CIS patients showed more significant activations of the contralateral primary SMC. Compared to RRMS patients with mild clinical disability, RRMS patients with no clinical disability had more significant activations of the primary SMC, bilaterally, and SMA. Compared to SPMS patients, RRMS patients with clinical disability had more significant activations of the contralateral inferior frontal gyrus (IFG), ipsilateral secondary sensorimotor cortex (SII), basal ganglia, bilaterally, and thalami, bilaterally. Compared to RRMS patients with clinical disability, SPMS patients had more significant activations of the superior frontal gyrus, bilaterally, middle frontal gyrus, bilaterally, ipsilateral IFG, and contralateral infraparietal sulcus (IPS).

Conclusions

Recent studies of MS patients with different disease phenotypes have suggested that an increased recruitment of the cerebral networks involved in the performance of simple motor tasks might represent a first step of cortical reorganization with the potential to maintain a normal level of function in the presence of brain structural damage, as shown in patients at presentation with CIS[2] and with RRMS[1] The progressive failure of these mechanisms, due to accumulating tissue damage, might, on the one hand, result in the activation of previously silent 'second-order' compensatory areas, and, on the other, contribute to the accumulation of irreversible disability, as shown in patients with PPMS.[4, 5] However, no studies have been performed to directly compare the movement-associated brain pattern of cortical activations between MS patients with different disease phenotypes.

This study shows that movement-associated cortical reorganization in MS varies with disease evolution. In the early stage of the disease, there is an increased recruitment of those areas "normally" devoted to the performance of the task, such as the primary SMC and the SMA. At a later stage, a bilateral activation of these regions is first seen, followed by a widespread recruitment of additional areas, which are usually recruited in normal people to perform novel/complex tasks, including the SII, the IPS and several regions in the frontal lobe.

References

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