Regional Distribution and Clinical Correlates of White Matter Structural Damage in Huntington Disease: A Tract-Based Spatial Statistics Study

R. Della Nave, A. Ginestroni, C. Tessa, M. Giannelli, S. Piacentini, M. Filippi and M. Mascalchi

From the Radiodiagnostic Unit (R.D.N.), San Giuseppe Hospital, Empoli, Italy; Radiodiagnostic Section (A.G., M.M.), Department of Clinical Physiopathology, and Department of Neurological and Psychiatric Sciences (S.P.), University of Florence, Florence, Italy; Radiology Unit (C.T.), Versilia Hospital, Camaiore (Lucca), Italy; Department of Medical Physics (M.G.), Pisa Hospital, Pisa, Italy; and Neuroimaging Research Unit (M.F.), Department of Neurology, Scientific Institute and University San Raffael, Milan, Italy.

Please address correspondence to Mario Mascalchi, PhD, Radiodiagnostic Section, Department of Clinical Physiopathology, University of Florence, Viale Morgagni 85, 50134, Florence, Italy; e-mail: m.mascalchi@dfc.unifi.it

BACKGROUND AND PURPOSE: HD entails damage of the WM. Our aim was to explore in vivo the regional volume and microstructure of the brain WM in HD and to correlate such findings with clinical status of the patients.

MATERIALS AND METHODS: Fifteen HD gene carriers in different clinical stages of the disease and 15 healthy controls were studied with T1-weighted images for VBM and DTI for TBSS. Maps of FA, MD, and $\chi\|\$ and $\chi\perp\$ were reconstructed.

RESULTS: Compared with controls, in addition to neostriatum and cortical GM volume loss, individuals with HD showed volume loss in the genu of the internal capsule and subcortical frontal WM bilaterally, the right splenium of the corpus callosum, and the left corona radiata. TBSS revealed symmetrically decreased FA in the corpus callosum, fornix, external/extreme capsule, inferior fronto-occipital fasciculus, and inferior longitudinal fasciculus. Areas of increased MD were more extensive and included arciform fibers of the cerebral hemispheres and cerebral peduncles. Increase of the $\chi\|$ and a comparatively more pronounced increase of the $\chi\perp$ underlay the decreased FA of the WM in HD. Areas of WM atrophy, decreased FA, and increased MD correlated with the severity of the motor and cognitive dysfunction, whereas only the areas with increased MD correlated with disease duration.

CONCLUSIONS: Microstructural damage accompanies volume decrease of the WM in HD and is correlated with the clinical deficits and disease duration. MR imaging–based measures could be considered as a biomarker of neurodegeneration in HD gene carriers.