

Diffusion tensor imaging and MRS relaxometry at 3T in patients with idiopathic Parkinson disease

Carsten Krautmacher¹, Frank Träber¹, Petra Mürtz¹, Omid Kanimogaddam¹, Okan Gür¹,
Wolfgang Block¹, Tanja Schmitz-Hübsch¹, Ulrich Wüllner¹, Hans H. Schild¹

¹University of Bonn, Bonn, Germany

Synopsis

DTI has the potential to uncover structural changes in brain tissues of patients with idiopathic Parkinson disease. After evaluating the feasibility of DTI at 3T in healthy controls, we compared ADC- and FA-values of 12 patients and 11 controls. We found significant differences in the substantia nigra and basal ganglia. Additional MRS relaxometry, which should theoretically be more accurate at 3T than at lower field strengths, showed a trend towards shorter T2 relaxation times in basal ganglia of patients reflecting the expected higher iron content.

Purpose

Patients with idiopathic Parkinson disease (IPD) commonly show histopathologic changes in their substantia nigra and their basal ganglia. These may manifest as abnormalities in diffusion tensor imaging (DTI) and MRS relaxometry. This study was designed to test the feasibility of DTI at 3T and to search for differences between patients and healthy controls using DTI and MRS relaxometry.

Materials and Methods

We examined 12 patients suffering from IPD and 11 healthy controls with DTI and MRS relaxometry on a 3T whole body system (Gyrosan Intera 3.0T, Philips, Best, The Netherlands). Additional 11 healthy controls were examined with DTI only at 1.5T (Gyrosan Intera 1.5T, Philips). DTI was performed using a fat-suppressed single-shot SE EPI acquiring b-values of 0 and 1600s/mm². Sequence parameters were identical at 3T and 1.5T (TR 3200ms, TE 95ms, 11 slices of 5mm thickness, FOV 21cm²). Apparent diffusion coefficient (ADC) and fractional anisotropy (FA) maps were calculated. MRS relaxometry was performed by a non-water suppressed SE-series with nine echo times varying between 32 and 700ms (TR 2400ms, 8 NSA, VOI-size 1.5-1.8cm³). T2 relaxation times were measured in the putamen and globus pallidus and corrected for CSF content by bi-exponential fitting.

Results

DTI of controls at 1.5T and 3T showed no considerable differences. Comparison between patients and controls at 3T yielded significantly higher ADC [10^{-6} mm²/s] in the right substantia nigra (654 vs. 552, p=0.038) and the left globus pallidus (777 vs. 557, p=0.005) of patients. FA [10^{-3}] was significantly lower in the right substantia nigra (440 vs. 638, p=0.010) of patients. MRS relaxometry of patients vs. controls showed a trend towards shorter T2 relaxation times in the putamen (54.0 vs. 55.5ms, p=0.557) and in the globus pallidus (43.7 vs. 46.2ms, p=0.315) of patients.

Conclusion

In healthy subjects, DTI is feasible at 3T yielding data similar to DTI at 1.5T. Significantly higher ADC and lower FA in Parkinson patients potentially reflect cell and fiber loss in the substantia nigra and globus pallidus. The trend towards shorter T2 relaxation times in patients may represent the expected higher iron content in diseased basal ganglia.