Improved sensitivity and specificity in the diagnosis of Parkinson's Disease from Diffusion Kurtosis Imaging

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Purpose: Parkinson's Disease (PD) is a neurodegenerative diseases of unknown cause, characterized by small step length, stooped posture and festination gait. Complete separation of idiopathic PD from other Parkinsonian variations has been difficult, because of presence of common signs and symptoms[1]. Previous study showed that Fractional Anisotropy in substantia nigra was lower in PD, yet there was considerable overlap between patients and controls[2]. The current study proposed to assess the diagnostic accuracy of PD by diffusion kurtosis imaging[3] and compared it with conventional tensor-derived indices.

Methods and Materials: The study protocol complied with the tenets of the Declaration of Helsinki and was approved by the local Institutional Review Board. All participants gave written informed consent. 30 patients, who met the Gelb criteria[4] for probable or possible PD, were enrolled. 30 age range matched healthy persons, who was free from neuropsychiatric disorders and recruited in the general population, served as controls.

DTI data were acquired using a spin-echo EPI sequence with the following parameters: TR/TE =7400 ms/83 ms, isotropic voxel size of 2 mm and 56 axial slices. Diffusion-weighting gradients were applied in 64 non- collinear directions and b-value of 1000 s/mm^2. The mean kurtosis was calculated from a series of diffusion weighted acquisitions of multiple b-values, using the same EPI sequence except an increased slice thickness of 5 mm. The diffusion-weighting gradients were applied in three orthogonal directions, with the b-value increased from 0 s/mm^2 to 4000 s/mm^2 in steps of 100 s/mm^2. The indices in comparison were mean kurtosis (MK), Fractional Anisotropy (FA), Mean/Axial/Radial Diffusivity (MD/AD/RD).

Results: The figures showed the results of Receiver Operative Curve analysis from Regions of Interest (ROI) in Caudate (a), Putamen (b), Globus Pallidus (c) and Substantia Nigra (d). All regions in comparison showed significantly higher Area Under Curve from Mean Kurtosis than all conventional tensor-derived indices, with the smallest AUC of 0.84 in globus pallidus. The best performance was in substantia nigra, which has a sensitivity and specificity of approximately 0.87 and 0.92.

Conclusion: In patient of idiopathic Parkinson's Disease, the mean kurtosis in the basal ganglia has significantly improved diagnostic sensitivity and specificity when compared to conventional diffusion indices in differentiating from normal controls.

Ref: 1. Ghaemi et al. JNNP 2002;73:517, 2. Chan et al, JNNP 2007;78: 1383, 3. Helpern, et. al. MRM. 2005; 53:1432-1440, 4. Gelb, et al *Ar.c Neur. 56*(1), 33.