DIFFUSION KURTOSIS IMAGING AS A PRE-SYMPTOMATIC MARKER IN AN A-SYNUCLEINOPATHY MOUSE MODEL

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Introduction: Diffusion kurtosis imaging (DKI) was recently developed to characterize the non-Gaussian behavior of water. Since water in the brain is restricted by several tissue structures, kurtosis can be considered a quantitative measure of the complexity of the brain tissue microstructure.

Aims: We tested DKI as a potential early marker for Parkinson's disease (PD) in the motor cortex, the hippocampus and the caudate putamen of a pre-symptomatic human mutant α-synuclein (αSYN) overexpressing mouse model for PD.

Methods: Five month old (Thy-1)-h[A30P]αSYN transgenic (TG) mice (n=7) were compared with age matched wild type (WT) animals (n=7) for changes in diffusion parameters. The imaging protocol included high resolution (125µm x 125µm) multi-slice fast spin echo imaging with diffusion sensitizing gradients along 15 directions. Accurate tensor estimates for the diffusion tensors and the diffusion kurtosis tensors were obtained by using a constrained maximum likelihood estimator, which includes a Rician noise model. The fixed noise level was estimated from the histogram mode of the image background.

Results: Anatomy based region of interest analysis showed significant differences in kurtosis and diffusion parameters between the TG and the WT mice in the three examined regions.

Conclusions: At five months of age the (Thy1)-h[A30P]αSYN TG mice are pre-symptomatic, but abundantly express the transgenic protein in the protease K labile conformation that characterizes native αSYN. However, with DKI we were able to detect subtle microstructural differences which provides an important step toward developing a non invasive pre-symptomatic marker for PD.