Increased Diffusion Kurtosis of Gray Matter in Schizophrenia

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Introduction

• Gray matter (GM) alterations have been long known to exist in schizophrenia (SZ), with cortical thinning consistently reported by previous studies [1]; however, there is little understanding of how gray matter is affected at the microstructural level, with most knowledge to date arising from invasive, postmortem studies.
• In this study, we employed diffusion kurtosis imaging (DKI) [3] to describe microstructural properties of gray matter in patients with chronic SZ compared to healthy controls (HC).
• DKI is an extension of the diffusion tensor imaging (DTI) that derives mean kurtosis (MK), a metric that describes non-gaussian effects of water diffusion in tissues and reflects tissue complexity.
• MK was previously shown to be sensitive to GM changes due to both development [4] and pathology, such as inflammation [4].
• Cognitive impairment in schizophrenia has been documented by the Wisconsin Cart Sorting Test (WCST) and linked to abnormalities in frontal lobe structures [6].

Objective: To use MK, axial kurtosis (AK), radial kurtosis (RK) and mean diffusion (MD), measures to quantify microstructural properties of gray matter in SZ.
• H0: Altered diffusion metrics will be found in gray matter in the SZ compared to HC group.
• H1: Microstructural asymmetry patterns will differ in the SZ versus HC group.
• H2: Executive function measured by cognitive assessments will be correlated to alterations in gray matter diffusivity.

Methods

• DKI, B0 field map, and anatomical MPRAGE T1-weighted data was acquired using a 3T Trio Siemens scanner.
• All participants were right-handed males aged 30 to 55 years old
• dMRI data preprocessing included motion and eddy current correction and distortions from B0 field inhomogeneities.
• MK, RK, AK and MD maps were calculated using in-house developed software.
• ROIs were first derived in each subject using Freesurfer processing of the T1-weighted images and then transferred into the diffusion space.
• Cognitive assessments were administered by a trained psychologist to test a range of executive cognitive functions.

Results

Diffusion in GM of Lobes

Increased Diffusion in GM Within Lobes

Abnormal Laterality of MK in Schizophrenia

Conclusions

These results support our hypotheses that gray matter microstructure is altered in schizophrenia. These alterations may be a direct result of microstructural reorganization due to cortical thinning or may reflect other microstructural alterations such as inflammation or dysmyelination [5]. We note that the dMRI increase pattern observed here was previously reported to reflect astrogliosis in a rat model of traumatic brain injury [4]. Future studies will further examine these hypotheses using a multimodal approach that includes Magnetic Resonance Spectroscopy and quantitative Magnetization Transfer in addition to the DKI approach.

References

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