Normal right-to-left asymmetry in fractional anisotropy of superior occipitofrontal fasciculus disappears in schizophrenia

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INTRODUCTION

Normal asymmetry or laterality of measurements found between right and left cerebral hemispheres can be lost in patients with schizophrenia [1]. Recent studies suggest impairment of thalamo-prefrontal connectivity may be implicated in pathogenesis of schizophrenia [2] and the superior occipitofrontal fasciculus (SOFF) may play a role [3]. The purpose of our study was to investigate whether asymmetry existed in diffusivity of SOFF extending to the thalamus through a tract-specific diffusion analysis with the assistance of diffusion tensor tractography (DTT).

SUBJECTS and METHODS

Subjects

Nineteen right-handed male patients with schizophrenia and 20 right-handed, age-matched, male control subjects were enrolled. All patients were diagnosed according to DSM-IV criteria (American Psychiatric Association 1994) by experienced psychiatrists. Their mean disease duration was 6.9 ± 6.0 years (mean ± standard deviation). All patients received antipsychotic drugs during the whole course of the disease. The mean age of the patients and the controls were 28.8 ± 7.0 and 29.5 ± 4.9 years respectively.

MR acquisition protocol

Diffusion tensor imaging was conducted on a 1.5 T clinical scanner (SignaHorizon, GE Healthcare, Wis, USA) with a single-shot echo-planar sequence (TE/TR = 78/7000 ms, 6 MPG directions, b-values = 0 -1000 s/mm^2, NEX = 4, FOV = 24 cm, 30 contiguous, 5-mm-thick slices, matrix = 128×128). After realignment, DTT was created using dTV [4] with a streamline method. Localization of SOFF was based on a published literature [3]. Two regions of interest (ROIs) were drawn on SOFF in different locations (the seed ROI on an anterosuperior location and the target ROI on a posteroinferior location) in order to visualize fiber bundles of SOFF extending to the thalamus (DTT-SOFF). Obtained trajectories were segmented and fractional anisotropy and apparent diffusion coefficient (ADC) of SOFF on a tract-specific basis.

Analysis

Five ROIs were placed on right and left DTT-SOFF, between the seed ROI and the target ROI, respectively. FA and ADC values were measured on each ROI and the mean values were compared between right and left SOFF. Two-tailed paired t-test was used for a test for difference and statistical significance was set at $P = 0.01$ based on Bonn-Ferroni correction for multiple comparisons.

RESULTS

Right and left DTT-SOFF was successfully visualized in all subjects. Results of measurements are shown in Table 1. Significant difference in FA (right < left) was observed in the controls ($P < 0.001$), but not in the patients ($P = 0.06$). Asymmetry (right > left) was not significant in ADC for both the patients and the controls ($P = 0.05$ and 0.21, respectively).

Our results suggest white matter directionality of SOFF may be lost left dominantly in schizophrenia. A recent study showing left thalamic volume reduces dominantly in schizophrenia support our results [5].

CONCLUSION

Together with previous studies, disappearance of normal asymmetry in FA of SOFF may support implication of thalamo-prefrontal circuitry abnormality in pathogenesis of schizophrenia.

REFERENCES

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	Fractional anisotropy		Apparent diffusion coefficient ($\times10^{-3}$ mm^2/s)	
	Right	Left	Right	Left
Schizophrenia	0.36 ± 0.03	0.39 ± 0.04	0.78 ± 0.04	0.76 ± 0.04
Control	0.41 ± 0.04*	0.45 ± 0.04*	0.73 ± 0.04	0.72 ± 0.02

Table 1. Results of measurement of fractional anisotropy (FA) and apparent diffusion coefficient (ADC)

Data are expressed as mean ± standard deviation.

* $P < 0.001$