

A diffusion tensor imaging study of white matter microstructure concerning suicidality in major depressive disorder

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TARGET AUDIENCE: Researchers who are interested in neuropsychiatric application of diffusion tensor imaging and also those who are interested in suicidal behavior or depression.

PURPOSE: Depression is a common psychiatric disorder affecting many people globally, and the worst outcome is suicide. Microstructural abnormalities of white matter (WM) in major depressive disorder (MDD) patients and associations with suicide behaviors had been studied with diffusion tensor image (DTI) before [1]. However, previous researches usually focus on either suicidal behavior or ideation. Present study aimed to give a more complete profile for the cerebral white matter microstructural abnormalities in major depressive disorder patients concerning suicide behavior by quantify the suicide idea and correlate with imaging information.

METHODS: The study was approved by local ethical committee and written consent was obtained. 34 major depressive disorder patients (mean age=33.1, male=13) and 45 healthy controls (HC, mean age=34.1, male=16) received MRI scans on a 3T magnet for diffusion tensor imaging. The patients were divided into three subgroups according to professional suicide evaluation: suicide attempters who had committed suicide at least once (SA, n=9), patients with (SI, n=14) and without suicide ideation (NSD, n=11). Hamilton Anxiety Rating Scale (HAMA), Hamilton Depression Rating Scale (HAMD), Barratt Impulsiveness Scale (BIS) and Columbia Suicide Scale were used to evaluate the mental state of all subjects. Fractional anisotropy (FA) maps were generated from each individual using DtiStudio (Johns Hopkins Medical Institute, Laboratory of Brain Anatomical MRI) and then put into SPM8 for normalizing and smoothing. Two sample t-test was done to compare the differences of FA between patients and controls with age and sex as covariates, threshold at $p < 0.005$ (uncorrected) at voxel level and 50 for cluster size. Fractional anisotropy values were extracted for further subgroup comparisons and correlation analysis.

RESULTS: Demographic and clinical characteristics are shown in Table 1. We found significant decrease in FA in the left splenium corpus callosum (SCC) in depressive patients comparing with healthy controls (Figure 1). There was no increased FA in any brain region in patients group. In subgroup comparison, SA showed significant decreased FA value than SI and NSD, while there was no significant difference between SI and NSD group. There is a negative correlation between regional mean FA values and sub-factor 1 (anxiety/somatization) and sub-factor 5 (retardation) of HAMD.

DISCUSSION: Abnormalities in the corpus callosum (CC) in patients with depressive disorders have been reported in previous MRI studies, but often in genu [2, 3]. The present study showed decreased FA value in the splenium of CC in depressive patients and this is more obvious in suicide attempters as shown in subgroup comparison. Suicide attempters showed more significant decrease than patients without suicide attempt, no matter they had suicidal ideation or not. Previous study has indicated that history of suicide attempt might be an indicator of high risk for future suicide [4]. Our current study gave support for this notion by demonstrated that people with suicide history do have more severe cerebral alteration as revealed by diffusion tensor imaging. In depressive patients, the change of FA correlated with scores for sub-factors of HAMD including symptoms of anxiety/somatization and retardation but not general symptoms of depression. This suggests that in future studies, we should also pay more attention to sub-scores which may be more relevant to particular brain changes.

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Table 1 Demographic and Clinical Characteristic

	SA (n=9)	SI (n=14)	NSD (n=11)	HC (n=45)	ρ	Contrast
	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)		
Age	30.44(6.77)	35.29(9.37)	37.18(9.6)	34.09(9.62)	0.432	—
Education year	13.33(3.50)	11.71(3.15)	12.91(3.15)	13.24(4.24)	0.620	—
HAMD total	29.44(10.05)	30.57(8.92)	21.82(5.47)	—	0.034	SA, SI> NSD
Anxiety/Somatization	10.67(5.10)	10.85(4.22)	7.73(3.74)	—	0.179	—
Retardation	9.22(3.50)	8.69(2.14)	7.64(2.01)	—	0.366	—
HAMA	45.11(15.05)	40.50(10.26)	29.55(5.20)	—	0.006	SA, SI> NSD
BIS	60.56(17.54)	57.93(8.92)	65.45(11.14)	—	0.329	—

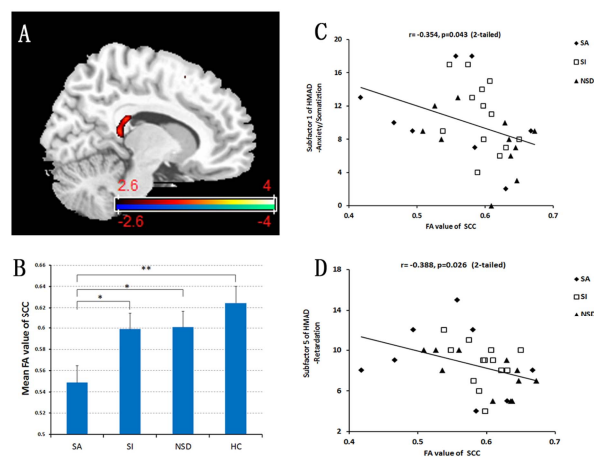


Fig. 1 A: Significant FA decrease in splenium of corpus callosum in depressive patients.

B: Mean FA values of splenium corpus callosum of four groups. Suicide attempters showed significant decrease than other three groups. *: $p < 0.05$, **: $p < 0.001$.

C and D: Correlation between FA value in splenium of corpus callosum and subfactor 1 and 5 of Hamilton Depression Rating Scale.