

Changes of brain activities and metabolites in the right dorsolateral prefrontal cortex in patients with obsessive compulsive disorder

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Purpose: The obsessive compulsive symptoms are mainly related to the dysfunctional cortico-striatal-thalamic circuit (CSTC), a network involving the prefrontal cortex, striatum, thalamus in pathogenesis. Several neuroimaging or spectroscopy studies revealed differential brain activation patterns during performing memory tasks and metabolic concentration changes in the CSTC circuits. However, the findings from the studies mentioned above have not been consistent. We performed ¹H MRS and fMRI study during the implicit memory tasks for the quantification of the brain metabolites and identification of the brain activation patterns in OCD patients.

Subjects and Methods: A total of 24 subjects consisting of a dozen patients with OCD with a duration of illness exceeding 5 years and an educational level over 15 years (mean age, 29.4±7.2years), who were diagnosed by DSM-IV-RT, and 12 healthy controls (mean age, 33.4±6.4years) with no history of neurological or psychiatric illness. The subjects underwent 3T MRI examinations with an 8-channel receive birdcage head coil. The stimulation paradigm for fMRI study consisted of 5 times rest conditions, 2 times encoding of two-syllable words and 2 times implicit retrieval of previously learned words, each lasted for 14, 18, and 18 seconds, respectively. To position the voxel for MRS associated with fMRI, the real-time fMRI analysis was performed using Neuro3D software. The results obtained from the Neuro3D software were later confirmed by analyzing the data using the SPM8 package (Fig. 1). The single-voxel ¹H MRS were performed using a PRESS with TR/TE= 2,000/30 ms, 96 acquisitions (scanning time 3 minutes and 20 seconds), 1,200 Hz spectral width, 1,024 data points, and 8cm³ (20×20×20mm) voxel size. The MR spectra were post-processed and analyzed by using an MR spectroscopy data analysis package.

Results and Discussion: As compared with healthy controls, the predominant activation areas in patients with OCD during implicit memory task showed the superior/middle/inferior frontal gyri, dorsolateral prefrontal cortex, orbitofrontal gyrus, fusiform gyrus, angular gyrus, cerebellum and calcarine gyrus (uncorrected; $p<0.005$). But, no brain activity area was observed in the normal control as contracted to the OCD patients. Figure 2 and Table 2 compare the metabolite concentrations in the right DLPFC. The metabolite ratios of $\beta\gamma$ -Glx/Cr and mI/Cr were significantly different between OCD and healthy controls. Note that no significant concentration differences were observed in NAA/Cr, Cho/Cr, Lac/Cr, Lip/Cr and α -Glx/Cr. Especially, the right DLPFC showed a distinct abnormality in the brain activities and metabolic concentration. These results support that OCD symptom stems from the abnormal neurotransmission of glutamate in the right DLPFC and this glutamatergic disorder correlates with different brain activation.

Conclusion: It is concluded that patients with OCD and healthy controls have differential brain activation patterns and metabolite concentration changes during implicit memory tasks. These findings would be helpful to understand the neural mechanism associated with OCD.

Reference : 1. Milad MR et al, *Trends Cogn Sci* 2012 jan ;16(1) : 43-51 / 2. Kim H et al., *Hum Psychopharmacol* 2005 jul ; 20(5) : 309-326

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Table 1 Significant brain activities in implicit memory between patients with OCD and healthy controls (uncorrected : $p<0.005$).

Anatomical area	Abbr.	Side	BA ^a	MN coordinate			t-value	Cluster
				x	y	z		
Superior frontal gyrus	SFG	R	6	26	6	62	3.14	45
Middle frontal gyrus	MFG	L	45	-42	44	30	3.88	127
Inferior frontal gyrus	IFG	L	44	-56	22	28	3.40	19
Orbitofrontal gyrus	OFG	R	11	26	36	-20	3.40	28
Dorsolateral prefrontal cortex	DLPFC	R	9	40	16	58	3.03	10
Fusiform gyrus	FuG	R	20	36	-12	-36	4.23	42
Calcarine gyrus	CcG	R	19	28	-54	8	3.11	29
Angular gyrus	AnG	R	7	36	-74	42	3.02	14
Cerebellum	Cb	L	-	-44	-72	-32	3.33	28

^aBA indicates Brodmann's area.

Subject (Mean±SD)		P value
Healthy controls	patients with OCD	
α -Glx/Cr	0.45±0.09	0.48±0.11
mI/Cr	0.42±0.16	0.68±0.24
Cho/Cr	0.81±0.12	0.77±0.08
$\beta\gamma$ -Glx/Cr	1.15±0.21	0.91±0.21
NAA/Cr	1.66±0.15	1.69±0.19
Lac/Cr	0.20±0.06	0.16±0.05
Lip/Cr	0.47±0.06	0.47±0.08

Table 2 Variation of the metabolites concentration in the right dorsolateral prefrontal cortex(DLPFC) between patients with obsessive compulsive disorder(OCD) and healthy



Figure 1. The brain areas predominantly activated during working memory in patients with OCD over healthy controls by using SPM8 (uncorrected; $P<0.005$). The localized voxels covering the DLPFC for the ¹H MRS are shown

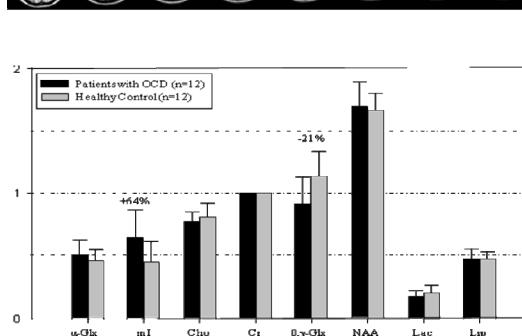


Figure 2. Comparison of the brain metabolites in the right dorsolateral prefrontal cortex(DLPFC) between patients with obsessive compulsive disorder(OCD) and healthy controls