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Analysis of the relationship between cerebellar volume and psychological parameters in 20s male adults

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Abstract

This study measured the cerebellar volume of normal male adults in 20s with magnetic resonance imaging (MRI) and analysed the relationship between cerebellar volume and various psychological parameters. The cerebellar volume of 58 males (mean age, 24.0±2.8 years) was measured using MRI. The Symptom Checklist-90-R (SCL-90-R) and the Component of Type A Behavior tests were performed. Using linear regression analysis, the relationship between cerebellar volume and psychological parameters was analysed. As phobic anxiety and ambition increased, cerebellar volume of normal male subjects in 20s decreased. This study showed that for even normal male adults, there exists a possible relationship between various psychological parameters and cerebellar volume.

Keywords: Cerebellar volume, psychological parameters, 20s male adults

1. Introduction

Lots of studies regarding the relationship between the cerebellum and cognition, behaviour, and psychological diseases have been conducted. There have been reports that the cerebellar volume of children and adults with attention deficit hyperactivity disorder (ADHD) is smaller than that of normal subjects [1, 2, 3]. Brambilla, Hardan, Ucelli di Nemi, Perez, Soares, and Barale (2003) [4] reported that the cerebral and cerebellar volumes of patients with autism are increased. The cerebellar volume of schizophrenic patients is smaller than that of normal subjects [5, 6]. Barkataki, Kumari, Das, Taylor, and Sharma (2006) [7] also

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reported that the cerebellar volume of patients with schizophrenia or antisocial personality disorder (ASPD) is smaller than that of normal subjects.

There have been a number of studies concerning the relationship between cerebellar volume and various psychological diseases, such as ADHD, autism, schizophrenia, and ASPD. However, there have been few studies about the relationship between cerebellar volume and various psychological parameters in normal subjects. Therefore, this study measured the cerebellar volume of normal male adults in their 20s with magnetic resonance imaging (MRI) and analysed the relationship between cerebellar volume and various psychological parameters.

2. Methods

58 male college students in their twenties (24.0±2.8 years) participated in the study. Participants were screened to exclude a history of psychiatric or neurological disorders and brain damage. The overall procedure was explained to all subjects. All subject signed participation consent forms. All examinations were performed under the regulations of our Institutional Review Committee.

The Symptom Checklist-90-R (SCL-90-R) [8] and the Component of Type A Behavior [9] were performed. The SCL-90-R is classified into 9 lower ranks (somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism) and consists of 90 problems. Each problem represents a single typical psychological symptom and calculates 5 point scales (‘do not have’ to ‘severe’). The Component of Type A Behavior consists of 4 lower ranks (tenseness, ambition, activity, and unrepressed) and has 34 yes-or-no problems. As the total points increases, the type A character becomes stronger.

Magnetic resonance imaging was conducted using a 3.0-T FORTE machine (ISOL Technology, Korea) equipped with whole-body gradients and a quadrature head coil. T1-weighted brain images were obtained with a three-dimensional, magnetization-prepared, rapid-gradient echo sequence (TR/TE/TI=10/4/100 ms; slice thickness, 1.5 mm; field of view, 220×192×192 mm^3; number of slices, 128; slice gap, 0; matrix size, 256×224×128; and number of excitations, 2).

Brain Voyager 2000 software (Brain Innovation BV, Germany) was used for separation of the cerebellar regions and their volume measurements. After the two pre-processing routines of inhomogeneity correction and sigma filtering, a region-growing algorithm based on image brightness was carried out for automatic segmentation. Finally, manual segmentation was carried out by one of the authors who have sufficient knowledge in neuroanatomy to process boundary and detailed regions properly. The cerebellum was extracted by excluding cerebellar peduncles, the brainstem, and the medullary vela regions. After measuring the regions of interest, the total cerebellar volume was calculated by summation of the cerebellar volume in each slice, obtained by multiplication of the areas by the slice thickness.

Linear regression analysis, using SPSS (version 12.0), was carried out by setting each psychological parameter score as an independent variable and cerebellar volume as a dependent variable.

3. Results

As phobic anxiety increased, cerebellar volume of normal male subjects in 20s decreased ($p= .018$) as shown in Table 1 and Fig. 1(a). As ambition increased, cerebellar volume decreased ($p= .024$) as shown in Table 1 and Fig. 1(b).

4. Discussion

This study analysed the relationship between cerebellar volume and various psychological parameters in normal male adults in 20s.

The frequency of occurrence of generalized anxiety disorders is greater for patients with ADHD than for normal subjects [10, 11]. Of adults with ASPD, 54.3% have anxiety disorders [12], accompanied with symptoms of anxiety [13]. Schizophrenia

patients show higher anxiety compared with normal subjects [14]. Some 41.5% of schizophrenia patients have an anxiety disorder, and schizophrenia patients with anxiety disorders show severe degrees of schizophrenia as compared to schizophrenia patients without anxiety disorders [15]. This study showed that phobic anxiety in normal subjects increased, the cerebellar volume decreased. It is believed that this is a meaningful result when compared with the published results that cerebellar volume of patients with ADHD and schizophrenia with higher anxiety decreased [1, 2, 3, 5, 6, 7].

Eysenck and Fulker (1983) [9] reported that as the tendency for type A behaviour became higher, ambition became higher, and this tendency had a static relationship with neurotic tendencies. Wiles, Zammit, Bebbington, Singleton, Meltzer, and Lewis (2006) [16] reported that neurotic tendencies are important factors for symptoms of schizophrenia. The cerebellar volume in schizophrenia is smaller than that of normal subjects [5, 6, 7]. These published studies support the result of this study that as ambition increased, cerebellar volume decreased.

This study showed interesting results that for even normal male adults, there exists a possible relationship between various psychological parameters and cerebellar volume.

Table 1. Coefficient of regression for parameters of the Symptom Checklist-90-R and the Component of Type A Behavior from linear regression analysis.

	Parameters	Unstandardized coefficients		Standardized coefficients	t	Sig.	
		B	Std. Error	Beta			
The Symptom Checklist-90-R (SCL-90-R)	(constant)	155859.128	19872.705		7.843	0	R^2 = .200 F = 1.053 p = .418
	somatization	238.184	467.116	0.11	0.51	0.613	
	obsessive-compulsive	39.747	536.956	0.022	0.074	0.941	
	interpersonal sensitivity	496.262	575.874	0.256	0.862	0.394	
	depression	198.133	671.35	0.104	0.295	0.769	
	anxiety	110.563	681.338	0.048	0.162	0.872	
	hostility	100.413	564.445	0.045	0.178	0.86	
	phobic anxiety	-1321.313	539.491	-0.506	-2.449	**0.018**	
	paranoid ideation	95.041	592.598	0.039	0.16	0.873	
	psychoticism	-251.704	578.492	-0.146	-0.435	0.666	
The Component of Type A Behavior	(constant)	148198.899	6532.162		22.688	0	R^2 = .133 F = 1.835 p = .138
	tenseness	299.295	678.451	0.066	0.441	0.661	
	ambition	-2842.663	1214.957	-0.384	-2.34	**0.024**	
	activity	-1009.939	1819.666	-0.114	-0.555	0.581	
	unrepressed	1679.106	1726.26	0.195	0.973	0.336	

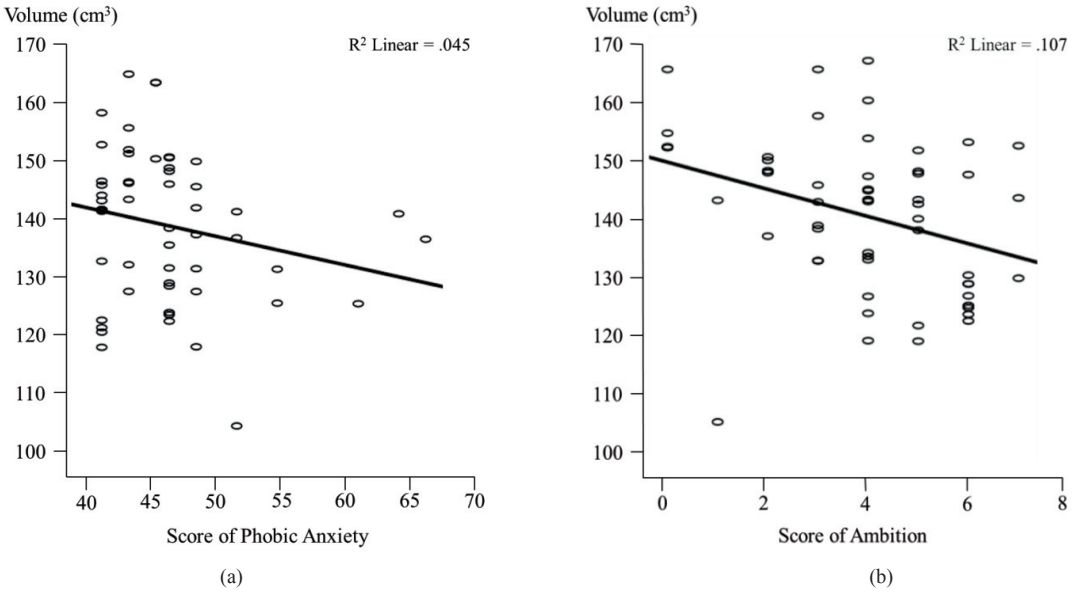

Figure 1. Relationship between cerebellar volume and scores of (a) phobic anxiety and (b) ambition.

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