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Comparison of Electroencephalography in Patients with Multiple Sclerosis and Normal People

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Abstract

Objective: The objective of this study was to compare of electroencephalography in patients with multiple sclerosis and normal people.

Materials and Methods: The study design was descriptive and causal-comparative. EEG signals from 30 MS patients and 30 normal counterparts were collected.

Results: The free of artifact waves were selected and were quantified by fast transformation of Fourier and absolute power of the bands of delta, theta, and beta in the frontal, central and occipital were obtained respectively.

Conclusion: According to the findings it can be suggested that should be many treatment centers and associations to strengthen monitoring and rehabilitation of cognitive function in MS patients.

Keywords: *Electroencephalography, Multiple sclerosis, Normal people*

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Introduction

Multiple sclerosis (MS) is one of the most common diseases of the central nervous system. In this disease myelin that is involved in the transmission of nerve impulses along the nerve fiber is damaged, if the myelin damage is trivial the nerve messages are transmitted with less problems, but if the damage is too much scar -tissue like myelin (the injured) is replaced by myelin the nerve signaling and transmission may be completely stopped [1]. The name of the disease, Multiple Sclerosis was chosen because lesions occur (MS) in the large areas of the central nervous system and scar tissue, the hard tissue is replaced the damaged myelin [2].

Studies have shown that mild cognitive impairments affect the people habits and normal life trends. The most common problems are: impairment of abstract thinking, attention, retrieving words, problem solving, visual-spatial disorders, and memory [3]. Also, the cognitive deficits in people with variations in lobes size and structure are more common compared with those with lesions in the cerebellum lobes, midbrain and spinal cord [4].

Cognitive dysfunction in MS is very broad, for instance all aspects of memory function may be impaired. Also actions as information processing and executive function may be impaired. In some studies, evidences of cortical dementia have been observed. In addition, there is attention and concentration disorder that can cause to impairment of daily function [5]. Another important factor that affects the ability of the mind and cognitive performance that has recently been proposed is the richness of person mind [6]. According to the cognitive reserve hypothesis, mental richness can reduce the negative impact of the disease on cognitive abilities. Somoviski [1] have emphasized the necessity of the research for prevention of descending trend of cognition in these patients with the mentioned hypothesis [7]. Recently spinal cord has been considered and some studies have shown that cervical cord cross section is small in these patients compared to control group and is related to inability [8].

In cases with equivocal or negative results in the brain or onset of MS with spinal cord symptoms, cervical cord MRI can play an important role in early diagnosis of cervical cord MS as well as monitoring of the effects. According to theoretical issues this study was done to compare the EEG in patients with MS and their normal counterparts.

Materials and Methods

The present causal-comparative study was conducted in 2014. In this study a group of patients with MS in the range of 30 to 50 years were compared with a group of normal subjects of the same age (control group). The number of samples for each group was 30 persons who referred to hospitals in Tabriz were selected by available sampling method. This study was approved and guided by the committee of Ethics of Tabriz University of Medical Sciences. Exclusion criteria were patients with other neurological and psychiatric disorders or alcohol consumption, traumatic brain injury or skull or medication for at least two weeks prior to the study, those who received psychological treatment with epilepsy and a history of taking anti-epithelial drugs. The subjects in the control group in terms of demographic characteristics were similar to the experimental group and their physical and mental health states were confirmed by specialists. Notably, all patients were right-handed. Interviews and diagnostic criteria (Diagnostic and Statistical Manual of Mental Disorders) were used to identify the patients.

Data collection tools

EEG system: a 21-channel quantitative EEG system is now widely used in neurological and psychological research and it will be used as a research tool. Using this device, patients' EEG was recorded for 21 channels. The wave's spectrum from 0.1 to 30 HZ for four alpha waves 8-13 HZ, beta waves 14-30HZ, theta waves 4-7HZ and delta waves 0.1-4 HZ were recorded. Due to the high volume of the available data and the results of previous research, data areas F7, F8, FP1, FPZ, FP2, F3, F4, FZ were selected for frontal lobe and data areas C3, CZ, C4 for central and regional data O1, OZ, O2 series lobes of occipital area were selected for research.

Results

Descriptive statistics were used to analyze the data, the results are shown in Table 1.

Before using parametric multivariate analysis of covariance default of homogeneity of variance was evaluated by Leven test. Based on the results, the default homogeneity of variance in both variables was confirmed. The test was not significant for any of the variables. Also Box test was used for test the assumption of homogeneity of covariance.

As can be seen in Table 2 there is a significant difference between the two groups in the delta waves, theta and beta in the frontal lobe, beta wave in central and beta waves in the occipital.

Table 1: Descriptive statistics (mean and standard deviation) of the person with MS and normal wave activity in the frontal, central and occipital areas.

	Subjects	Component	Mean	SD
Frontal	Delta	MS	216.10	13.10
		Normal	207.13	16.57
	Theta	MS	66.63	8.61
		Normal	58.20	7.30
	Alpha	MS	354.70	52.44
		Normal	347.27	27.92
	Beta	MS	24.00	5.17
		Normal	41.03	8.02
Central	Delta	MS	217.30	9.24
		Normal	215.33	9.13
	Theta	MS	36.06	7.95
		Normal	36.60	6.18
	Alpha	MS	226.46	5.01
		Normal	227.46	29.68
	Beta	MS	19.73	6.53
		Normal	27.46	6.14
Occipital	Delta	MS	182.26	13.44
		Normal	180.83	17.49
	Theta	MS	17.80	4.75
		Normal	16.76	3.91
	Alpha	MS	46.03	9.12
		Normal	44.10	10.10
	Beta	MS	8.66	2.08
		Normal	17.40	3.87

Table 2: Students' multivariate analysis of variance to determine the difference between the two groups of variables.

Dispersion	Dependent variable	Sum squares	DF	Mena squares	F	P
Frontal	Delta	1206.01	1	1206.01	5.40	0.024
	Theta	1066.81	1	1066.81	16.71	0.001
	Alpha	721.06	1	721.06	0.409	0.525
	Beta	4352.01	1	4352.01	95.43	0.001
Central	Delta	58.01	1	58.01	0.687	0.411
	Theta	4.26	1	4.26	0.084	0.773
	Alpha	15.00	1	15.00	0.014	0.908
	Beta	897.06	1	897.06	22.29	0.001
Occipital	Delta	30.81	1	30.81	0.127	0.723
	Theta	16.01	1	16.01	0.844	0.362
	Alpha	56.06	1	56.06	0.605	0.440
	Beta	1144.06	1	1144.06	118.09	0.001

Discussion

The present study was carried out by the aim of comparison the EEG in patients with MS and their normal counterparts. The results showed that there is a significant difference between the two groups in the delta waves, theta and beta in the frontal lobe, beta wave in central and beta waves in the occipital area.

Likani et al [9] studied the MS patients compared with the control group, and found the greater theta in central forehead area ($p < 0.005$). Coherence and solidarity of theta tape was reduced between the same regions ($p < 0.02$). Continuity and coherence of α tape in local communication and local and long-distance communication was reduced ($p < 0.0005$). These findings in the patients MRI was accompanied by sub-cortical lesions and in patients with high levels of cognitive involvement. There was a meaningful relationship between the hemisphere theta (p

= 0.02) and alpha (p = 0.017) and the continuity and integrity anterior-posterior (p = 0.013) and sub-cortical MRI lesions with no relationship exclusively with peri-ventricular lesions. These findings support the assumption that cognitive impairment in MS depends on involvement of cortical communications related to de-myelination or losing of axons in white matter under the cortex. Also, their study showed a significant decrease in α and θ cohesion and solidarity between regions anterior-posterior area and the hemisphere in patients with progressive MS. In the patients with cognitive impairment compared to normal subjects and also compared to MS patients with normal cognitive functions, no significant difference was shown with control group and this reduction was significant. Since cohesion and continuity between two areas can depict reduction in their functions. However, other factors can affect the assessment of cohesion and continuity. The loss of continuity and coherence between O1 and O2 and alpha-1 and beta-1 between the F3 and F4 bars in normal subjects during mild drowsiness compared to the waking state were observed. These results were accompanied by loss of continuity and coherence between the hemispheres associated with increased continuity within the bars theta-1 and beta-1 between C4 and O2 [10].

Although, by visual inspection of EEG of the section with symptoms are omitted but some reductions in community among the hemispheres were founded that were not visible in EEG visual inspection. However, the continuity and consistency of theta bar in MS patients suffering from impaired cognitive was reduced compared with both normal participants and MS patients without cognitive impairment. Continuity and coherence between the hemispheric sub-cortical lesions negatively correlated to both tape.

Also, in the Lokani et al. research [9] there was a significant correlation between the continuity and consistency of anterior- posterior area and lesions found directly and immediately in the cortex (sub-cortical). It had been reported that cognitive impairments are mainly related to white matter under the cortex. These lesions may cause breakdown of the lower structures, but also projection of cortical-cortical. Higher longitudinal facio-locus and callosum corpus are candidates for anterior and posterior and hemispheres communication. However, its importance in determining the functional relationship has not clearly reflected in EEG coherence. Although there are no longitudinal studies of higher longitudinal facio-locus and higher EEG coherence the conflicting results obtained focus on callus body. It has been reported that the lesion or the degree of coordination and lack of symmetry reduce the impact on both hemispheres. The reminded hemisphere continuity in the patients with Acolossal is related to continuum in posterior junction (Ward) [11].

Moreover, the background EEG activity and the loss of continuity in MS patients with cognitive impairment compared to patients who did not have cognitive impairments and in patients with sub-cortical MRI lesions by MRI was seen compared to patients with lesions in anterior cortex. In addition sub-cortical lesion was highly correlated with decreased EEG coherence [12].

Other research which reported EEG abnormalities in MS [13], reported mainly slow increase in frequency and reduction of alpha bands. Spectral computer analysis [13] showed the relationship between disability and beta activity in the frontal central region and temporal activity in theta. Moreover, after improvement due to immunosuppressive therapy, a significant increase was seen in the mean frequency in the parietal occipital α.

Results showed that of the other regions with the lesion, lesions that are immediately and directly under the cortex can determine the power of EEG abnormalities in MS. Some studies showed a statistically significant correlation between a general cognitive impairment and severity of hemisphere white matter abnormalities, analysis of callus body and ventricular expansion. More correlation between cognitive impairment and sub-cortical lesion load was found [14]. Further analysis showed that there is a relationship between regional brain lesion and specific cognitive functions [15].

Conflict of interests

The authors declare no conflict of interest.

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