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Neuropsychological Evaluation of Visual Spatial Functions in Juvenile Myoclonic Epilepsy Patients

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Abstract

Objective: The main purpose of this research was to evaluate visual spatial functions in patients with juvenile myoclonic epilepsy (JME). The aim of this study was to determine the neuropsychological profile of subprocesses of visual spatial functions in JME patients.

Methods: Two different participant groups were included in the study. Twenty-two patients aged 18 years and older with a diagnosis of JME and 22 healthy volunteers with similar age, gender, and education status as the patient group were included as the control group. The Benton Face Recognition Test, Symbol Cancellation Test (SCT), Trail Making Test (TMT), and Judgment Line Orientation Test (JLOT) were used to evaluate visual spatial functions.

Results: The evaluation of neuropsychological tests showed that the JME patients underperformed in the JLOT and TMT compared with the control group, but the difference was not statistically significant. However, the results were statistically significant in some SCT sub-forms.

Conclusion: The results support the idea that JME patients have not only frontal lobe dysfunction but also a more global impairment in visual spatial functions.

Keywords: Juvenile myoclonic epilepsy, neuropsychological evaluation, visual spatial functions

INTRODUCTION

Juvenile myoclonic epilepsy (JME) is one of the most common forms of idiopathic generalized epilepsy, accounting for 5-10% of all epilepsy.[1] It typically begins during adolescence, between the ages of 12 and 18 although onset can occur between ages 6 and 22.[2] The condition is hereditary and affects both sexes equally.[1,3] JME is characterized by a triad; absence seizures, myoclonic jerks, and tonic-clonic seizures begin with age.[4] Seizures usually occur shortly after awakening or with sleep deprivation. Sleep deprivation is the most common seizure trigger, although other factors such as fatigue, alcohol consumption, stress, excitement, and premenstrual syndrome can also provoke seizures. Situations such as exams and travel may increase the likelihood of seizures.[5]

The effects of seizure types are often studied as causes of cognitive impairment in patients with epilepsy. While some patients do not experience cognitive impairment, others may have impairments in different functions.[6-8] It is commonly observed that patients with generalized seizures have lower cognitive scores. Some studies have reported learning difficulties throughout school life, even in those with normal intelligence and seizure control, in idiopathic generalized epilepsy.[7,9] There is a wealth of information on the cognitive effects of JME, which is the most common form of idiopathic generalized epilepsy and the focus of our study. Studies have shown that frontal lobe functions are especially impaired in patients with JME,[10,11] and that they also have impairments in visual and auditory attention and visual spatial functions.[12]

According to Piazzini et al.,[13] tests evaluating frontal lobe functions in patients with JME revealed cognitive impairment similar to with frontal lobe epilepsy. In another study by Sonmez et al.,[14] the cognitive performance of JME patients and healthy control groups were evaluated, and the patient group was found to have significant impairments in verbal and visual memory performance, frontal lobe functions, and visual spatial functions compared with the control group. Attention tests also showed that patients with JME had more difficulty maintaining attention than controls.[15-17] Multiple studies have reported that JME patients had worse results in verbal fluency tests and verbal and visual memory tests.[15] Executive functions associated with the frontal lobe have also been evaluated in previous research with findings related to JME. The objective of our study was to evaluate visual spatial functions using neuropsychological tests.

METHODS

Participants

The sample group for the study comprised 22 patients who were 18 years or older and who were diagnosed with JME. The patients were followed up at the neurology outpatient clinic of the Ondokuz Mayıs University Faculty of Medicine. Patients with other neurological, medical, or psychiatric conditions and those with persistent slow background activity on electroencephalography (EEG) were excluded from the study.

The study collected demographic information on the patient group, including age, gender, educational status, age at seizure onset, medication use, and psychiatric treatment history. A control group consisting of 22 healthy volunteers with similar demographic characteristics was also evaluated using the same cognitive and neuropsychiatric assessment protocol as the patient group. Participants who scored 14 or higher on the Hamilton Depression Rating Scale (HAM-D) were excluded from the study to minimize the impact of depression on the test results.

Neuropsychological Assessment

In this study, we applied neuropsychological tests; Trail Making Test (TMT), Symbol Cancellation Test (SCT), Benton's Face Recognition Test (BFRT), and Judgment of Line Orientation Test (JLOT), to the patient and control groups. Along with neuropsychological tests, patients' emotional states were measured using the HAM-D.

TMT consists of two parts. In part A, there are 25 numbered circles on a page. The subject is asked to connect the numbered circles sequentially with a pencil. In part B, 13 of the circles are marked with numbers and the others with letters. The subject is asked to combine the circles into a sequence of numbers and letters. The completion time of the task is the score received by the subject. This test provides information about visual attention, perseverance, and mental flexibility.

The SCT consists of four A4 sheets of regular letters, irregular letters, regular shapes, and irregular shapes. The subject is asked to mark certain letters and shapes on each page. Meanwhile, while the subjects are marking, the time is kept. Each page has 60 targets. It measures selective attention, visual spatial functions, and reaction time. Damage to the right posterior parietal hemisphere can result in impairment of SCT performance.

The BFRT requires the subject to identify 3 face photographs that match the stimulus face from 6 face photographs presented on a page just below it. The photographs are taken at different angles and brightness levels. The test measures the subject's ability to recognize faces, and the number of correctly matched faces determines the score. This test is sensitive to damage in the occipitotemporal cortical areas.

JLOT is a visual spatial orientation and perception test. The test includes 5 practice pages followed by 30 test pages. In this test, the subject is asked to match the two stimulus lines on the top with two of the eleven numbered lines on the bottom. The patient can score a maximum of 30 points. A high score indicates good visual spatial performance. JLOT is sensitive to injuries in the right posterior cortical regions.

HAM-D is a widely used clinician-based depression scale. It contains 17 items and is evaluated over 52 points.

Statistical Analysis

Kolmogorov-Smirnov and Shapiro-Wilk normality tests were applied to determine which test to use from the comparison tests. An independent two-sample t-test was used for two-category variables with a normal distribution, and a Mann-Whitney U test was used for two-category variables that did not show a normal distribution. The Kruskal-Wallis H test was used for variables that did not show normal distribution for variables with more than two categories. However, the Spearman's rank correlation coefficient was used for variables that did not show a normal distribution. The level of significance was set at $p \leq 0.05$. For statistical analysis, we used the Statistical Package for the Social Sciences version 22.0.

RESULTS

Patients with JME (n=22) and the control group (n=22) were evaluated. The patients and controls were similar to age, education, and gender distribution.

The mean age of the patients was 25.7±7.8; the mean age of the control group was 25.5±7.6 years. 63.6% of JME patients were female and 36.4% were male. The same pattern was observed in the control group. The education level of JME patients was as follows: 4.5% had primary school education, 36.4% had high school education, and 59.1% had university education. The education levels of the control group were as follows: 4.5% had primary school education, 9.1% had secondary school education, 31.8% had high school education, and 54.5% had university education (Table 1).

Neuropsychological Test Results

The group with JME scored lower than the control group on the two subforms of the SCT, which showed significant differences between the groups. The results from the TMT Part B and JLO tests were also lower than those of the control group, but the differences did not reach statistical significance (Table 2). All of the analysis results showed that patients with JME had lower scores than the control group. The control group outperformed the patients with JME, although the differences were not statistically significant.

DISCUSSION

The aim of this study was to evaluate various visual spatial functions in patients with JME. In recent years, there has been increasing

MAIN POINTS

- In our study, neuropsychological evaluation was performed in myoclonic epilepsy (JME) patients.
- The aim of this study was to determine the effect of the disease on visual spatial functions.
- JME disease can cause disorders in different areas of the brain, including visual and spatial functions.

research on the cognitive profile of patients with JME.[18,19] Results from cognitive assessments revealed that patients with JME performed significantly worse in visual spatial skills than controls, which is consistent with previous research in the field.

It is well known that two functional pathways are involved in mediating visual spatial functions.[20] Both these pathways originate from the primary visual cortex. The ventral pathway (occipitotemporal pathway) is crucial for object perception, whereas the dorsal pathway (occipitoparietal path) is important for the perception of object parts, object position relative to other objects, and visual-based movements toward objects.[21] These functions are processed as a whole. Rao et al.[22] suggested that the "what" and "where" pathways of the prefrontal cortex play a unifying role in visual spatial functions. Therefore, even though occipitoparietal and occipitotemporal locations are primarily associated with visual spatial functions, the prefrontal cortex may also play a significant role in these functions.

In the current study, because the negative effect of depression on cognitive functions is a fact, the HAM-D scale was used before moving on to the neuropsychological tests that we applied with the patient and control groups. In this context, for example, in Ergin's[23] study, patients with depressed JME were found to have more significant impairments in the clock drawing and JLO tests, which reflect visual spatial functions, than patients with non-depressed JME.

Table 1. Demographic characteristics of the cases are given

Groups		JME n=22 (50%)	Control n=22 (50%)
Female		n=14	n=14
Male		n=8	n=8
Education	Primary	n=1 (4.5%)	n=1 (4.5%)
	Secondary	n=8 (36.4%)	n=2 (9.1%)
	High school	n=13 (59.1%)	n=7 (31.8%)
	University		n=12 (54.5%)
Age		min=19 max=46 25.7±7.8	min=19 max=46 25.5±7.6

JME: Juvenile myoclonic epilepsy, min: Minimum, max: Maximum

Table 2. Results of the cognitive assessment (patients and controls)

Test	JME (n=22)	Control (n=22)	p
BFRT	47.18	47.82	0.542
JLO	18.75	26.25	0.051
TMT-A time	39.95	34.45	0.128
TMT-B time	101.81	80.05	0.057
SCT1	98.14	89.45	0.172
SCT2	98.14	89.45	0.172
SCT3	95.77	81.00	0.015*
SCT4	82.82	67.36	0.034*

*p<0.05.

BFRT: Benton Facial Recognition Test, JLO: Judgment of Line Orientation, TMT-A time: Trail Making Test A form, TMT-B time: Trail Making Test B form time, SCT1: Symbol Cancellation Test form 1, SCT2: Symbol Cancellation Test form 2, SCT3: Symbol Cancellation Test form 3, SCT4: Symbol Cancellation Test form 4, JME: Juvenile myoclonic epilepsy

There was no statistically significant difference between the JME and control groups test mean values in the BFRT results reflecting complex visual perception functions of visual and spatial functions. There are studies in the literature that support this finding. Sonmez et al.[14] and Turan[16] are consistent with the research findings obtained in the current study. The consistency of the results with the literature is important because the study was conducted and used in the same population.

In our study, no statistically significant difference was found between the control and JME groups in the results of the JLO test, which evaluates the orientation of visual and spatial functions. However, according to the JLO scores, the mean of the group with JME was lower than that of the control group. Although the effect of depression was neutralized, we can say that there was a significant difference at the border. In another study, JME patients showed significantly worse results than the control group, even when the effect of depression was neutralized.[23] Despite this, the results are not significant in some studies.[14,24]

In the current study, the results of the analysis of TMT scores revealed a borderline significant difference, although not statistically significant, in the completion time of the TMT Part B form. It was observed that the JME group performed unsuccessfully by completing the form in a longer time than the control group. Such a performance of the patient group in terms of the duration score suggests that there is a slowdown in psychomotor speed and concentration in JME.[25] Studies on TMT reveal activation involving the medial and dorsolateral prefrontal cortex. This activation has been specifically associated with TMT, part B.[26] Regarding visual spatial skills, it has been reported in many studies that visual attention is impaired in the JME.[19,27] The findings obtained from TMT scores in JME patients are supported by the literature.[15,28-30] Similarly, Pascalicchio et al.,[31] in their study comparing JME and a healthy control group, emphasized that patients with JME were less successful in tests requiring attention function.

We observed significant differences between the JME and control groups in some sub-forms of the SCT results reflecting visual scanning and sustained attention functions. In the study, the values of JME and control groups participants were statistically significant compared according to each subtest of SCT. It was observed that the JME group took longer to complete the two forms. By looking at the test results, we can conclude that the visual selectivity, visual motor, reaction speed, visual scanning, and continuous attention functions of JME patients are impaired. Considering that SCT is a visual spatial perception and screening test with a spatial component, it agrees with research showing mild impairment in visual spatial functions of JME.

Study Limitations

The small number of cases and lack of video EEG monitoring are the limitations of our study. Because of the small number of cases, we could not evaluate the effects of drugs on cognitive functions.

Future studies are needed to comprehensively determine the visual spatial abilities linked to JME, comparing patients with different epilepsy, and evaluations can be made by having a larger sample size.

CONCLUSION

We found finding suggestive of parietal lobe involvement in patients with JME. Based on our results and extensive literature review, we can conclude that visual spatial dysfunctions are consistently and distinctly present in JME. In conclusion, when evaluating cognitive functions in patients with JME, it is recommended to consider that patients may have disorders in different areas of the brain, including complex visual spatial functions.

Ethics

Ethics Committee Approval: Ondokuz Mayıs University Social and Humanity Sciences Ethics Committee Decisions (decision date: 05.02.2020, decision number: 2020/11).

Informed Consent: Consent form was filled out by all participants.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: N.C., H.A.Ş., Design: N.C., Data Collection or Processing: N.J., N.C., Analysis or Interpretation: N.J., N.C., H.A.Ş., Literature Search: N.J., Writing: N.J., H.A.Ş.

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