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Research paper

Cognitive deficits in the first 24 hours after the onset of first unprovoked generalized Tonic and clonic seizure

Zeinab Charmchi[a], Mohammad Sayadnasiri[b,*]

[a] Qazvin University of Medical Sciences, Qazvin, Iran
[b] University of Social Welfare and Rehabilitation Sciences, Razi hospital, Tehran, Iran

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ABSTRACT

Background: Many people with epilepsy suffer from cognitive deficits as a consequence of their seizure episodes. Relatively few researches have been undertaken to assess the short term impacts of seizure on cognitive function. This study aimed to evaluate changes in cognitive performance in adults with a new onset generalized seizure in the first 24 h after the onset of their attack.
Methods: After having given informed consent, 40 patients with first episode of unprovoked generalized tonic-clonic seizure were investigated with a neuropsychological test battery (Wechsler Memory Scale III). Their performance was compared with 40 healthy individuals from the patients' companions.
Results: Newly diagnosed patients had significantly worse performance in paired association recall which is a parameter of verbal memory; other memory parameters showed no significant changes after seizure attack.
Conclusion: Our data suggested that even with a one-time seizure episode, patients are susceptible to verbal memory impairment.

1. Introduction

There is a notable amount of studies implying cognitive impairment in patients with epilepsy.[1] Many have investigated the long term effects of seizure on cognitive function; however, the number of studies on short term memory assessment are only few in number.

There are several studies indicating cognitive function of people with epilepsy is already impaired at the time of diagnosis, although the causes of cognitive impairments in epileptic patients are thought to be multifactorial.[2–10]

Studies showed that cognitive function in patients with newly diagnosed epilepsy significantly declined compared to their matched healthy volunteers over the first 12 months of antiepileptic treatment.[6–9] Worse performance on some domains of cognition especially psychomotor speed, higher executive functioning and memory in patients with newly diagnosed epilepsy, was associated with treatment with some antiepileptic drugs (such as topiramate), generalized type of seizure and surprisingly, achieving an immediate first year seizure remission.[11]

Although a number of studies found a negative correlation between cognitive functioning and duration of epilepsy[12–17] other studies have not found evidences indicating any deterioration in cognitive functioning over time in epileptic patients.[18,19] However, there are many confounding factors such as aging, chronic antiepileptic drug side effects and comorbid diseases not considered in methodology of most of these studies; so, there are still controversial aspects of cognitive function in epileptic patients that must be elucidated. The aim of this study is to investigate changes in cognitive performance in adults with a new onset tonic and clonic seizure (GTCS) in the first 24 h after the onset of the seizure.

2. Methodology

The purpose of this cross-sectional study was to evaluate cognitive functions, particularly memory in patients with the first unprovoked GTCS in the first 24 h after the onset of their seizure.

In this study, all patients who presented with a first onset of GTCS to our hospital emergency room from March 2013 until November of the same year were assessed for cognitive deficits, if they did not have exclusion criteria and had agreed to take part in the study. All patients were evaluated with brain magnetic resonance imaging (MRI) and routine blood chemistry tests to exclude secondary seizure causes. Evidence of mass or vascular

* Corresponding author.
E-mail address: nasiri115@yahoo.com (M. Sayadnasiri).

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lesion, ventriculomegaly (more than 1.5 cm) and any hippocampal abnormalities were considered significant on MRI.

Significant abnormal findings in brain imaging, history of severe systemic diseases (including organ failures, diabetes, connective tissue diseases, and systemic vasculitis), any known psychiatric or neurologic disorders and taking drugs with prominent neuropsychiatric side effects were considered as exclusion criteria. Patients younger than 18 and older than 70 were also excluded.

A total of 40 individuals from patients' companions who were of similar age, gender and educational level in accordance to the patients were served as a control group. Both groups were assessed using comprehensive neurophysiological test battery of Wechsler Memory Scale third edition (WMS-III) validated in Persian.

WMS-III is a neuropsychological test designated to measure different aspects of memory function. It is made up of various subsets:

1. General cognitive screener in which semantic memory is evaluated, 2. Attention and concentration that is assessed through serial seven and reciting months of the year backward. 3. Story recall and paired association recall that are designated to measure episodic memory 4. Digit span recall that evaluates working memory and 5. Visual memory that is investigated through visual reproduction. We also added a few supplementary tests to assess other aspects of cognition apart from memory like abstract thinking, calculation and language.

To exclude clouded sensorium resulting of post-ictal state, we evaluated the patients' attention and concentration with the serial seven test before performing WMS-III to reassure that the patients were not in the post-ictal phase.

Our patients were Persian thus we used the translated form of Wechsler Memory Scale III which was provided by psychology research institute of Sina. The reliability and validity of the Persian version of the WMS has been also proved earlier.[20]

The battery took approximately 15–20 min to complete for each participants. Data were analyzed with SPSS-16 software using independent *t*-test and Chi-square test to examine any differences in demographic and neuropsychological characteristics between the patients and healthy volunteers. P-values ≤ 0.05 were considered significant.

3. Results

A total of 40 patients with first unprovoked GTCS who presented to the emergency room and 40 healthy individuals from patients' companions were considered as patient and control groups, respectively.

Table 1
Demographic and neuropsychological characteristics.

	Newly diagnosed	Controls	P-value
Number of patients	40	40	1
Male/Female	17/23[(a)]	16/24	
Age	31.4	31.6	0.94
Education			0.86
Primary School	8[(b)]	8	
Secondary School	9	10	
High School	19	20	
College	4	2	
Verbal memory	27.8 (6.3)	31.3 (4.1)	0.004
Immediate story recall	6.9 (3.54)	7 (2.38)	0.95
Immediate digit span recall	4.7 (0.89)	5 (0.75)	0.18
Paired association	12.92 (4)	16.23 (2.23)	0.001
Visual memory	10.25 (3.14)	10.32 (2.68)	0.909
Crude scores	52,5 (10.5)	56.6 (6.3)	0.04
Corrected scores	86.7 (9.7)	90.7 (5.8)	0.029

Note. Means are presented in the table and Standard deviations are presented in parenthesis. a is gender frequency distribution. b is education frequency distribution.

Demographic and neuropsychological characteristics of both groups are summarized in Table 1.

Evaluation of verbal memory function (comprising three parameters of immediate story recall, immediate digit span recall and paired association recall) showed significant difference in performance in paired association recall between two groups (p-value < 0.05; control group mean score = 16.23 and patient group score = 12.92); but two groups' performance were not significantly different in forward and backward digit span recall (p-value = 0.18) and immediate story recall (p-value = 0.95).

Patients' performance in visual memory did not indicate any significant decline compared to healthy individuals (p-value = 0.90). Finally, we calculated the crude and corrected memory scores of the two groups with the guideline that had been presented by the WMS III that resulted in significant differences between two groups (p-value = 0.04 and 0.02 respectively).

4. Discussion

This study showed paired association recall was the only parameter of verbal memory function that significantly impaired at early phase after first seizure attack. The advantage of our study is the assessment of memory function during a few hours after seizure onset that provided a precise estimation of seizure impact on brain cognitive function. Our data are mainly in agreement with the published literature indicating that verbal memory deficit are commonly present even at the time of a first unprovoked seizure.[21]

Ruhle et al. evaluated psychometric characteristics of 53 patients with first unprovoked seizure and demonstrated verbal memory (60%), non-verbal memory (30%) and executive (32%) dysfunctions in the participants.[21] Baker et al. investigated 147 patients with newly diagnosed epilepsy from SANAD study over the first 12 months of antiepileptic drugs treatment with neuropsychological tests; patients performed worse than healthy volunteers particularly in psychomotor speed, higher executive functioning, and memory.[11,22]

Taylor et al. found that untreated patients with newly diagnosed epilepsy appeared weaker in 6 out of 14 cognitive measures of neuropsychological battery particularly in the domains of memory and psychomotor speed compared to healthy individuals. Importantly, this study confirmed seizure induced cognitive changes irrespective to antiepileptic drug effects.[10] Witt et al. also reported a high prevalence of cognitive deficits at an early stage of epilepsy with 47.8% memory dysfunction. In this study, worse memory performance was related to generalized type of seizure attack but not to lower education or a lesional cause of epilepsy. Therefore, he suggested that application of a short and standardized neuropsychological screening before initiation of treatment can provide a baseline to evaluate future treatment success.[23]

Kalviainen et al. evaluated 74 adults with a newly diagnosed untreated seizure. He declared that the patients had a subtle deficit in tasks requiring memory and sustained attention and concluded that memory deficits may be secondary to attentional dysfunction.[24] In our study, patients were evaluated after clearance of post-ictal confusion and results showed no difference in attentional processing between two groups. Accordingly, Ruhle et al. indicated memory deficits were not improved when the patients were evaluated with a delay of some days after seizure onset.[21] Therefore, memory dysfunction in newly diagnosed epilepsy cannot be attributed to attentional deficit; it is an independent, probably irreversible pathologic process indicating the presence of an active epileptogenic focus. However, these cognitive signs do not predict seizure recurrence. Some authors declared that verbal memory impairment at the onset of epilepsy is very likely to be a risk factor for the development of epilepsy with a refractory course of treatment [25] but according to published data it could not be

stated that memory deficits after a first unprovoked seizure is an independent predictor of recurrent seizures.

Few longitudinal studies has been conducted about long term cognitive status of epileptic patients.[26–33] In Hermann et al. study, 20–25% of chronic temporal lobe epilepsy patients showed worse cognitive outcome, particularly in memory domain after 4 years follow-up.[26] On the other hand, Helmstaedter et al. evaluated 161 patients with surgically and non-surgically treated patients with refractory temporal lobe epilepsy and identified no evidence of significant cognitive decline over time.[27] Taylor et al. assessed 50 newly diagnosed epileptic patients using a comprehensive neuropsychological test battery during 5 years follow-up; most of cognitive parameters remained stable, although memory performance showed a progressive (but subtle) deterioration in 38% of patients.[28]

Although other causes other than seizure activity (such as antiepileptic drug side effects, mood disorder and underlying systemic diseases) are also related to memory problems of people with epilepsy,[34] our study documented to some extent the pure adverse effect of a seizure attack on memory function. Theoretically, it may be expected that predisposing causes of a new onset epilepsy such as brain lesions, genetic susceptibility and inter-ictal epileptic activity are likely present some times before seizure onset; so, memory deficits may exist even before a first unprovoked seizure. Accordingly, the result of our study cannot be attributed completely to seizure attack and the pathologic cognitive decline may have already happened. Retrospective studies searching for evidences of cognitive dysfunctions weeks before seizure onset may be worthwhile.

This study has some limitation. We did not re-assess memory performance after a period of time and did not evaluate effects of antiepileptic drugs to determine the stability of deficits. Therefore, we could not document any claims on the reversibility of observed cognitive deficits in the first 24 h. As a result, it is recommended that in future studies, patients' cognitive functions be investigated within a few days after the onset of the seizure to address if these deficits are permanent or not.

5. Conclusion

According to the result of this study, it has been concluded that even with a one-time seizure episode, patients are susceptible to transient or even permanent memory impairment.

It is highly recommended that in patients with even a one-time seizure episode early base line cognitive assessment should be performed and if abnormal, repeated at regular interval.

Considering detrimental effects of antiepileptic drugs on cognitive profile,[35] this assessment is mandatory before starting and choosing antiepileptic drugs.

Conflict of interest

The authors have none to declare.

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