Electroencephalogram Abnormalities on Unprovoked First Seizure in Children with Normal Development Are Not a Risk Factor for Recurrence

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Abstract

The purpose of this study was to retrospectively investigate the utility of electroencephalography (EEG) for estimating the recurrence rate of seizures in pediatric patients with normal development who experienced an unprovoked first seizure. Subjects included 100 children aged 0 to 15 years with normal development who underwent an EEG for suspected first seizure between December 1, 2012 and December 31, 2016. Among the 100 subjects, 61 showed EEG abnormalities, and seizures recurred in 43 of them. Normal brain waves were observed in 39 subjects, among whom seizures recurred in 23. No statistically significant difference was found in EEG abnormalities or the rate of seizure recurrence between the groups. The EEG did not appear to be a useful tool for prediction of the possible recurrence of epileptic seizures in the future in this patient population.

Key words
Unprovoked first seizure, children with normal development, EEG abnormalities

Introduction

Epilepsy is defined by the World Health Organization as a “chronic brain disorder of various etiologies characterized by recurrent seizures due to excessive discharge of cerebral neurons (epileptic seizures), associated with a variety of clinical and laboratory manifestations”¹). The incidence of epileptic seizures in pediatric patients is so high that many children are brought to pediatric departments for suspected epilepsy as the chief complaint. As defined, epilepsy comprises various symptoms, and it is sometimes difficult to differentiate the disease from other conditions. Moreover, even in children diagnosed as having epilepsy, it is difficult to determine the start time of treatment.

It is uncommon to administer antiepileptic drugs for the unprovoked first seizure of pediatric patients because the rate of recurrence is not high,²) and differences in intellectual prognosis have not been found between individuals treated early and those treated later after repetitive seizures³). However, epileptic seizures in children have such a profound effect on their parents/caregivers that we have experienced some cases in which parents request early treatment of children showing normal development. If the occurrence of subsequent seizures in such cases can be predicted at the first seizure, it may be possible to appropriately select those children for whom treatment should be initiated. EEGs have been performed for many cases of suspected epilepsy, and some studies have reported that abnormal EEG findings are associated with recurrence rate⁴). However, these studies were performed in adult patients and individuals with symptomatic epilepsy. To determine whether EEG is useful for predicting recurrent seizures following the unprovoked first seizure in children with normal development, we conducted a retrospective study investigating EEG results and recurrent seizures and their timing by analyzing data obtained from electronic medical records.

Subjects and Methods

The subjects included children aged 0–15 years
Table 1. Breakdown of Subjects

|                  | Recurrent cases | Non-recurrent cases |
|------------------|-----------------|---------------------|
| Total (persons)  | 66              | 34                  |
| Males            | 34              | 17                  |
| Females          | 32              | 17                  |
| Mean age (year)  | 7.59            | 6.94                |

Ratio of M/F, Mean age: t test N.S

Table 2. Relationship between EEG Abnormality and Recurrent Seizures

| EEG abnormality     | Recurrent cases | Non-recurrent cases |
|---------------------|-----------------|---------------------|
| Presence (persons)  | 43              | 18                  |
| absence (persons)   | 23              | 16                  |

X² value: 1.406, N.S

Table 3. Relationship between Local EEG Abnormality and Recurrent Seizures

| Local EEG Abnormality | Recurrent cases | Non-recurrent cases |
|-----------------------|-----------------|---------------------|
| Presence (persons)    | 39              | 13                  |
| Absence (persons)     | 23              | 16                  |

X² Value: 2.636, N.S

who underwent EEG for suspected first seizure between December 1, 2012 and December 31, 2016 and were followed up at the authors’ hospital over 1 year. Patients with delayed psychomotor development detected at the initial examination, those who experienced situation-related and non-epileptic seizures, or those with multiple seizures before the initial examination were excluded. Cases were selected from a database of electronic medical records that was searched for disease name. Data collected included age, sex, EEG results, presence or absence of recurrent seizures, and time of recurrence, and a statistical analysis was conducted. Evaluation of EEG results was performed by a specialized physician who was a member of the Japan Epilepsy Association.

This study was approved by the Clinical Study Division of the Life and Ethical Committee of St. Marianna University School of Medicine (Approval No. 4167).

Results

During the study period, 113 children with normal psychomotor development underwent EEG for suspected epilepsy. However, 11 patients who experienced multiple seizures before the initial examination (including childhood absence epilepsy), one with paroxysmal kinesigenic dyskinesia diagnosed afterward, and one patient with psychogenic non-epileptic seizures diagnosed afterward according to EEG data acquired during the seizure were excluded, thus leaving 100 subjects for analysis.

Among these 100 subjects, 66 (34 males, 32 females; mean age, 7.59 years) experienced recurrent seizures during the study period, and 34 (17 males, 17 females; mean age, 6.94 years) had normal EEG profiles (Table 1). No significant difference in age or male/female ratio was found between the recurrent and non-recurrent groups. In 58 (88%) of the 66 subjects, recurrent seizures occurred within 12 months of the initial seizure. Among eight subjects who experienced recurrent seizures after ≥ 13 months, five showed EEG abnormalities and three had normal EEG results.

Of the 100 subjects analyzed, 61 had abnormal EEG results, among whom seizures recurred in 43. There were 39 subjects with normal EEG profiles, among whom 23 suffered recurrent seizures (Table 2). Chi-squared testing revealed no statistically significant relationship between abnormal EEG results and the rate of seizure recurrence.

Abnormal EEG results included local epileptic discharge in 52 subjects and repeated seizures in 39 subjects (Table 3). Again, chi-squared testing revealed no statistically significant relationship between local epileptic discharge and the rate of seizure recurrence.

Discussion

In a prospective study investigating pediatric unprovoked first seizure, Shinnar et al. reported that EEG abnormalities were detected in 135 of 321 (42%) cases. Moreover, the rate of detection of abnormalities was higher in symptomatic than in idiopathic cases. Among 103 symptomatic cases with EEG abnormality, recurrent seizures were found in 54%, whereas in 165 cases without an EEG abnormality, the recurrence rate was 25%.

Wirrell reported that epileptic EEG abnormalities were detected in 18–56% of pediatric patients after the first seizure, and in data reflecting combined adult and pediatric cases, the number of cases of epi-
leptic EEG abnormality with repeated seizures was approximately twice that of the normal EEG cases\(^3\). Moreover, Mizorogi et al. reported that in children with unprovoked first seizure, the presence of local related seizure and local epileptic discharge are risk factors for the recurrence of seizures\(^6\).

In contrast, Marson et al. conducted a large-scale, prospective, randomized comparative study and reported that although the early treatment group was superior to the delayed treated group in suppression of the number of seizures, no significant differences were found in long-term prognosis and employment situation\(^7\). More specifically, it was concluded that the number of seizures does not influence the natural course of epilepsy. However, many cases of epileptic seizures are those of convulsion or disturbances of consciousness, and repeated seizures in children cause significant anxiety in their parents/guardians.

It is widely believed by non-medical workers in Japan that epileptic seizures induce a reduction in intelligence. In particular, many guardians request early treatment of their normally developing children with who experience a seizure. Thus, if the risk for seizure recurrence can be evaluated appropriately, it would be useful for mitigating anxiety in parents and guardians.

In this study, we investigated the presence or absence of EEG abnormalities and the rate of seizure recurrence in children with normal development and found no association between EEG abnormalities and the rate of seizure recurrence. Referring to a report by Mizorogi et al.\(^6\), local epileptic discharge and the rate of seizure recurrence were also investigated, and no significant differences were found.

Although many previous reports have described a relationship between EEG abnormalities and rates of seizure recurrence, the results of the present study did not support such a relationship. One possible explanation is that the subjects in our study were limited to children with normal development. In previous studies, the subject populations comprised adults and patients with symptomatic epilepsy. However, several studies also targeted children with normal development. In their prospective studies, Kim et al.\(^8\) and Arthur et al.\(^9\) identified the risk factors for children who had recurrence of seizures and reported that EEG abnormality does not constitute a risk factor for seizure recurrence in children with normal development. We focused on the presence or absence of brain wave abnormalities and compared between two groups, including children who did not have recurrence of seizures. To the best of our knowledge, there are no previous reports investigating the same factors as the present study. In children with normal development, because the rate of seizure recurrence cannot be predicted by the presence or absence of EEG abnormalities, we believe that the indications for early treatment based on the EEG abnormality need to be carefully evaluated.

There are several limitations to the present investigation. It was conducted in single facility, and the follow-up periods were different according to individual cases. The number of seizure recurrences after the end of the follow-up in our hospital is unknown, and the evaluation of normal development was a subjective interpretation of the parents/guardians.

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