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Original article

Risk for developing epilepsy and epileptiform discharges on EEG in patients with febrile seizures

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Abstract

Purpose: The aim of the present study was to investigate the correlation between epileptiform discharges on EEGs after febrile seizures and the prognosis of patients in terms of the development of epilepsy and recurrence of febrile seizures. This study also evaluated the characteristics of epileptiform discharges and EEG changes on follow-up examination. *Methods:* This study consisted of 36 children who presented to our hospital with febrile seizures and whose electroencephalograms (EEG) showed epileptiform discharges. The development of epilepsy and the recurrence of febrile seizures were compared between the study group ($n = 36$) and the control group ($n = 87$), which included children with febrile seizure but with normal EEG findings. *Results:* No significant correlation was detected between the recurrence rate of febrile seizures in patients with normal EEG (23 out of 87, 26.4%) findings and that of patients whose EEGs showed epileptiform discharges (12 out of 36, 33.3%) [adjusted OR 0.67 (0.26–1.68)]. However, 9 (25.0%) out of 36 patients with epileptiform discharges on EEG had epilepsy compared to 2 patients (2.3%) in the control group. The correlation was statistically significant [crude OR 10.88 (2.47–47.88) and adjusted OR 8.75 (1.49–51.6)]. *Conclusion:* Epileptiform discharges on the EEGs of patients with febrile seizures are important predictive risk factors of the development of epilepsy.

Keywords: Febrile seizure; Epilepsy; EEG; Epileptiform discharges

1. Introduction

Febrile convulsions are the most common types of seizures in children with fever but without evidence of intracranial infection. Febrile seizures mainly occur in children who are 3 months to 5 years old and the incidence rate is 2–5%. Although most of the children who receive proper treatment for acute febrile convulsions show complete recovery without any neurological complications, the incidence rate of epilepsy is higher in these children than in normal children [1].

An electroencephalogram (EEG) is not indicated after a simple febrile seizure, although it may be useful for evaluating patients with complex or atypical features or with other risk factors for later epilepsy development. However, patients who develop simple febrile seizure occasionally undergo electroencephalography because of parental demand, frequent repetition of febrile seizures, or because of their physician's recommendation. The reported incidence rate of EEG abnormalities in children with febrile seizures varies from 2% to 86% [2–4].

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Although the slowing of background activity accounts for the majority of EEG abnormalities after febrile seizures, in some cases, epileptiform discharges are detected.

Japanese investigators have reported that the spectral characteristics of EEG are predictive of subsequent epilepsy in children with febrile seizures [5].

Other investigators reported that EEG findings lacked predictive value for the later occurrence of either febrile or unprovoked seizures [6–7], although patients with febrile convulsions have a higher incidence rate of epilepsy compared with the normal population.

There is no consensus regarding the correlation between epileptiform discharges on EEG in febrile seizure patients and the development of epilepsy.

In addition, there is no published information about the clinical significance of epileptiform discharges on EEGs after an episode of febrile seizures.

The aim of the present study was to investigate the correlation between epileptiform discharges on EEGs after febrile seizures and the prognosis of patients in terms of the development of epilepsy and recurrence of febrile seizures. This study also evaluated the characteristics of epileptiform discharges and EEG changes on follow-up examination.

2. Patients and methods

The present study is a retrospective one including 36 children who presented to our hospital from January 2001 to December 2010 with febrile seizures and epileptiform discharges on EEG.

The indications for admission were complex febrile seizures, although patients with simple febrile seizure sometimes admitted on the basis of parent's request, or if patients were at a high risk of recurrence during the febrile illness period.

A febrile seizure was defined as a seizure associated with a body temperature $\geqslant 38$ °C in the absence of central nervous system infection, metabolic disturbance, or acute electrolyte imbalance. Children with hepatic or renal failure, intoxication, trauma or known neurologic disorders, or previous unprovoked seizures were excluded from the study.

Patients with abnormal neuroimaging findings were also excluded from the study.

A febrile seizure was described as complex when the duration was >15 min, when repeated convulsions occurred within 24 h, or when focal seizure activity or focal findings were present during the postictal period. Unprovoked seizures were defined as those that had no immediately recognizable stimulus or cause. Epilepsy was defined as the incidence of two or more unprovoked seizures. The EEG was normally recorded with an 18 channel digital machine for 30 min in the sleep and waking state.

All EEGs were read by two experienced pediatric neurologists. Only focal spikes, sharp waves, or generalized spikes and waves were included as epileptiform discharges. The foci of epileptiform discharges were classified into five regions, namely the frontal, central, centro-temporal, parietal, temporal and occipital areas. The control group consisted of 87 patients who had febrile seizures and normal EEGs, and who presented our hospital during the same period as the study group.

The development of epilepsy, recurrence of febrile seizures, and changes in the follow-up EEGs at least during 6 months were evaluated in the study and control groups. In addition, the recurrence of febrile seizures and development of epilepsy were compared between the study group ($n = 36$) and the control group, which included febrile seizure children with normal EEGs ($n = 87$).

The institutional review board of our hospital approved the retrospective review of the charts and the electroencephalography data.

Statistical analysis of the differences between the two groups was performed by multivariate logistic regression and the student t-test. Statistical significance was set at $P < 0.05$.

3. Results

The study group included children who presented to our hospital with febrile seizures and whose EEGs showed epileptiform discharges ($n = 36$), and the control group, consist of febrile seizure children with normal EEGs ($n = 87$).

The average age (39.4 ± 24.5 months) of the abnormal EEG group was higher than that of the control group (25.9 ± 17.2 months) ($P < 0.05$). The males outnumbered the females more significantly in the abnormal EEG group than in the control group ($P < 0.05$), with the ratio of males to females measuring at 2.6:1 in the abnormal EEG group and 1.12:1 in the control group.

A total of 26 out of the 36 (72.2%) patients in the study group and 79 of the 87 (90.8%) patients in the control group were admitted to the hospital. The first EEGs were obtained 4.4 ± 10.0 and 4.5 ± 4.9 days after the occurrence of febrile seizure in the study and control groups, respectively. The follow-up EEGs were obtained at 6.1 ± 5.3 months after the first examination without any specific problems of the patients.

Eight patients in the study group received lorazepam for the acute treatment of seizures but none of patients were treated with phenobarbital. In the control group, 26 patients received lorazepam and 3 patients were treated with phenobarbital respectively as acute treatment for seizures. There was no significant difference in the acute treatment between the study and control groups. The average follow-up period was 26.4 ± 19.6 and