NEUROIMAGING IN CHILDREN WITH FIRST AFEBRILE SEIZURES: TO ORDER OR NOT TO ORDER?

Fariba Khodapanahandeh MD*, Homayon Hadizadeh MD**

Seizures are common in children and 5% of all medical attendances to accident and emergency departments are related to seizures. The role of emergent neuroimaging for those children with first afebrile seizure is, however, not well-defined. We reviewed medical charts of 125 children who were admitted with a new-onset afebrile seizure to the Pediatric Ward of Rasool Akram Hospital and underwent CT scan or MRI of the brain. Neuroimaging was performed for 95% (119/125) of these children over the first few hours of their arrival to the Emergency Department. In 90% (107/119) of them, the result was normal. There was a significant relationship between abnormal neuroimaging and focal seizure ($P < 0.001$), and with age under 2 years ($P < 0.002$). Therefore, it is recommended that CT scan or MRI to be performed in children with first afebrile seizure who present with focal seizures, abnormal neurologic findings, or age under 2 years.

Keywords: Computed tomography scan • magnetic resonance imaging (MRI) • seizure, afebrile • seizure, focal

Introduction

The purpose of performing an emergent neuroimaging study in a child with first afebrile seizure is to detect a serious condition that may require immediate intervention. The purpose of performing a nonurgent neuroimaging study, which can be deferred to the next several days or later, is to detect abnormalities that may affect prognosis and therefore have an impact on long-term treatment and management. Guidelines for obtaining emergent neuroimaging in adult patients presenting with seizures have recently been published. It is recommended that emergent brain computed tomography (CT) scan should be performed for most adults with a new-onset seizure, because of the large proportion of the structural lesions such as stroke or neoplasm in adult population. The prevalence of abnormal neuroimaging in an adult with a new-onset seizure is 34% to 45%. However, the role of emergent neuroimaging in children presenting with first afebrile seizure is still not well-defined. Based on several studies, the prevalence of abnormal neuroimaging in pediatric patients with a new-onset afebrile seizure is estimated to be 0% to 21%.

Nevertheless, the American Academy of Neurology states that these evidences are not sufficient to make a recommendation at the level of guideline for the use of routine neuroimaging in children with a new-onset seizure. The objective of this study was to determine those children with a new-onset afebrile seizure who were more likely to have abnormal neuroimaging findings.

Patients and Methods

Study design/patients

In this case series, medical charts of 125 children aged between one month and 15 years with a new-onset afebrile seizure, admitted to the Pediatric Ward of Rasool Akram Hospital, Tehran, Iran, between 1999 and 2004 were reviewed. We defined the first seizure using the International League against Epilepsy (ILAE) criteria to include multiple seizures within 24 hours, with recovery of consciousness between seizures. We excluded...
neonatal seizures (before 28 days of life), first seizures lasting 30 minutes or more (status epilepticus), and febrile seizures, because these disorders are diagnostically and therapeutically different. Patients with their first afebrile seizure and absence of any laboratory abnormalities were entered into the study.

Historical and clinical data included patient’s age, sex, and the presence of any predisposing conditions, generalized or focal type of seizure, temperature, focal neurologic signs, and any other abnormal findings in the neurologic examination.

The reports of CT scans and magnetic resonance imagings (MRI) performed over the first few hours of arrival to hospital were studied. All the emergent neuroimaging studies were conducted without the injection of contrast medium.

Laboratory data included serum electrolytes, calcium, magnesium (if performed), and blood sugar.

Statistical analyses were conducted using SPSS software. Variables were reported as mean ± SD. \( \chi^2 \) analysis was performed to determine the correlation between age of the patients and type of seizure with abnormal findings on neuroimaging.

A \( P \) value of <0.05 was considered statistically significant.

Results

There were 650 patients admitted with the diagnosis of seizure over this five-year period. One hundred and twenty-five (19.2%) of these patients had new-onset afebrile seizures and formed our study group. There were 68 (54.4%) females and 57 (45.6%) males. The mean ± SD age of patients was 53 ± 48 months (range: one month – 15 years).

Neuroimagings were obtained in 119 (95%) patients. Emergent CT scan, as an initial study, was performed in 108 (90.8%) and MRI in 11 (9.2%) patients.

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Three of five patients with brain hemorrhage, apparent in neuroimaging, had bleeding disorders due to coagulation factor deficiencies; the other two had a history of closed head trauma.

Cyanotic heart disease with right to left shunt resulted in brain ischemia in one patient. Brain tumor, tuberous sclerosis, acute disseminated encephalomyelitis, systemic lupus erythematosus, and arachnoid cyst were among the other predisposing factors for afebrile seizures. Ten of 12 patients had abnormal findings on neurologic examination.

Fifteen (12.6%) patients were under two years of age, of whom seven (47%) had abnormal neuroimaging findings. Based on the Chi-square test, there was a significant relationship \( (P < 0.002) \) between the age of patients and neuroimaging abnormalities.

Twenty-seven (22%) patients presented with focal and 92 (78%) with generalized seizures (Table 2). Out of 27 patients with focal seizures, eight (30%) and out of 92 with generalized seizures, only four (4%) had abnormal neuroimaging results (Fisher’s exact test, \( P < 0.001) \).

A significant relationship was also found between the focality of seizure and abnormal findings in neuroimaging (Chi-square test, \( P < 0.001) \) (Table 2).

Discussion

Approximately 4 – 6% of children are expected to have a seizure by the age of 16 years. About

<table>
<thead>
<tr>
<th>Table 1. Neuroimaging abnormalities.</th>
<th>Frequency</th>
</tr>
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<tbody>
<tr>
<td>Abnormal findings</td>
<td></td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>5</td>
</tr>
<tr>
<td>Epidural (1)</td>
<td></td>
</tr>
<tr>
<td>Parenchymal (3)</td>
<td></td>
</tr>
<tr>
<td>Subdural (1)</td>
<td></td>
</tr>
<tr>
<td>Brain tumor (Medulloblastoma)</td>
<td>1</td>
</tr>
<tr>
<td>Calcification (Tuberous sclerosis)</td>
<td>1</td>
</tr>
<tr>
<td>ADEM*</td>
<td>2</td>
</tr>
<tr>
<td>SLE*</td>
<td>1</td>
</tr>
<tr>
<td>Brain ischemia (CHD with Rt-Lt shunt)</td>
<td>1</td>
</tr>
<tr>
<td>Arachnoid cyst</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
</tr>
</tbody>
</table>

* = acute disseminated encephalomyelitis; ♦ = systemic lupus erythematosus.

<table>
<thead>
<tr>
<th>Table 2. Correlation between type of seizure and abnormal neuroimaging.</th>
<th>Focal</th>
<th>General</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neuroimaging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal</td>
<td>8 (6.7%)</td>
<td>4 (4.3%)</td>
<td>12 (11%)</td>
</tr>
<tr>
<td>Normal</td>
<td>19 (15.3%)</td>
<td>88 (73.7%)</td>
<td>107 (89%)</td>
</tr>
<tr>
<td>Total</td>
<td>27 (22%)</td>
<td>92 (78%)</td>
<td>119 (100%)</td>
</tr>
</tbody>
</table>
70% of these children are admitted and undergo different investigations. The role of emergent neuroimaging for children with a new-onset afebrile seizure is not well-understood. This is because the prevalence of neuroimaging abnormalities in this group has yet not been determined. However, regarding the results reported in the literature for adults, there has been a relatively high prevalence (between 34 – 45%) of CT scan abnormalities in adults with a new seizure. As a result, a recommendation has been published to perform emergent neuroimaging in large population of adults having their first seizure.

So far, several studies have reported the prevalence of abnormal neuroimaging in children with new-onset seizures. The prevalence of abnormal neuroimaging in these studies ranged between 0 – 21%. The proportion of children with febrile seizures ranged between 17% and 71%. It is important to note that children with febrile seizures, either simple or complex, are at low risk of neuroimaging abnormalities. Recently, Sharma et al reviewed a large number (n = 500) of patients presented with new-onset afebrile seizures. They excluded patients with febrile seizure (simple or complex) and those with recurrent seizures. Neuroimaging was performed in 475 patients and they reported the prevalence of 8%, as clinically-significant abnormal neuroimaging. Their study was reliable because of the selected exclusion criteria.

Our study reviewed 125 patients with their first afebrile seizure. All patients with simple or complex febrile seizures, as well as those with recurrent seizures were excluded. Neuroimaging was performed in 119 patients and abnormalities were found in only 10% of cases. The results showed that there was a significant relationship (P < 0.001) between focality of the seizure and abnormal neuroimaging. In addition, a significant relationship (P < 0.002) was found between an age of less than 2 years and abnormal findings in neuroimaging. The high-risk age was reported to be less than 24 months by Adamsbaum et al and less than 33 months by Sharma et al.

Ten (83%) out of 12 children with abnormal neuroimaging in our study had grossly abnormal findings on physical examination (coma, papilledema, focal neurologic deficits, unilateral pupil dilation, etc).

Based on our findings, we recommend that emergent neuroimaging should be performed in children with their first afebrile seizure, if there are abnormal neurologic findings, if the child presented with focal seizures, and if the age is less than two years.

Practice parameters, which have been recently published, recommend emergent neuroimaging to be performed in a child of any age, who exhibits a postictal focal deficit (Todd’s paresis) not quickly resolving, or who is not recovered to the preictal state within several hours after the seizure.

Based on our study, a relatively small number of children (10%) suffering from their first afebrile seizure had abnormal neuroimaging and the majority of this group also had abnormal neurologic examinations.

Although CT scan is more available in the emergency departments, MRI is accepted as a more sensitive neuroimaging modality for children presenting with seizure.

References