

## Excessive testing in emergent evaluation of children with first unprovoked seizure

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### Abstract

**Background:** The first episode of an afebrile seizure is a common cause of admission of children to emergency departments. A lot of tests are routinely performed for these patients. The cost of such an evaluation is high and benefits are doubtful. We conducted this study in order to evaluate the results of the tests and find out what tests are necessary for children with first unprovoked seizure.

**Methods:** In a 7-year retrospective study files of 150 children aged between 1 month and 14 years admitted with first afebrile seizure to the pediatric ward of Rasool Akram hospital were reviewed. Reports of the brain neuroimaging studies (Ct-scan & MRI) and laboratory tests were extracted.

**Results:** 150 patients with a mean age of  $53 \pm 48$  months qualified for inclusion in the study. 143 (95%) of 150 children with first afebrile seizure were imaged. Ninety percent (128/143) had normal neuroimaging. Emergent computed tomography as the initial study was performed in 90% (128/143) and MRI in 10% (15/143). Sixty patients had both MRI and CT-scans. Clinically significant neuroimaging abnormalities were reported in only 9.7% (14/143). There was a significant relation ( $P < 0.001$ ) between focal seizures and abnormal neuroimaging. Children under 24 months of age were also more prone to have abnormal imaging ( $p < 0.002$ ). Laboratory tests including complete blood count (CBC) and chemistry panel (Na, K, Ca, BUN, Cr) were performed for all. Only two patients had low serum calcium level, later diagnosed as vitamin D resistant rickets.

**Conclusions:** The most important aspect of management of a child after a first afebrile seizure is careful history taking and physical examination. Laboratory tests should be requested in very limited situations. Emergent brain CT-scans are recommended for children with focal seizures, abnormal findings on physical examination, presence of any predisposing factors and those under 24 months of age.

**Keywords:** unprovoked seizure, focal seizure, neuroimaging.

### Introduction

Seizures are common in children and 5% of all medical attendances are related to seizures. In a child with a first nonfebrile seizure, diag-

nostic evaluation influences the therapeutic decision and the need for hospital admission and specific follow up plans. First afebrile seizure according to the definition of the International league against epilepsy (ILAE) is a single seizure or multiple seizures within 24 hours

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with recovery of consciousness between seizures. The evaluation of a child with first afebrile seizure is often driven from adult protocols. Physicians usually prefer to take the safe side and perform as much tests as are available in order to avoid any accusation of malpractice. But one should remember that children are not small adults.

The causes of first seizures and its consequences in children are different from adults.

The prevalence of abnormal neuroimaging in adult onset new afebrile seizure is 34% to 45% [1,2]. Because of the large proportion of structural lesions such as stroke and neoplasm, emergent neuroimaging has been recommended for most adults with new-onset afebrile seizure. The role of emergent neuroimaging in children presenting with new onset afebrile seizure is not well defined. Based on several studies the prevalence of abnormal neuroimaging in pediatric onset first afebrile seizure ranged from 0% to 21% [3,4]. There is sufficient evidence to provide recommendation that an EEG should be obtained in children with first afebrile seizure [5]. The decision to perform other studies, including LP, laboratory tests and neuroimaging for the purpose of determining the cause of the seizure and detecting potentially treatable abnormalities depends on the age of the patient and the specific clinical circumstances. The purpose of this study was to determine abnormal laboratory tests and neuroimaging in children with new onset afebrile seizure.

### Methods

Files of 700 patients admitted with a diagnosis of seizure to the pediatric intensive care unit of Rasool-e-Akram Hospital between April 1999 and April 2006 were reviewed. 150 (21.4%) of these patients who met the criteria for first afebrile seizure according to the definition of the International League Against Epilepsy (ILAE) were included in the study and formed our study group. We excluded the re-

maining 550 children for diagnosis of febrile seizures, meningitis, encephalitis, and electrolyte abnormalities associated with gastroenteritis. All seizures that occurred during the neonatal period and those lasting more than 30 minutes were also excluded from the study.

Historical, clinical, neuroimaging and laboratory data were collected from medical records. Historical data included the following: age, sex, presence of predisposing conditions (e.g., coagulation abnormality, head trauma), number and focality of seizures.

Clinical data were: temperature, patient's mental status (sleepy, confused, etc) and focal neurological signs.

Laboratory data included chemistry panel (Na, K, Ca, BUN, Cr ) and complete blood count (CBC). Brain computed tomography and magnetic resonance imaging reports were studied.

Statistical analysis was performed using Statistical Program for the Social Sciences (SPSS) version 11. Descriptive variables were reported as mean  $\pm$  SD.  $\chi^2$  analysis was performed to test for the differences in proportion of categorical variables. A P value of less than 0.05 was considered statistically significant.

### Results

There were 81(54.4%) girls and 69 (45.6%) boys. The mean age of patients was 53 months (range 1 month and 15 years with standard deviation of 48 months).

Laboratory tests including complete blood count (CBC) and chemistry panel (Na, K, Ca, BUN, Cr) were performed for all children and the results were within normal range except for two children who had low serum calcium levels. They had other findings on physical examination and laboratory tests and were later diagnosed with rickets.

Neuroimaging was obtained in 95% (143/150). Emergent brain computed tomography as the initial study was performed in 90% (128/143) and MRI in 10% (15/143). In 45 pa-

| Investigation                    | Cases No. (%) |
|----------------------------------|---------------|
| Complete blood count             | 150 (100)     |
| Urea and creatinine              | 150 (100)     |
| Serum electrolyte                | 150 (100)     |
| Blood glucose                    | 150 (100)     |
| Serum calcium level              | 150 (100)     |
| Electroencephalogram             | 138 (92)      |
| Computed tomography brain scan   | 128 (90)      |
| Magnetic resonance brain imaging | 60 (40)       |

Table 1. Investigation performed for children admitted with first unprovoked seizure.

tients MRI was performed on a nonemergent basis and overall 60 (40%) patients had both MRI and CT-scans.

Neuroimaging results were normal in 90.3 % (129/143). Significant neuroimaging abnormalities were reported in 9.7% (14/143) and only one of them needed emergent neurosurgical operation. Five patients presented with brain hemorrhage. 3 of them had bleeding disorders because of clotting factor deficiency. One patient with brain ischemia had cyanotic heart disease with a right to left shunt.

Electroencephalography was performed for 92% (138/150). Table 1 shows investigations provided for children with first afebrile seizure.

12.6% (19/150) of patients were under 24 months of age and 9 of them had abnormal neuroimaging which showed a significant relation ( $P < 0.002$ ) between the age of the patient and imaging abnormalities (Table 2).

120 (80%) patients had generalized seizures and 30(20%) presented with focal seizure.

A significant relation ( $P < 0.001$ ) was found

between focality of seizure and abnormal findings in neuroimaging.

### Discussion

Approximately 4% to 6% of children will have a seizure by 16 years of age [6] and generally, seventy percent of seizure disorders start in childhood. After a first afebrile seizure children are brought to the emergency department where emergency medicine physicians who are usually trained in adult care visit them. Considering the high prevalence of vascular events and tumors as the underlying cause of seizure in the adult group; they routinely perform the same tests for children as adults which usually include an emergent brain computed tomography scan, complete blood count, electrolytes, blood sugar, calcium and other routine tests.

However, the causes of first seizures in children and adolescents are quite different from adults, so that, their evaluation and treatment should not be the same [7-9].

For those children coming to the emergency department with a new onset afebrile seizure the role of emergent neuroimaging is not well defined, because the prevalence of neuroimaging abnormalities in this age group has not yet been extensively investigated. In contrast, enough evidence for adult patients exists which reveals the prevalence of CT abnormalities between 34% and 45% [1,10]. According to adult studies the incidence of neoplastic lesions or an acute infarction ranged between 22% and 26% [11,12].

Sharma et al [13] reviewed 500 children presenting with new onset afebrile seizure. They

| Abnormal neuroimaging | Age under 24 months |             |            |
|-----------------------|---------------------|-------------|------------|
|                       | Yes                 | No          | Total      |
| Yes                   | 9 (6.4%)            | 7 (4.9%)    | 16 (11.3)  |
| No                    | 10 (6.9%)           | 117 (81.8%) | 127(88.7%) |
| Total                 | 19 (13.3%)          | 124 (86.7)  | 143(100%)  |

Table 2. Correlation between age and neuroimaging abnormalities.

excluded patients with febrile seizure (simple or complex) and those with recurrent seizures.

Neuroimaging was obtained in 475 patients. Clinically significant abnormal neuroimaging was noted in 8% of patients. Their exclusion criteria make their study more reliable than previous studies. They defined children with predisposing factors such as bleeding disorders or closed head trauma, those younger than 33 months of age and focal seizures as high risk groups.

Our study reviewed 150 patients with first afebrile seizure. Neuroimaging was performed in 143 patients. Fourteen (9.7%) patients had abnormal findings and only one of them needed emergent neurosurgical operation.

Our results showed that there was a significant relationship ( $P < 0.001$ ) between focality of seizure and abnormal neuroimaging which was compatible with Sharma et al and Mayatal et al's [8,13] studies. In addition, a significant relationship ( $P < 0.002$ ) was found between age less than 2 years and abnormal findings in neuroimaging. High risk age was less than 33 months in Sharma et al's study and less than 24 months in Adamsbum et al's study [9,13].

Eleven (80%) out of 14 children with abnormal neuroimaging in our study had grossly abnormal physical examination (coma, pupil edema, focal neurological sign, unilateral pupil dilation, etc).

The Quality Standards Subcommittee of the American Academy of Neurology, the Child Neurology Society, and the American Epilepsy Society, [5] after reviewing the published literature, has written that after a first unprovoked nonfebrile seizure in a child or adolescent there is insufficient evidence to support a recommendation to routinely perform a lumbar puncture, laboratory studies or routine neuroimaging. The subcommittee concluded that urgent imaging could be reserved for the very small group of children with new-onset neurological deficit or long lasting changes in mental status.

MRI, which often requires sedation in small

children, could be done on a non-emergency basis for specifying epileptic syndromes.

Berg et al [14] reviewed 613 children with newly diagnosed epilepsy. Neuroimaging revealed a small but significant number of serious problems not previously suspected. Most of these children had partial seizures or focal EEG abnormalities and they recommended that neuroimaging should be considered during the evaluation of children with newly diagnosed epilepsy, especially for those with neurological deficits or partial seizures or focal EEG abnormalities.

The study by Sharma et al [13] provides strong support for those conclusions of Berg et al [14].

All of these studies recommend that well-appearing children who are not in high risk categories may be discharged from the emergency department without emergency scanning.

Freeman [15] according to data derived from several credential studies [5,8,14,15] recommends that unless there are specific circumstances (e.g. history of head trauma, alteration in mental status, the presence of new neurological deficit), blood work, a lumbar puncture, and neuroimaging do not need to be performed in the emergency department evaluation of a child with first afebrile seizure. Our study showed that focal seizures, age less than 24 months and the presence of predisposing factors were associated with abnormal findings in neuroimaging.

### Conclusion

The present study showed that the use of unnecessary investigations was very common, Investigations, though resulting in significant expense, proved to be of little diagnostic value. Diagnostic procedures should be performed only when specifically called for by the patient's condition.

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