Original Research Article

Evaluation of neuroimaging findings in new onset afebrile seizures in children

Maheshkumar Muthuraja[1], Manikandan Paramasivam[2]*

[1]Department of Pediatrics, [2]Department of Neonatology, Saveetha Medical College and Hospital, Saveetha Nagar, Thandalam, Chennai, Tamil Nadu, India

Received: 28 January 2018
Accepted: 18 February 2018

*Correspondence:
Dr. Manikandan Paramasivam,
E-mail: makped2015@gmail.com

ABSTRACT

Background: New onset afebrile seizures are very common in children. They are diagnosed by neuroimaging techniques. The aim of the present study was to examine the presenting characteristics and to assess and compare the prevalence of neuroimaging and neurological abnormalities in new onset afebrile seizures in children.

Methods: This prospective study was conducted in a tertiary care hospital at Chennai during the period from July 2014 to August 2016. Out of 65 patients included in the study, 58 had an MRI, 5 had a CT scan and 2 patients had a neurosonogram. All the findings were documented in the proforma and evaluated for incidence of neuroimaging abnormality in children.

Results: The most common age group to be affected was the adolescent age group followed by the infantile group. The most common presentation noticed was generalized seizures 72% (47/65). Among the primary generalized seizures, GTCS 57% (27/47) was the most common. Of the 65 patients in our study, 22 had Neuroimaging abnormality and 16 had neurological abnormality. The most common abnormalities seen in various neuroimaging studies were ring enhancing lesions 10 (45%). Ring enhancing lesions were more common in the adolescent age group, while structural disorder was more common in the infantile age group.

Conclusions: Neuroimaging techniques helped in finding the brain developmental abnormalities among children with afebrile seizures.

Keywords: Afebrile seizures, Neuroimaging abnormalities, Neurological abnormalities

INTRODUCTION

A seizure is a common neurological problem that occurs in children.[1] A seizure is a transient occurrence of signs and/or symptoms resulting from abnormally excessive or synchronous neuronal activity in the brain. Unprovoked seizures are type of seizure with no obvious precipitating cause.

Approximately 4 to 6% of children will have afebrile seizures by 16 years of age among whom 30% are liable to develop epilepsy later, while 20% of those are liable even if all clinical and radiological evaluation is normal.[2]

Neuroimaging is usually obtained to establish etiology and to plan appropriate clinical cure.[3] The purpose of performing an urgent 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 non- urgent neuroimaging study, which can be deferred to the next few days or later, is to detect abnormalities that may affect prognosis and therefore have an impact on long-term treatment and management.[4,5]

The study was conducted with the objective to assess and compare the prevalence of neuroimaging and

neurological abnormalities in new onset afebrile seizures in children of different age groups by using neuroimaging techniques.

METHODS

This prospective study was conducted at tertiary care hospitals in Chennai during the period from July 2014 to August 2016. After getting approval from institutional ethics committee, study was conducted in children aged 1 month to 16 years with afebrile seizures, admitted to our hospitals satisfying the study inclusion criteria. Informed consents were taken from all from the parent or the legal guardian of the study subjects after explaining to them in detail the nature of the study.

Inclusion criteria

All children aged 1 month to 16 years getting admitted with new onset afebrile convulsive episode(s) were included in the study. Exclusion criteria were children having convulsion with a history suggestive of acute antecedent events like trauma, drugs, toxins, convulsions associated with fever, cerebral palsy, neonatal seizures, seizures due to electrolyte imbalances and pervasive developmental disorder/intellectual disability.

Sample size calculation

It is based on prevalence of neuroimaging abnormality 20%

$n = Z^2pq/d^2$

Where Z = standard normal value 1.96; p is the prevalence of neuroimaging abnormality q=1-p; d is clinically allowable error (10%). Replacing these by values, the estimated sample size is 65.

$n = 3.841 \times 20 \times 80 / 10^2 = 61.45$

We have rounded up to nearest value of 65. Power 80% and alpha error 5% was considered for sample size calculation.

All the demographic data, historical and clinical data was collected and recorded for every patient included in the study in pre-structured proforma. History included patient's age, sex, time and place of seizures, duration of seizures, type of seizures (generalized, focal, multifocal myoclonus), the presence of any predisposing conditions (history of fever, diarrhea with dehydration, ear discharge, exanthematous illnesses, cough with expectoration or any skin infections) and any antecedent events (history of drug ingestion, trauma, and toxins). History of pork ingestion or any history of contact with open case of tuberculosis was also obtained.

Detailed general examination and head to foot examination were done to look for markers of

tuberculous infection and neurocutaneous lesions. Vital signs including temperature were monitored. Detailed Neurological examination was made done specifically to look for focal neurologic signs and any other abnormal findings. Other systems were examined.

Neuroimaging was done after stabilization and sedation given if needed to reduce motion artefacts. Neuroimaging was done either as urgent or non-urgent study. MRI was preferred in most situations as it better detected the abnormality compared to other imaging modalities. CT and neurosonogram were considered if the patient could not afford MRI. MRI was performed at 3 Tesla. The entire imaging was evaluated by an experienced pediatric radiologist and reassessed in cases of doubt with pediatric neurologists. The findings were documented in the proforma. Neuroimaging findings are categorized into normal study and the abnormalities were classified as ring enhancing lesions, neurodegenerative disorders, tumors, cerebrovascular accident, congenital structural defect, calcifications, neurocutaneous syndrome, metabolic disorders and others categorized as miscellaneous.

Statistical analysis

The data collected from the patients was entered in a Microsoft Excel spreadsheet and analyzed using SPSS v16.0. All the categorical variables were expressed either as percentages or proportions. The comparison of categorical variables was done using chi square test or Fisher's exact test based on the number of observation. Logistic regression analysis was used to find the predictive factors for the neuroimaging abnormality. All 'p' values less than 0.05 were considered statistically significant.

RESULTS

All patients in this study underwent neuroimaging, mostly MRI. Out of 65 patients 58 had an MRI, 5 had a CT scan and 2 patients had a neurosonogram (Figure 1).
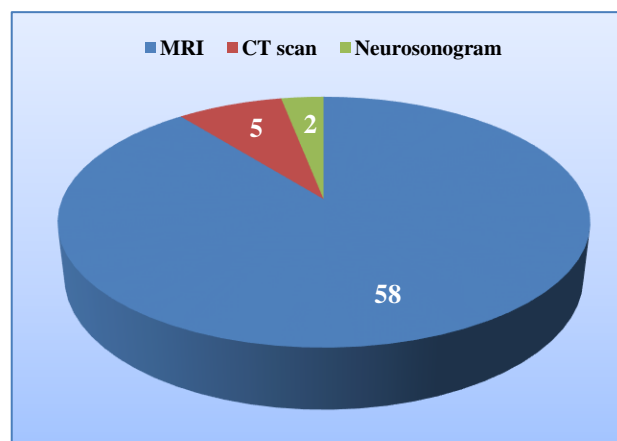

Figure 1: Types of neuroimaging techniques underwent by patients.

Table 1: Patient characteristics.

Characteristics	No. of patients (n=65)	Percentage
Age		
Infants (1 month to 1 year)	8	12
Toddler hood (1 to 3 years)	3	5
Preschool children (3 to 6 years)	5	8
School age (6 to 10 years)	3	5
Adolescence (10 to 16 years)	46	70
Gender		
Boys	36	55.4
Girls	29	44.6
Types of seizures		
Primary generalized seizures	47	72
GTCS	27	57
Clonic and myoclonic	8	17
GTS	4	9
Focal and multifocal seizures	18	28

Table 1 presents the patients characteristics. The most common age group to be affected was the adolescent age group (10-16 years) followed by the infantile group (1 month to 1 year). Infants accounted for 12% (n = 8) of the study population, toddlerhood 5% (n = 3), preschool children 8% (n = 5), school age children 5% (n = 3) and adolescents accounted for 70% (n = 46).

Among the study population, 55% were boys (n = 36) and 45% were girls (n = 29) presenting with seizures. Primary generalized seizures accounted for 72% (n = 47), focal and multifocal seizures accounted for about 28% (n = 18). Among the primary generalized seizures, generalized tonic-clonic seizures (GTCS) 57% (n = 27) were the most common, followed by clonic and myoclonic variety with 17% each (n = 8) and GTS 9% (n = 4).

Of the 65 patients in the present study, 22 had neuroimaging abnormality and 16 had neurological abnormality. This difference in abnormality among patients was found to be statistically significant (p = 0.001). Of 16 children with neurological abnormality, 5 had post ictal deficits, 4 had altered level of consciousness, and 7 children had a GCS of <9.

The most common abnormalities seen in various neuroimaging studies were ring enhancing lesions (REL) seen in 10 patients, followed by structural disorders in 4 children (Table 2).

Table 2: Types of abnormalities.

Types of abnormalities	No. of patients	Percentage
Neurological abnormalities	**N=16**	
GCS<9	7	43.75
ALOC	4	25
Postictal deficits	5	31.25
Neuroimaging abnormalities	**N=22**	
Ring enhancing lesions (REL)	10	45.45
Congenital structural disorder (CSD)	4	18.18
Neurodegenerative disorder (NDD)	2	9.09
Cerebral vascular disorder (CVD)	2	9.09
Tumors	1	4.54
Miscellaneous	3	13.63

As shown in Table 3, among the causes for REL, neurocysticercosis accounted for 6 of the 10 patients, whereas tuberculoma accounted for the remaining 4.

Age distribution in REL showed all patients were in the adolescent age group. REL were seen more in boys 60% (n = 6), than in girls 40% (n = 4) and were more commonly seen in the parietal region in 50% (n = 5), followed by the frontal region 30% (n = 3) and temporal region 20% (n = 2).

Table 3: Patients characteristics among the cases of REL.

Characteristics	Number of patients (n=10)	Percentage
Age		
Adolescence (10 to 16 years)	10	100
Gender		
Boys	6	60
Girls	4	40
Regions involved		
Left	6	60
Right	4	40
Risk factors		
Family history or contact with TB	1	10
Pork ingestion	1	10
Malnourished/low socioeconomic status	8	80

Congenital structural defects accounted for 6% (n=4) of patients among the study group.

Among the structural defects, disorders of segmentation (schizencephaly), cerebellar malformations (Dandy-Walker malformation), malformation of cortical development (Lissencephaly) and arachnoid cyst were

seen in one patient each (25%). Most of these patients were infants (Table 4).

Table 4: Patients characteristics among the cases congenital structural defects.

Characteristics	No. of patients (n=4)	Percentage
Age		
Infants (1 month to 1 year)	4	100
Risk factors		
Schizencephaly	1	25
Cerebellar malformations	1	25
Lissencephaly	1	25
Arachnoid cyst	1	25

DISCUSSION

Afebrile seizures are one of common problem in children of all ages. This might be due to birth asphyxia, neurocysticercosis and nervous system infections and other risk factors.[6,7] The basis of incidence can be evaluated by EEG. It is mostly useful in investigating afebrile epileptic seizures and its risk of recurrence. It is advantageous to perform neuroimaging (CT or MRI) in children who had two or more afebrile epileptic seizures and who do not have EEG features of an idiopathic epilepsy. MRI is superior to CT in demonstrating elusive brain developmental abnormalities.[8,9]

In the present study, seizures were more common in adolescents (n = 46) and least common in preschool and school aged children. These findings were in accordance with the observations of Rasool et al and Tavassoli et al.[10,44] Field C et al stated that the incidence is high in infancy, whereas between 1-10 years of age the incidence plateaus and then drops in teenage age groups.[12] The difference observed was due to large size of the adolescent age group in our study.

In the present study, the most common seizure type was generalized seizure accounting for 60% (n = 47) followed by focal and multifocal which were 27% (n = 18). Among the primary generalized seizures, GTCS 57% (n = 27) were the most common, followed by clonic and myoclonic each 17% (n = 8) and generalized tonic seizures 9% (n = 4). This was comparable with other studies done by Hauser et al and Khodapanhandeh et al.[13,14]

In the present study, normal neuroimaging accounted for 67% (43/65) whereas neuroimaging abnormalities were found in 33% (n = 22). The incidence of neuroimaging abnormality compared too many other studies such as those done by Poudel et al, Rasool et al, Kalnin et al, Mathur et al, Mohammadi et al which showed neuroimaging abnormality to be around 27 % to 35% in new onset afebrile seizures.[6,10,15-17]

Of the 65 patients in the present study, 22 had neuroimaging abnormality and 16 had abnormalities on neurological examination. Among the patients with neurological abnormality, 11 had neuroimaging abnormality (69%). Similar observations were also made by Hussein et al which showed patients with neurological abnormality were more likely to have neuroimaging abnormality than those without.[18]

Among 22 patients with neuroimaging abnormalities, the most common noticed were REL 45% (n = 10), followed by congenital structural disorders 18 % (n = 4) and others (NDD, CVA, TUM, MISC) 37% (n = 8) which is comparable to many studies done by Singhiet al and Saini et al.[19,20]

Neurocysticercosis was the most common cause for REL in children, which accounted for 60% (n = 6). Singhi et al also showed NCC as the commonest cause of REL in India.[19] Both tuberculomas and neurocysticercosis were seen mostly in parietal region in 5 patients which is comparable to previous studies conducted in India by Sachdev et al.[21]

Congenital structural defects constituted to 18% (n=4) of neuroimaging findings. The most common age group affected was the infantile period. Studies done by Aprahamian et al found CSD to be the most common cause of afebrile seizures in the infantile period, concurring with the present study.[22]

CONCLUSION

The findings of the study concluded that neuroimaging techniques helped in finding the brain developmental abnormalities among children with afebrile seizures particularly among the adolescent and infantile age groups. Ring enhancing lesions were more common in the adolescent age group, while structural disorder was more common in the infantile age group.

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