

Partial Seizures in Children- Incidence, EEG and CT Scan as Diagnostic Aid

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ABSTRACT

BACKGROUND

The present study was conducted to determine the incidence of partial seizures in children 5 - 15 years of age and evaluate EEG and CT scan as diagnostic tools in partial seizures in children.

METHODS

This is a hospital based observational study done for 2 years among children in the age group of 5 - 15 years presenting with focal seizures. Children presenting to our hospital with focal seizures defined as per International League against Epilepsy Classification formed the study group. A total of 87 patients were included. Children were investigated for the aetiology of focal seizures with routine and specific investigations including Mantoux test, CSF analysis, blood sugar, neuroimaging CT scan and/or MRI and EEG. All the findings were recorded in a pre-designed proforma and results were analysed. MRI was done in cases where differentiating NCC from tuberculoma by CT scan was a diagnostic dilemma and also in cases where CT was inconclusive. EEG was done in all cases. In all these children, appropriate standard treatment protocol was carried out.

RESULTS

The incidence of focal seizures was more common in between 5-10 years of age. Female to Male ratio was 1.12:1. CT evaluation of the patient showed that 93% of the patients had a lesion in the brain. Infections were the major cause of focal seizures. NCC and Tuberculoma were the major causes. Abnormal EEG pattern was seen in majority of the cases of 66%.

CONCLUSIONS

Focal seizures are one of the commonest type of seizures seen in children, associated with a localized lesion in the brain. Infective causes are the major aetiological factors.

KEYWORDS

Children, Focal seizures, CT, EEG, NCC, Tuberculoma

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BACKGROUND

Focal or partial seizure is a seizure that originates from a localized area of the cerebral cortex and has neurologic symptoms specific to the affected area of the brain. The behavioural manifestations of focal seizures relate not only to the region of the brain involved during the ictal discharge but also to the maturation of the nervous system and the integrity of the pathways necessary for clinical expression.¹

Focal seizures can be mistaken when the presence of secondary convulsive movements prompts casual observers to label the event, a “generalized tonic-clonic” seizure. With this misdiagnosis, critical elements of the seizures are overlooked. Careful consideration of the unique features present in Paediatric focal seizures can help to improve the diagnostic accuracy. Focal seizures are not infrequent in children. In fact, the most frequent childhood epilepsy is probably benign childhood epilepsy with centro-temporal spikes in EEG also called as Benign Rolandic Epilepsy.² Acute-onset partial seizures in an otherwise asymptomatic child may be idiopathic or symptomatic. In developing countries like India, more than 60% of partial seizures are symptomatic. The causes of symptomatic partial seizures in children in India have been found to be somewhat different from those reported from the West. Although common reported causes from developed countries (after exclusion of perinatal insults) are gliomas, cortical dysplasias, calcifications, and infarcts, those reported from Indian studies are predominantly infections (neurocysticercosis and tuberculomas).³

Focal seizures account for 60% of all seizure disorders in children⁴ and in 40 – 60% of cases an identifiable aetiology is found which can be treated effectively if appropriate diagnosis is made. Because of a significant chance of finding some structural cerebral lesion, an imaging procedure such as CT scan is indicated essentially for every child with a partial seizure⁴. Sufficient information is available regarding the clinical profile and aetiology of partial seizures in children from developed countries.^{4,6} Surprisingly, similar studies on children from developing tropical countries are scarce. Only in recent times, some studies have focused on the value of computed tomographic (CT) findings in infants and young children with focal epilepsy.

We wanted to study the incidence of partial seizures in children 5-15 years of age. We also wanted to evaluate EEG and CT scan as diagnostic tools in partial seizures in children.

METHODS

This is a hospital based observational study conducted at Katuri Medical College and Hospital (Dept. of Paediatrics), Guntur, over a period of 2 yrs. from Nov. 2016 to Oct. 2018). Children in the age group of 5-15 yrs. presenting with focal seizures were included in the study. Children with febrile seizures and degenerative disorders of CNS were excluded from the study.

Children presenting to our hospital with focal seizures defined as per International League against Epilepsy Classification formed the study group. A total of eighty seven were included, of which 6 cases were from outpatient department and 81 children from inpatient department. A detailed history was taken and clinical examination was done to look for any neurological abnormality, presence of neuro-cutaneous markers and/or associated illness. Children were investigated for the aetiology of focal seizures with routine and specific investigations including Mantoux test, CSF analysis, blood sugar, with neuroimaging CT scan and/or MRI and EEG. All the findings were recorded in a pre-designed proforma and results were analysed. MRI was done in cases where differentiating NCC from tuberculoma by CT scan was a diagnostic dilemma and also in cases where CT was inconclusive. EEG was done in all cases. And in all these children, the appropriate standard treatment protocol was carried out.

CT Findings Used

1. Tuberculoma was considered based on the size of the lesion (>20 mm), irregular margins, associated midline shift, conglomerate lesions, isodense contents, peripheral thick enhancement and presence of perilesional oedema as described by Iyyer et al.⁷
2. The diagnosis of Neurocysticercosis was considered based on size of the lesion (<20 mm), regular margins, no midline shift, multiple ring or disc lesions, eccentric scolex and calcified lesions as described by Rajshekar et al.⁸

RESULTS

Age wise distribution of the cases in the present series it was observed that 68 cases were recorded between 5-10 years of age comprising of 78%. 19 cases were observed between 11-15 years comprising of 22%. It showed that the incidence of partial seizures was more below 10 years of age. The predominant age group observed was 5-10 years (78%). Sex wise analysis of partial seizures, it was observed that the incidence in male and female children was 41 and 46 respectively. So, the incidence was slightly more in females.

Seizure Semiology	Present Study
Total No. of Cases Studied	87
Motor Symptoms	100%
Sensory Symptoms	6%
Staring Spell	25%
Complex Vs Simple	74% & 3%
Right sided Vs Left sided	62% & 38%

Table 1. Seizure Semiology

In the present series of seizure semiology it was observed the various manifestations like motor manifestations, sensory manifestations, staring spell, complex vs simple, right sided vs left side were seen 100%, 6%, 25%, 74% & 3% and 62 & 38% respectively. Analysis of the past history it revealed past history of seizures were present in 15 out of 87 cases, family history of seizures were

present in 2 patients and history of tuberculosis in 2 cases. Head circumference of total 87 children, 2 (2%) had microcephaly (< 3 SD). Of total 87 patients, a vast majority (80%) had normal GCS at presentation.

Sl. No.	GCS	No.
1.	<10	6
2.	10-12	11
3.	13-15	17
Normal	15	53

Table 2. Glasgow Coma Scale at Presentation

Evaluation of the admitted patients by Glasgow Coma Scale it was observed that 53 patients were normal as against the abnormality was found in 34 patient. Comprising of 39% as some of these patients were have secondary generalization.

Neurological Deficit	No. of Cases
No neurological deficit	69
Hemiparesis	10
Monoparesis	3
Tods palsy	3
quadriparesis	2

Table 3. Neurological Deficit at Presentation

Evaluation of neurological deficit: various neurological deficits was observed in 18 cases comprising of 20.6%. Among the various neurological deficits hemiplegia, monoparesis, Todd's paralysis and quadriplegia were seen in 10, 3, 3, 2 respectively of the 18 cases with neurological deficit 2 case with Todd's paralysis recovered completely the remaining 16 cases had persistent deficits. 69 cases were neurologically normal.

CT Findings	No.	%
NCC	45	55.5%
Tuberculoma	8	9.8%
NCC / Tuberculoma	4	4.9%
Tuberous Sclerosis	1	1.2%
Stroke	2	2.4%
Unidentifiable Aetiology	13	16%
Cortical Malformation	1	1.2%
Meningitis	2	2.4%
Perinatal Insult	2	2.4%
Brain Abscess	3	3.7
Not Done	6	

Table 4. Aetiology of Seizures

In the study group of 87 cases 81 patients were evaluated by CT scan and the remaining 6 cases CT scan was not done because EEG showed benign rolandic epilepsy in them. Among the 81 cases evaluated by CT scan nearly 45 cases found to have Neurocysticercosis, tuberculoma in 8 cases, doubt full cases of Ncc/Tuberculoma in 4 cases. Other cases like tuberous sclerosis complex, meningitis, brain abscess and stroke were found in 1, 2, 3 and 2 respectively. In 13 cases among the cases evaluated by CT scan were found to have Normal brain structure. From the above analysis it was observed that infections were the major cause of Partial seizures.

All doubtful cases like NCC/Tuberculoma, Benign Rolandic Epilepsy and Cerebral stroke were evaluated by MRI which is more specific than CT scan revealed normal for all Rolandic Epilepsy and NCC/ Tuberculoma were confirmed as tuberculoma. CT evaluation of 45 NCC 37 were found to have single solitary lesion were as 8 had multiple lesions.

Evaluation of the dietary habits of the patients with partial seizures it was observed 8 patients out of 30 vegetarians and 37 patients out of 57 non vegetarians were found to NCC comprising of 21 and 77% respectively. The reason for the presence of NCC among the vegetarians probably may be due to contamination of the soil contamination of Vegetables in pork infested areas. CT evaluation of solitary NCC revealed ring enhancing in 28, disc enhancing in 1 and calcified in 8 cases. Ring enhancing lesion was the most common type followed by calcified lesions.

	Right	Left
Parietal	11	9
Occipital	-	1
Fronto-parietal	2	7
Temporo-parietal	1	1
Multiple lobes involved	5	

Table 5. Lobes Involved in Solitary NCC

Evaluation of the location of the NCC it was observed that majority of lesions were found in parietal lobe comprising of 20 cases followed by involvement of fronto parietal in 9 cases. Among the 8 cases evaluated by CT scan 6 cases were found to have lesion in the parietal lobes. Among all the 87 cases of partial seizures evaluated by EEG 58 cases were found to have abnormal EEG findings out of which focal discharges were found in 43 cases (74%). Rest of the EEG findings were shown in the table.

Diagnosis	No. of Cases
Inflammatory Granulomas and Infections	62 (71%)
• Neurocysticercosis	45
• Tuberculoma	12
• Meningitis	2
• Brain Abscess	3
Perinatal Insult	2 (3.4%)
Rolandic Epilepsy	5 (5.5%)
Cortical Malformation	1 (2.2%)
Neurocutaneous Syndrome	
• Tuberous Sclerosis	1 (2.2%)
• Stroke	3 (1.1%)
No Identifiable Cause	13 (14.9%)

Table 6. Aetiology of Focal Seizures

Etiological evaluation of 87 cases of partial seizures 62 cases were found to be infectious in origin comprising of 71%. The remaining non identifiable partial seizures were seen in 13 cases. In the remaining 12 cases non-infectious lesions were found. So partial seizures infections are the commonest cause of partial seizures in children.

Various Aetiology	5 - 10 Yrs.	11 - 15 Yrs.
NCC	31	14
Tuberculoma	12	-
Rolandic epilepsy	5	-
Stroke	3	-
Cortical Malformation	-	1
Pyomeningitis	1	1
Neuro Cutaneous Syndrome	1	-
Brain Abscess	3	-
Perinatal Insult	2	-
Unidentifiable Aetiology	10	3

Table 7. Age of Presentation of Focal Seizures with Various Aetiology

NCC was predominantly observed between 5 - 10 years age group. The commonest age group of occurrence of tuberculoma was 5 – 10 years. Cortical malformations were commonly found in younger children.

DISCUSSION

Focal or partial seizure is a seizure that originates from a localized area of the cerebral cortex and involves neurologic symptoms specific to that affected area of the brain. The behavioural manifestations of focal seizures relate not only to the region of the brain involved during the ictal discharge but also to the maturation of the nervous system and the integrity of the pathways necessary for clinical expression. Evaluation of the focal seizures was undertaken in the Department of Paediatrics over a period of 2 years to know the exact incidence and cause of focal seizures. 87 cases who were admitted in department of paediatrics were evaluated thoroughly by taking detailed history and thorough physical examination. All the cases were investigated by EEG and CT scan. In doubt full cases MRI was taken.

Age Wise Distribution

Evaluation of 87 cases 68 cases were seen between 5-10 years of age and 19 cases were 10-15 years of age comprising of 78% and 22%. So, the incidence of partial seizures was below 10 years of age. The results of the present series was compared with studies done by other authors as shown below. Evaluation of partial seizures by various authors as shown above 100 cases were seen by Singhi et al³ in the age group of 4-10 years with mean age of 6 years and Ramesh et al⁶ seen 172 cases between 2-15 years of age. In the present series, studied in the age group of 5-15 years with mean age of 8.2 years. Ramesh et al in 2000 years studied partial seizures in 172 cases in the age group of 2-15 years without mentioning the mean age.

Sex Incidence

The incidence of partial seizures was more in female children comprising of 53% as against 47% in male children. There was a slight preponderance of partial seizures in female children. The sex ration female to male is 1.12:1 Singhi et al³ in 1997 reported the sex ratio from female to male- 1:1.5. Ramesh et al⁶ in 2000 reported the sex ration from female to male- 1:2.2 the present study was slightly differed from the studies of other authors.

Seizure Semiology

In the present series of seizure semiology, it was observed the various manifestations like motor manifestations, sensory manifestations, staring spell, complex vs simple, right sided vs left side were seen 100%, 6%, 25%, 74% & 3% and 62 & 38% respectively. The present study was compared with Singhi et al³ motor seizures, complex vs simple and right sided vs left side were in correlation with the study of the above author and there was slight difference of the manifestations staring spell and sensory like.

Past History and Family History

Past history and family history revealed 15 cases were having seizures before the evaluation of the patients, History of Tuberculosis in 2 patients. Family history of seizures was observed only in 2 cases out of 87.

Evaluation of Seizure Patients by GCS

Evaluation of the patient by Glasgow Coma Scale at the time of seizure attack, 53 children were found to be normal with GCS 15 and the remaining 34 patients with Glasgow Coma Scale was less than 15.

Neurological Deficit

Neurological examination of the patients showed without deficit in 69 patients and with deficit in 18 cases in the form of Hemiparesis, monoparesis, Todd's palsy and quadriparesis comprising 20.6%. Hemiplegia was the major deficit seen in the present series. The present series was compared with the study of Singhi et al (1997).³

Aetiology of Seizures

Etiological evaluation by CT scan of the children showed 63 patients were having seizures of infective origin out of which NCC was found in 45 patients and 8 with Tuberculoma comprising of 55.5% and 9.8% respectively. Neurological involvement in Tuberos sclerosus was found in 1 case. CT scan was not done in 6 cases as those cases were found to have Rolandic Epilepsy by EEG. When the present study was compared with singhi et al,³ Vibha et al⁵ it showed that there is variation of mainly NCC with the study of other authors as show in the table above. NCC in which the present study recorded 43% cases of NCC whereas Singhi et al and Vibha et al reported 13%, 20.3% respectively.

Aetiology of Focal Seizures

When the present study was compared with the studies of other authors like Singhi et al,³ Vibha et al⁵ where the infections were the common cause of focal seizures in all the studies. But the incidence of NCC was the major cause of focal seizures in the study of vibha et al and present study where the incidence was 61% and 69% respectively. The incidence of NCC was only 13% in the study done by Singhi et al. The incidence of tuberculoma was 39% when compared with study of singhi et al and present study where the incidence was 12% and 14.5% respectively. From the above comparison it was observed that infection was the major cause of focal seizures. The overall incidence of childhood epilepsy from birth to 16 years is approximately 40 cases in 100,000 children per year (4 – 10%) of which 60% are focal seizures and more than 50% starts in childhood.⁹ Wadia et al,¹⁰ reported, at least 26% of Indian patient with focal epilepsy has Solitary Contrast Enhancing CT Lesion. Tuberculosis of the nervous system may itself present in many forms – Tuberculoma, cranial osteitis, Tubercular meningitis. Its contribution to partial seizures has been widely reported in literature. Its incidence is higher in developing countries as compared to the developed world.¹¹ In children tuberculomas are more common in the infratentorial compartment unlike adults in whom supratentorial lesions predominate.¹² NCC is common in underdeveloped countries due to unhygienic practices. NCC is infestation of human central nervous system with tissue cysts of pork tapeworm *Taenia solium*. Human beings acquire cysticercosis through faeco-oral contamination with *T. Solium* eggs or poor hygiene practices in food handling by

tape worm carriers. Clinical presentation of NCC can be variable. Seizures are the commonest presentation of NCC (50-80%).¹³ Various types of seizures have been described among patients with NCC including generalized, focal and rarely myoclonus and acquired epileptic aphasia. In general, it seems that about half the cases have partial seizures and the other half generalized seizures, a proportion similar to that of the general population.¹⁴⁻¹⁶

Summary

The incidence of focal seizures was more common in between 5-10 years of age. The incidence of focal seizures was slightly more in females than males. The sex ratio from Female to Male: 1.12: 1 Motor symptoms were found in all the cases of focal seizures followed by complex vs simple, right sided vs left sided, staring look and sensory symptoms in order of frequency. Past history of seizures history of Tuberculosis in some children and family history of seizures were found in some children of focal seizures. Evaluation by Glasgow Coma scale at the time of seizures majority of the children were found to be normal and abnormal in some cases. Neurological examination of the patients revealed that majority of the children were normal and small number of children were found to have neurological deficit among which hemiparesis was the commonest. CT evaluation of the patient showed 93% of the patients were found to have a lesion in the brain which indicates a localized lesion for development of focal seizures. It infers a localized lesion is the primary of development of focal seizures.

Etiological evaluation by CT showed that infections were the major cause of focal seizures which are treatable and preventable by implementing the vaccination programs and treatment of the primary cause. Among the causes of focal seizures NCC and Tuberculoma were the major causes of focal seizures which are totally preventable and curable. Dietary evaluation of the children with focal seizures majority of the children with focal seizures are non-vegetarians, but sizable number of vegetarians were found to have a lesion in the brain with focal seizures so proper cleaning and cooking of the dietary items are very important to prevent the primary lesions in the brain. Improper cooking, improper cleaning or eating of raw items might be responsible for causing infective lesions in the brain. EEG evaluation revealed abnormal EEG pattern was seen in majority of the cases of 66% and normal 34% of cases, so evaluation of the patient by CT scan and EEG are complimentary to each other. Incidence of normal hemiparesis and Todd's palsy in our study was comparable with the study of Singhi et al.³

CONCLUSIONS

Focal seizures are one of the commonest type of seizures seen in children which require detailed evaluation. Most of the times, focal seizures are associated with a localized lesion in the brain. Among the localized lesions, infective causes are the major aetiological factors for causing focal seizures which are totally preventable and curable.

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