

Electroencephalogram and MRI Changes in the Cases of Febrile Seizure Plus and Complex Febrile Seizure in a Tertiary Care Hospital of West Bengal, India

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Abstract

Introduction: Febrile seizure (FS) is a relatively common childhood condition. This is one of the most frightening and distressing condition for the parents if they have no previous encounter with seizures. However, it is not as harmful and frightening as it appears to be, as FSs do not increase the risk of mortality, mental retardation, or cerebral palsy in these children.

Aims: The aims of this study were to find out any significant magnetic resonance imaging (MRI) changes in complex FSs (CFS), to determine the electroencephalogram (EEG) changes at least after 2 weeks of seizure in "FS plus" and "CFS," and to compare the EEG changes in "FS plus" versus "CFS."

Materials and Methods: The present study was a hospital-based cross-sectional observational study. This study was conducted from November 2021–October 2022 in Burdwan Medical College and Hospital.

Results: EEG was done in all CFS and FS PLUS cases after 2 weeks. EEG changes not found in majority of children. Total we found four EEG changes, one in FS PLUS group, and three in CFS group. This is 5.5% in FS PLUS group and 13.6% in CFS group. One FS PLUS patient shows EEG abnormality, cerebral dysrhythmia. In CFS, three patients show EEG changes. One patient shows cerebral dysrhythmia, second EEG change was generalized slowing, and third EEG change of CFS was spike and wave complex.

Conclusion: CFS has more risk of future epilepsy than simple FS plus. Further, EEG and neuroimaging are indicated for the cases which have high risk of future recurrence and epilepsy. Hence, we had done EEG and MRI in all cases of CFS to find out any significant abnormality which can predict its future outcome. However, we did not find any abnormality in MRI and no specific changes in EEG.

Key words: Electroencephalogram, Febrile seizure, Magnetic resonance imaging, Pediatric

INTRODUCTION

Febrile seizure (FS) is a relatively common childhood condition. This is one of the most frightening and distressing condition for the parents if they have no previous encounter with seizures. However, it is not as harmful and frightening as it appears to be, as FSs do not

increase the risk of mortality, mental retardation, or cerebral palsy in these children. The only medical consequence of an initial FS is a greater chance of having recurrent FSs and a slight potential risk of later epilepsy.

The prognosis for FS usually has been found to be good. Such seizures are not associated with any detectable brain damage and epilepsy may eventually develop in only a small minority of children who have had multiple FSs.^[1]

A FS is defined as "seizures that occur between the ages of 6 months and 60 months with a temperature of 38°C or higher, that are not the result of the any central nervous system infection or any metabolic imbalance, and that occur in the absence of a history of prior a FSs".^[2]

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Month of Submission : 12-2022
Month of Peer Review : 01-2023
Month of Acceptance : 01-2023
Month of Publishing : 02-2023

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1. Simple FS –it is a primary generalized, usually tonic-clonic in nature, associated with fever, lasting for <15 min, and not recur within 24 h period
 2. **FS plus – FSs that continue past the usual age where they are expected to resolve (6 years) and/or accompanied by afebrile generalized or focal seizures
 3. Complex FS (CFS) – Fever with seizures with any of the following features: focal and/or prolonged for more than 15 min and/or recur within 24 h and/or have incomplete recovery within 1 h
 4. Febrile status epileptics – it is a FS lasting more than 30 min.
2. Children presenting with isolated seizures without any fever or those having any signs of CNS infection
 3. Those children with history of birth asphyxia/developmental delay/epilepsy.

Children with CFSs can be said to have a small but identifiable risk for later epilepsy, based on genetic, developmental, and acquired factors. If these children develop persistent temporal lobe seizures, they are likely to continue to experience seizures in later life.

Aim

The aim of this study was to find out any significant magnetic resonance imaging (MRI) changes in CFS.

Primary Objective

The primary objective of this study was to determine the electroencephalogram (EEG) changes at least after 2 weeks of seizure in “FS plus” and “CFS.”

Secondary Objective

The secondary objective of this study was to compare the EEG changes in “FS plus” versus “CFS.”

MATERIALS AND METHODS

Study Design

This was a hospital-based cross-sectional observational study in Burdwan Medical College and Hospital.

Study Period

This study was November 2021–October 2022.

Inclusion Criteria

The following criteria were included in the study:

1. Children between 6 months and 7 years of age who was admitted with FSs in the inpatient ward
2. Children who are neurologically normal except for the seizure
3. Children of parents who were give the consent to allow their children to participate in the study.

Exclusion Criteria

The following criteria were excluded from the study:

1. Children aged <6 months and >7 years and admitted with fever and seizure

RESULTS AND DISCUSSION

This study was an attempt to find any specific or significant EEG changes in CFS and FS PLUS and compare it if found. As FS PLUS is a new term, we really want to find out whether this new entity is similar to FS or CFS in respect to incidence, age, and duration of seizure or EEG changes. We also tried to find out any significant MRI changes in CFS.

Sex

Here, in our study out of 148 children with FS, male was 85 and female was 63. Hence, 57.4% was male and 43.6% was female. This male preponderance is corroborative with other studies.

In all cases of FSs, 22 cases were of CFS. In 22 CFS patients, 17 were male and five were female, so 77% male and 23% female patients were in total CFS patient. In 18 of FS PLUS patients, male were 10 (55.5%) and female were 8 (44.5%). Yücel *et al.*^[3] showed 66% male in all CFS in their study.

Age

In our study, children of FS between 6 month and 7 year were taken. Mean age was 16.3378 ± 9.2262 months. Offringa *et al.*^[4] showed that most FS occurs between 6 months and 3 year of age end mean age was 18 months, which is similar to our study [Table 1].

Family History of FS

In this study, total 51 patients of FS had family history of [Table 2] FS, which was 34.5% of total FS. In 22 of CFS patients, nine patients had positive family history of FS, which is 41% of total CFS. Moreover, among the 18 patients of FS PLUS, five patients had positive family history which is 27.8% of total simple FSs (SFS) PLUS.

History of Previous FS

In our study, out of 148 patients, 32 patients previously had a FS episode. Hence, 21% patients had history of previous FS. In 22 CFS cases, three patients had history of previous FS, which is 13.6% of total CFS patient. In 18 FS PLUS cases, four had history of previous FS, which is 22.2% of total FS PLUS.

Type of FS

In our study, total 148 patients enrolled with FS. Twenty-two children comes under the definition of CFS, which

Table 1: Distribution of common parameters

Parameters	Number	Mean	SD	Minimum	Maximum	Median
Age	148	16.3378	9.2262	6.0000	55.0000	12.0000
Duration of seizure (min)	148	9.2973	7.1147	3.0000	50.0000	8.0000
Number of occurrence in first 24 h of febrile seizure	148	1.1689	0.4268	1.0000	3.0000	1.0000
Time between 2 nd episode	22	15.4545	4.7079	6.0000	22.0000	16.0000
Duration of fever at onset of seizure (days)	148	1.1081	0.3116	1.0000	2.0000	1.0000

Table 2: Association between family history of febrile seizure: Type febrile seizure

Family history of febrile seizure	Type febrile seizure			Total
	CFS	SFS	FS plus	
No	13	71	13	97
Row %	13.4	73.2	13.4	100.0
Col %	59.1	65.7	72.2	65.5
Yes	9	37	5	51
Row %	17.6	72.5	9.8	100.0
Col %	40.9	34.3	27.8	34.5
Total	22	108	18	148
Row %	14.9	73.0	12.2	100.0
Col %	100.0	100.0	100.0	100.0

CFS: Complex febrile seizure, SFS: Simple febrile seizures, FS: Febrile seizure

is 14.9%. Eighteen children were come under FS PLUS, which is 12.1%. Remaining 108 children were simple FS. Gourabi *et al.*^[5] study shown 39 out of 214 (18%) cases were of CFS, in all FS. In these 39 CFS children, 23 were shown repetitive type of convulsion in a single episode of febrile convulsion, which is now we are considering as FS PLUS. This was 23 out of 148 means 15.5%, so our study is corroborative with other studies.

Type of Convulsion

In our study, out of 148 febrile convulsions, 139 patients had GTCS, and nine patients had focal seizure. In 22 cases of CFS, nine cases had focal seizure and 13 cases had GTCS.

Number of Seizure in single episode of FS

In a single episode of FS within 24 h, 126 cases had only one occurrence of seizure. Nineteen cases had two occurrence of seizure within 24 h. Three cases had three episodes of occurrence of seizure [Table 3].

Duration of Seizure

In CFS, the mean duration of seizure (mean± SD) of [Table 1] patients was 21.2727 ± 11.8691. In FS, the mean duration of seizure (mean ± SD) of patients was 7.0556 ± 2.4942. In FS plus, the mean duration of seizure (mean ± SD) of patients was 8.1111 ± 2.3487. Distribution of mean duration of seizure versus type FS was statistically significant (*P* < 0.0001).

Table 3: Association between cause of fever: Type of febrile seizure

Cause of fever	Type febrile seizure			Total
	CFS	SFS	FS Plus	
Ear infection	0	1	0	1
Row %	0.0	100.0	0.0	100.0
Col %	0.0	0.9	0.0	0.7
Gastroenteritis	4	31	4	39
Row %	10.3	79.5	10.3	100.0
Col %	18.2	28.7	22.2	26.4
Respiratory infection	18	67	14	99
Row %	18.2	67.7	14.1	100.0
Col %	81.8	62.0	77.8	66.9
Urinary tract infection	0	9	0	9
Row %	0.0	100.0	0.0	100.0
Col %	0.0	8.3	0.0	6.1
Total	22	108	18	148
Row %	14.9	73.0	12.2	100.0
Col %	100.0	100.0	100.0	100.0

CFS: Complex febrile seizure, SFS: Simple febrile seizures, FS: Febrile seizure

Table 4: Association between EEG CHANGES: Type febrile seizure

EEG changes	Type febrile seizure			Total
	CFS	SFS	FS Plus	
No	19	0	17	36
Row %	52.8	0.0	47.2	100.0
Col %	86.4	0.0	94.4	24.3
Yes	3	0	1	4
Row %	75.0	0.0	25.0	100.0
Col %	13.6	0.0	5.6	2.7
Total	22	108	18	148
Row %	14.9	73.0	12.2	100.0
Col %	100.0	100.0	100.0	100.0

EEG: Electroencephalogram, CFS: Complex febrile seizure, SFS: Simple febrile seizures, FS: Febrile seizure

Distribution of Cause of Fever

In our study, all cases of FS were investigated to find out the cause of fever. Among the 148 cases, number of children with respiratory infection was 99 (66.9%), gastroenteritis was 39 (26.4%), urinary tract infection was 9 (6.1%), and one case had ear infection.

Febrile Status Epilepticus

In our study, out of total 148 FS, eight patients had seizure duration more than 30 min. Hence, eight patients

included under febrile status epilepticus, which is 5.4% of total FS.

EEG Changes

EEG was done in all CFS and FS PLUS cases after 2 weeks. EEG changes were not found in majority of children. We found total four EEG changes, one in FS PLUS, and three in CFS [Table 4]. This is 5.5% in FS PLUS and 13.6% in CFS. One FS PLUS patient shows EEG abnormality, cerebral dysrhythmia. In CFS, three patients show EEG changes that one patient shows cerebral dysrhythmia, second EEG change was generalized slowing, and third EEG change of CFS was spike and wave complex. With all these EEG changes, no management changes were made. These few EEG changes were not the cause of any alteration in diagnosis. Any of these children whether had epilepsy or recurrence of FS will need a long-term follow-up of all cases.

Grill and Ng^[6] showed four EEG abnormalities out of 32 cases which are 12.5%. In this study, they taken only cases of SFS PLUS.

Rasool *et al.*^[7] showed in their study that they had 15.6% EEG changes in CFS cases. They had done EEG within 48 h.

MRI Changes

In our study, we had done MRI for all CFS cases to observe any changes in MRI following CFS that can predict the future seizure, but all the MRI we had done of CFS were normal.

Teng *et al.*^[8] performed a retrospective review of 79 children meeting the criteria for CFSs from whom data had prospectively been collected, though 71 of them were ultimately analyzed. Forty-six of the 71 (65%) patients underwent neuroimaging (either CT scans in the emergency department or MRI within 1 week), and none had any significant intracranial pathology demanding of emergent intervention.

Shinnar *et al.*^[9] showed 11.5% MRI changes in total FSE cases.

This study was done for a long period of 7 years and they had taken a large number of cases. However, our study was done for a period of 1 year and samples were smaller than them.

CONCLUSION

FS is a very common condition, most of the cases are benign, but there are some cases which had slight potential risk of later epilepsy. FS plus can have family history or genetic cause.

CFS has more risk of future epilepsy than simple FS. Further, EEG and neuroimaging are indicated for the cases which have repeated recurrences and EEG changes. Hence, we had done EEG and MRI in all cases of CFS to find out any significant abnormality which can predict its future outcome. However, we did not find any abnormality in MRI and no specific changes in EEG.

A total of 148 patients of FS were included in this study aged between 6 month and 7 years. Mean age in this study was 16 months. Among this, 57.4% was male and 43.6% was female.

In our study, 34.5% patients of FS had family history of FS. Most common cause of fever was respiratory infection. The mean duration of seizure was significantly higher in CFS compared to SFS and FS Plus. About 21% patients had history of previous FS. Eight patients included under febrile status epilepticus which is 5.4% of total FS.

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How to cite this article: Pal M, Mishra SN, Nayek S, Nayek K. Electroencephalogram and MRI Changes in the Cases of Febrile Seizure Plus and Complex Febrile Seizure in a Tertiary Care Hospital of West Bengal, India. *Int J Sci Stud* 2023;10(11):61-64.

Source of Support: Nil, **Conflicts of Interest:** None declared.