



## CSF Evaluation in Children with First Episode of Febrile Seizures

### KEYWORDS

febrile seizures; bacterial meningitis; lumbar puncture

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**ABSTRACT** Objective: To assess CSF profile of children aged 6–18 months with history of first episode of febrile seizures, and evaluate the incidence of bacterial meningitis.

*Materials and methods:* Children aged 6–18 months admitted with history of first episode of febrile seizures during July 2009–August 2011 were included. Children with previous history of febrile seizures, seizure disorder, and children on antibiotics for >48 hours were excluded. After taking informed consent from parents, lumbar puncture was performed. Results were prospectively analyzed.

*Results:* 64.2% presented with simple febrile seizures, of which 3.9% had acute bacterial meningitis and 3.9% had probable acute CNS infection other than bacterial meningitis. None of the study population, who had acute bacterial meningitis or probable acute CNS infection other than bacterial meningitis, had clinical features of meningitis.

*Conclusion:* Suspicion of bacterial meningitis should be entertained in the age group of 6–18 months even in conditions of simple febrile seizures

### INTRODUCTION

Febrile seizure (FS) is one of the most prevalent causes of admittance to paediatric emergency wards worldwide (Fetveit, 2008). It may also signify a serious underlying acute infectious disease such as sepsis or bacterial meningitis. It is the most common form of childhood seizure, affecting 2–5% of all children and usually appearing between 6 months and 5 years of age. FS may be provoked by any febrile bacterial or more usually viral illness. No specific level of fever is required to diagnose FS. It is essential to exclude underlying meningitis in all children presenting with fever and seizures, either clinically or, if any doubt remains, by lumbar puncture.

American Academy of Pediatrics (AAP) practice parameters recommend that lumbar puncture (LP) need not be performed for well-appearing, fully immunized children who present with a simple febrile seizure. It should be considered when meningeal signs and symptoms, such as neck stiffness and Kernig and Brudzinski signs, are present or when the history or examination findings suggest intracranial infection. Lumbar puncture is an option for a child aged 6 to 12 months with a simple febrile seizure if the immunization status is unknown or insufficient for Hib or *S pneumoniae*. It is also an option for a child with a febrile seizure who has had previous antibiotic therapy, since such treatment can mask meningeal signs (AAP, 2013). The issue of whether a well appearing child presenting with FS is at increased risk for bacterial meningitis has remained controversial (Nozicka, 1997; Rosenberg, Simon, Felter, and Davis, 1992).

Based on guidelines for diagnosis and management of childhood epilepsy issued in 2009, Indian Academy of Pediatrics (IAP) also recommends LP for infants less than 1 year with suspected meningitis (Guidelines for Diagnosis and Management of Childhood Epilepsy, 2009). Probability of bacterial meningitis in children with fever and seizure varies from 0.6 to 14% (Shrestha, 2010; Armon, Stephenson, MacFaul, Hemingway, Werneke, and Smith, 2003).

Although there are quantitative data regarding the lumbar puncture yield among patients presenting with first simple febrile seizure, there is not much data from the large cohort of patients especially in Indian studies.

The objective of this study was to evaluate the incidence of bacterial meningitis among infants in the age group of 6 months to 18 months, who present with first episode of febrile seizures.

### MATERIAL AND METHODS

The study included children aged 6–18 months, who were brought to the hospital within 12 hours of a first episode of febrile seizures. Children with the following conditions were excluded from the study:

- Previous history of febrile seizures
- Known seizure disorder
- Syndromes associated with seizures
- Previous history of trauma (head injury)
- Children who already received antibiotics for more than 48 hours

Children whose parents refused to give consent were also excluded from the study. A detailed history of each child was taken. A complete examination of the child including vitals, Glasgow Coma Scale, bulging anterior fontanelle, neurological status, and other systemic examination was performed at the time of presentation. After taking informed consent from parents a lumbar puncture was performed and cerebrospinal fluid (CSF) was collected in a sterile container and sent for the following investigations.

1. CSF cell count with differential count using an automated haematology analyser and confirmed with examination in Neubauer's chamber wherever required.
2. CSF glucose using Hexokinase method using Dade Behring RHL dimension fully automated analyzer.
3. CSF protein analysed using Pyrogallolmethod using Dade Behring RHL dimension fully automated analyzer.
4. CSF Gram stain identified by Hucker's method.
5. Blood and CSF samples were processed both by conventional and automated methods (BACTEC).

**Definitions for the study purpose:**

**Probable acute CNS infection:** Cases presented with fever, seizure, clinical course compatible with CNS infection, and CSF showing >5 cells per mm<sup>3</sup> (Kliegman, Behrman, Jenson, and Stanton, 2011). This group was further subdivided into

Acute bacterial meningitis (Kimia, Capraro, Hummel, Johnston, and Harper, 2009):

Bacterial growth from CSF specimen obtained ,

OR

CSF pleocytosis or abnormal bio-chemistry with growth of a pathogen likely to cause acute bacterial meningitis from blood sample obtained ,

OR

A bacterial pathogen identified on a Gram-stain of CSF.

Probable acute CNS infection other than bacterial meningitis

**(Abnormal CSF):** Cases who did not fulfil acute bacterial meningitis criteria but had only CSF pleocytosis: >5 cells/mm<sup>3</sup>

**2. Febrile seizure:** Cases who presented with fever and seizures, and clinical course compatible with febrile seizure, with CSF WBC ≤5 cells/mm<sup>3</sup>.

These CSF values were taken as normal:

CSF WBC: upto 5 cells/mm<sup>3</sup>

CSF Sugar: >50 mg/dl

CSF Protein: 20–45 mg/dl

Statistical analysis: SPSS Software

**RESULTS**

Among children admitted with first episode of febrile seizure, 76.7% (n=92) were in the 6–12 month group and 23.3% (n=28) in the 13–18 month group. 55% (66) were

male and 45% (54) female children. 64.2% (n=77) presented with simple febrile seizures and 35.8% (n=43) had atypical febrile seizures.

Based on the definitions made for the study, out of 120 cases, 4.2% (n=5) had acute bacterial meningitis and 5% (n=6) were probable acute CNS infection other than bacterial meningitis (see Table 1).

**TABLE 1**  
**Etiological Classification**

Etiology	SubClassification	No. of cases	Percentage of cases
Probable acute CNS infection (n =11)	Acute bacterial meningitis	5	4.2%
	Probable acute CNS infection other than bacterial meningitis	6	5%
Febrile seizure (n =109)		109	90.8%
TOTAL		120	100%

In the 6–12 month group, 4.3% (4/92) had acute bacterial meningitis and 5.4% (5/92) had probable acute CNS infection other than bacterial meningitis (see Table 2). In the 13–18 month group, out of 28 cases 3.6 % (n=1) had acute bacterial meningitis and 3.6% (n=1) had probable acute CNS infection other than bacterial meningitis. Acute bacterial meningitis is seen slightly more in the 6–12 month group compared to other age groups; it is not statistically significant (p = 0.180). In the given age groups, none of the patients with acute bacterial meningitis or probable acute CNS infection other than bacterial meningitis had clinical features suggestive of meningitis.

**TABLE 2**  
**Probable Acute CNS Infection in different age groups**

Age (months)	Febrile Seizure (≤ 5 cells/mm <sup>3</sup> )	Probable acute CNS infection (>5 cells/mm <sup>3</sup> )		TOTAL
		Acute bacterial meningitis	Probable acute CNS infection other than bacterial meningitis	
6 – 12	83 (90.2%)	4(4.3%)	5(5.4%)	92(100%)
13 – 18	26(92.9%)	1(3.6%)	1(3.6%)	28(100%)
Total	109	5	6	120

**TABLE 3**  
**Final diagnosis in different types of febrile seizures**

Type of Seizure presentation	Febrile Seizure (≤ 5 cells/mm <sup>3</sup> )	Probable acute CNS infection (>5 cells/mm <sup>3</sup> )		TOTAL
		Acute-bacterial meningitis	Probable acute CNS infection other than bacterial meningitis	
Simple Febrile Seizure	71(92.2%)	3(3.9%)	3(3.9%)	77(100%)
Atypical Febrile Seizure	38(88.4%)	2(4.7%)	3(7.0%)	43(100%)
TOTAL	109	5	6	120

77 cases presented with simple febrile seizures. Of these

3.9% (3/77) had acute bacterial meningitis and 3.9% (3/77) had probable acute CNS infection other than bacterial meningitis. In the 43 who presented with atypical febrile seizures, 4.7% (2/43) had bacterial meningitis and 7% (3/43) had probable acute CNS infection other than bacterial meningitis (see Table 3). Incidence of acute bacterial meningitis is nearly equal in both simple febrile seizure and atypical febrile seizure and not statistically significant ( $p = 0.655$ )

## DISCUSSION

The importance of studying the frequency of bacterial meningitis in children with first febrile seizures in different age groups is because of the AAP guidelines for doing lumbar puncture to rule out meningitis which state that, "In the evaluation of infants or young children after first simple febrile seizures a lumbar puncture should be strongly considered in a child younger than 12 months and should be considered in children between 12 and 18 months" (AAP, 2013).

On analysing the incidence of children admitted with first episode of fever with seizures in two age groups, 76.7% cases were in the 6–12 month group and 23.3% were between 13 and 18 months. In Shrestha's (2010) study, among the 110 cases who were admitted with febrile seizures in the group 6 months to 5 years, 25.4% were in the 6–12 month group, 28.1% were between 12 and 18 months, and 46.4% were >18 months. In the study, male to female ratio was 1.2:1. A similar pattern was observed by Mohammadi and Ravaghi (2004).

The CSF analysis done showed CSF pleocytosis in 9.2% cases ( $n = 11$ ) among 120 cases. A similar kind of study done by Mohammadi and Ravaghi (2004) in 159 cases in the age group between 6 months to 60 months showed 3.1% ( $n = 5$ ) CSF pleocytosis. Another study by Kimia et al. (2009) showed 3.8% CSF pleocytosis but these were children who had first episode of only simple febrile seizures.

For this study, children with CSF pleocytosis were divided into two groups. Those with features fulfilling the criteria for bacterial meningitis were classified as Acute bacterial meningitis and others with CSF pleocytosis ( $>5$  cells/mm<sup>3</sup>) were classified as Probable acute CNS infection other than bacterial meningitis.

Among 120 cases, in our study acute bacterial meningitis was confirmed in 4.2% ( $n = 5$ ) and probable acute CNS infection other than bacterial meningitis was found in 5% ( $n = 6$ ). The incidence of bacterial meningitis is nearly equal to the incidence of probable acute CNS infection other than bacterial meningitis (i.e., viral or partially treated meningitis). The other 90.8% (109) cases were given the final diagnosis of febrile seizure.

In the 5 cases that were found to have acute bacterial meningitis, 2 had positive CSF culture and Gram stain, 1 had both positive CSF and blood culture with Gram stain, 1

had positive blood culture, and 1 had positive CSF Gram stain. In the study by Shrestha (2010), 14.54% cases had bacterial meningitis. In various studies the probability of bacterial meningitis in children presenting with fever and seizures varied between 0.6 to 14% (Armon, 2003).

In confirmed bacterial meningitis cases ( $n = 5$ ), two cases showed growth in CSF culture [*Streptococcus pneumoniae* ( $n = 1$ ) and *Streptococcus agalactiae* ( $n = 1$ ) each]. One showed growth only in blood culture with *Staphylococcus haemolyticus* ( $n = 1$ ) with no organism in CSF culture. One showed growth in both CSF and blood culture of *Salmonella* species ( $n = 1$ ) and one was only Gram stain positive [Gram positive cocci]. Similar kind of study by Geiseler and Nelson (1982) showed *S.pneumoniae*, *Salmonella* and *H.influenzae* in 16 children who presented with fever and seizures.

In the 6–12 month age group, out of 92 cases 4.3% ( $n = 4$ ) had acute bacterial meningitis and 5.4% ( $n = 5$ ) had probable acute CNS infection other than bacterial meningitis. In the 13–18 month group, out of 28 cases 3.6% ( $n=1$ ) had acute bacterial meningitis and 3.6% ( $n=1$ ) had probable acute CNS infection other than bacterial meningitis. Similar pattern was observed by Shrestha (2010) in which bacterial meningitis was diagnosed in 21.4% of cases aged 6–12 months ( $p=0.022$ ), 19.3% were aged 12–18 months and 7.54% were aged 18–60 months.

In our study, the incidence of bacterial meningitis is slightly more in the age group 6–12 months compared to the group 13–18 months which is similar to the study mentioned above.

On analysing the incidence of bacterial meningitis with the type of seizures, out of 77 who presented with simple febrile seizures 3.9% ( $n=3$ ) had acute bacterial meningitis and out of 43 who presented with atypical febrile seizures 4.7% ( $n = 2$ ) had acute bacterial meningitis. The incidence of bacterial meningitis is slightly more in children who presented with atypical febrile seizures compared to the children who presented with simple febrile seizures but not statistically significant ( $p = 0.655$ ). In the examined age groups, none of the patients had clinical features suggestive of meningitis; though later CSF examination showed a diagnosis of acute bacterial meningitis or probable acute CNS infection other than bacterial meningitis.

## Limitations of the study:

As the sample size was small in the study, it is possible that some of risk factors studied for acute bacterial meningitis may not have reached statistical significance.

## CONCLUSION

Suspicion of bacterial meningitis should be entertained in the age group of 6 to 18 months even if the child presents with simple febrile seizures.

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