

A Hospital-Based Assessment of the Prevalence of Bacterial Meningitis in Children with Apparent Febrile Seizure

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Abstract

Aim: The aim of the present study was to determine the frequency of meningitis in children with FS(febrile Seizure)and related risk factors.

Methods: This cross-sectional study was performed on 550 patients aged 6 months to 6 years who had first attack of seizure with fever in the Pediatric Ward of Jawaharlal Nehru medical College and Hospital, Bhagalpur, Bihar, India from December 2021 to September 2022. Patients were divided into 2 groups. Those with simple febrile seizure with one tonic colonic seizure attack for less than 15 minutes. Those cases who had multiple attacks or seizures lasting more than 15 minutes, or had focal seizures were categorized as complex FS.

Results: Of those 300 patients were male (54.54%) and 250 were female (45.45%). In children who had not undergone an LP, meningitis could be excluded according to clinical status. The majority of patients with meningitis and all patients with bacterial meningitis were in the age group less than 18 months old. The majority of patients with meningitis had presented with their first attack of FS (45 cases, 90%) when compared with patients with a normal LP (44%) and this was statistically significant ($p < 0.001$). 17 patients with meningitis (34%) and 180 patients with a normal LP (36%) were been pretreated with antibiotics before admission and this was not statistically significant. According to logistic regression analysis, independent variables for predicting meningitis were neurological deficits, postictal drowsiness, body temperature, level of Hb, and WBC. Postictal drowsiness ($p = 0.001$), neurologic deficit ($p = 0.000$), and body temperature $\geq 38.5^\circ\text{C}$ ($p = 0.032$) were among the clinical signs, which were statistically significant predicting factors for meningitis. Laboratory tests including white blood count (WBC) $\geq 15000 \text{ mm}^3$ ($p = 0.002$), and hemoglobin (Hb) $< 10.5 \text{ gr/dl}$ ($p = 0.010$) also had statistical significance in predicting meningitis.

Conclusion: In conclusion, our findings suggested that the frequency of bacterial meningitis in children who presented with febrile seizure (FS) is not high. Meningitis is more common in patients less than 18 months old with febrile seizure (FS); however, complex features of seizures, first attack of FS or impaired consciousness seem to be significant risk factors for meningitis and an LP should be in mind in this situation.

Keywords: Bacterial meningitis; Febrile seizure; children

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Introduction

Seizures occur in the context of many childhood illnesses, and account for approximately 1–5% of all emergency departments (ED) visits. [1,2] It is broadly defined as a seizure accompanied by fever without evidence of central nervous system (CNS) infections, occurring in children 6 months to 5 years of age. [3] The association between seizure and bacterial meningitis (BM) is well established. [4-6]

It is therefore imperative to rule out BM prior to making the diagnosis of FS. However, the diagnosis of FS in certain subgroups of children with an apparent FS is a challenge: FS may be the sole manifestation of BM in infants [3]; complex features of seizure can increase the risk of BM in others. [7,8] Accordingly, when these children present with an apparent FS, clinicians may remain uncertain about

the risk of BM. In acute situation, the most challenging issue is to make a decision whether a lumbar puncture (LP) is necessary to rule out BM. Knowledge of the prevalence of BM among various subgroups of children with FS can assist clinicians to make appropriate clinical decisions in such challenging situations.

Seizure can be seen in meningitis in one out of 6 patients of whom one-third have no signs of meningeal involvement. [9] Some predicting factors of meningitis in young children who present with seizure and fever may be seizure duration above 30 minutes, neurologic deficit, and postictal drowsiness. [10] Prevalence of meningitis ranges between 2.4-17% in those children who have seizure and fever. [10-12] Seizures are the first manifestation of meningitis in 16.7% of children and in one-third of these patients, whereas meningeal signs and symptoms may not be evident. [9] Therefore, it is mandatory to exclude underlying meningitis in children presenting with fever and seizure prior to making the diagnosis of febrile seizure the initial concern in these children is always to make a proper decision regarding to do an LP to exclude meningitis. Awareness of the prevalence of meningitis and its related factors in children presenting with FS to help pediatrician to make proper decisions in these situations is necessary. [13] Some of these studies suggest that in the absence of typical meningeal signs, then an LP should be considered in children with complex seizures, prior antibiotic therapy, age less than 12 months, or incomplete vaccination history. [14]

The aim of the present study was to determine the frequency of meningitis in children with FS and related risk factors.

Materials and Methods

This cross-sectional study was performed on 550 patients aged 6 months to 6 years who had first attack of seizure with fever in the Pediatric Ward of Jawaharlal Nehru medical College and Hospital, Bhagalpur, Bihar, India from December 2021 to September 2022. Patients were divided into 2 groups. Those with simple FS with one tonic clonic seizure attack for less than 15 minutes. Those cases who had multiple attacks or seizures lasting more than 15 minutes, or had focal seizures were categorized as complex FS.

The patient records were evaluated for LP for meningitis, which was defined as abnormal changes in cell count, protein, and sugar as well as positive culture result. Age, gender, seizure type and duration, postictal drowsiness, neurologic deficit, body temperature, previous family history of FS, white blood cell count (WBC), and hemoglobin (Hb) were also recorded.

The inclusion criteria included patients aged 6-18 months old with first attack of convulsion and fever. Exclusion criteria included any history of FS or epilepsy, any neurological disorder including hydrocephaly, cerebral palsy, any metabolic disorder including hypoglycemia, hypocalcemia, hypomagnesemia, traumatized LP, and incomplete records. A statistician calculated the sample size, and data were analyzed using the Statistical Package for Social Sciences version 11 (SPSS Inc., Chicago, IL, USA). Statistical tests including chi square and t test were used. Logistic regression analysis was used to evaluate predicting factors for meningitis. Statistical significance was set at a p-value <0.05.

Results

Table 1: Clinical aspects of first seizure patients with and without meningitis

Variables	Meningitis (n=50) No. (%)	Non-meningitis(n=500) No. (%)	Odds Ratio	95% CI	P-value*
Gender					
Female	20 (40%)	230 (46%)	0.820	0.334-2.154	0.854
Male	30(60%)	270 (54%)			
Age					
<18 m.	38 (76%)	240 (48%)	4.310	1.371-12.886	00.9
> 18 m.	12 (24%)	260 (52%)			
Seizure type					
Simple	8 (16%)	350 (70%)	0.064	0.019-0.234	<0.001
Complex	42 (84%)	150 (30%)			
Seizure recurrence					
First attack	45 (90%)	220 (44%)	10.435	2.354-45.262	<0.001
Recurrent attack	5 (10%)	280 (56%)			
Altered consciousness					
No	10 (20%)	470 (94%)	55.225	16.84-175.61	<0.001
Yes	40 (80%)	30 (6%)			
Pre-treatment with antibiotic					
No	33 (66%)	320 (64%)	0.890	0.337-2.436	1.00
Yes	17 (34%)	180 (36%)			

Of those 300 patients were male (54.54%) and 250 were female (45.45%). In children who had not undergone an LP, meningitis could be excluded according to clinical status. The majority of patients with meningitis and all patients with bacterial meningitis were in the age group less than 18 months old. The majority of patients with meningitis had

presented with their first attack of FS (45 cases, 90%) when compared with patients with a normal LP (44%) and this was statistically significant ($p < 0.001$). 17 patients with meningitis (34%) and 180 patients with a normal LP (36%) were been pretreated with antibiotics before admission and this was not statistically significant.

Table 2: Independent variables for predicting meningitis among first seizure patients with and without meningitis

Variables	EXP(B)	95% CI lower-upper	P-value
Neurologic deficit			
Yes	28.745	2.645-322.420	0.004
No	1		
Postictal drowsiness			
Yes	3.210	1.550-6.415	0.001
No	1		
Body temperature			
$\geq 38.5^{\circ}\text{C}$	1.820	1.036-2.712	0.032
$< 38.5^{\circ}\text{C}$	1		
White blood cell count			
$\geq 15000 \text{ mm}^3$	2.462	1.340-4.070	0.002
$< 15000 \text{ mm}^3$	1		
Hemoglobin			
$< 10.5 \text{ gr/dl}$	1.891	1.150-3.240	0.010
$\geq 10.5 \text{ gr/dl}$	1		

According to logistic regression analysis, independent variables for predicting meningitis were neurological deficits, postictal drowsiness, body temperature, level of Hb, and WBC. Postictal drowsiness ($p=0.001$), neurologic deficit ($p=0.000$), and body temperature $\geq 38.5^{\circ}\text{C}$ ($p=0.032$) were among the clinical signs, which were statistically significant predicting factors for meningitis. Laboratory tests including white blood count (WBC) $\geq 15000 \text{ mm}^3$ ($p=0.002$), and hemoglobin (Hb) $< 10.5 \text{ gr/dl}$ ($p=0.010$) also had statistical significance in predicting meningitis.

Discussion

Febrile seizures (FS) are the most common type of childhood seizures, affecting 2–5% of children older than 1 month and most commonly from 6 months–5 years old. [15,16] It is possibly a major cause of pediatric admissions worldwide. [17] febrile seizure are defined as seizures accompanied by fever without evidence of intracranial infection, metabolic disturbance, or a history of previous afebrile seizures. [18] Febrile seizures are classified as simple or complex. Simple febrile seizures lasted for less than 15 minutes and did not recur within 24 hours. Complex febrile seizures are focal, prolonged (> 15 minutes), and/or recurrent within 24 hours. [19] The majority of febrile seizure are benign, and self-limiting occur due to electrical abnormality in the brain triggered by the rapid rise of temperature. [20] However, a substantial number of them are suggestive of underlying pathology. [21,22] FS may

be triggered by fevers from viral infections, focal bacterial infections and meningitis. [23]

Of those 300 patients were male (54.54%) and 250 were female (45.45%). In children who had not undergone an LP, meningitis could be bacterial meningitis excluded according to clinical status. The majority of patients with meningitis and all patients with were in the age group less than 18 months old. The majority of patients with meningitis had presented with their first attack of FS (45 cases, 90%) when compared with patients with a normal LP (44%) and this was statistically significant ($p < 0.001$). 17 patients with meningitis (34%) and 180 patients with a normal LP (36%) were been pretreated with antibiotics before admission and this was not statistically significant. Ehsanipour et al that reported 3.6% of meningitis and 1.6% of BM in children aged 6 mo.–5 yr. with FS. [24] In addition, Al-Eissa in his study in Saudi Arabia found a 3.5% frequency of meningitis and 1.5% of BM among patients aged 3mo-5 yr. with FS. [25] Ghotbi and Shiva found that prior antibiotic use is a risk factor for meningitis among children with FS. [26] Casasoprona et al concluded that in cases of prior antibiotic therapy in children with FS, an LP should be considered. [27]

According to logistic regression analysis, independent variables for predicting meningitis were neurological deficits, postictal drowsiness, body temperature, level of Hb, and WBC. Postictal drowsiness ($p=0.001$), neurologic deficit ($p=0.000$),

and body temperature $\geq 38.5^{\circ}\text{C}$ ($p=0.032$) were among the clinical signs, which were statistically significant predicting factors for meningitis. Laboratory tests including white blood count (WBC) ≥ 15000 mm³ ($p=0.002$), and hemoglobin (Hb) < 10.5 gr/dl ($p=0.010$) also had statistical significance in predicting meningitis. Chin et al [28] performed a study in London on patients aged 29 days to 15-years-old. They found that 17% of cases of status epilepticus associated with fever had acute bacterial meningitis. They also detected that 1.2% of patients with acute bacterial meningitis had short seizure. Accordingly prolonged seizure can be an important sign of meningitis in patients with seizure and fever.

In a study by Kimia et al [29] on 704 cases aged 6 months to 18 months with first simple febrile seizure, LP was performed in 271 (38%) cases. Their study revealed that 10 cases (3.8%) had aseptic meningitis, with CSF abnormal cell count and no bacterial infection.

Meningitis is a relatively common infection in infants and young children, and is clinically diagnosed as the first complex febrile seizure (FCFS). Although no cases of bacterial meningitis (BM) were found in infants and young children with their first simple febrile seizure (FSFS), presumed viral meningitis (PVM) is not uncommon.

Conclusion

In conclusion, our findings suggested that the frequency of bacterial meningitis in children who presented with FS is not high. Meningitis is more common in patients less than 18 months old with FS; however, complex features of seizures, first attack of FS or impaired consciousness seem to be significant risk factors for meningitis and an LP should be in mind in this situation. Lack of meningeal irritation signs does not exclude meningitis especially in younger children.

References

- Pallin DJ, Goldstein JN, Moussally JS, Pelletier AJ, Green AR, Camargo CA. Seizure visits in US emergency departments: epidemiology and potential disparities in care. *International journal of emergency medicine*. 2008 Jun;1(2):97-105.
- Armon K, Stephenson T, Gabriel V, MacFaul R, Eccleston P, Werneke U, Smith S. Determining the common medical presenting problems to an accident and emergency department. *Archives of disease in childhood*. 2001 May 1;84(5):390-2.
- American Academy of Pediatrics. Provisional Committee on Quality Improvement, Subcommittee on Febrile Seizures (1996) Practice parameter: the neurodiagnostic evaluation of the child with a first simple febrile seizure. *Pediatrics* 97: 769–772; discussion 773–765.
- Dubos F, De la Rocque F, Levy C, Bingen E, Aujard Y, Cohen R, Bréart G, Gendrel D, Chalumeau M, Bacterial Meningitis Study Group. Sensitivity of the bacterial meningitis score in 889 children with bacterial meningitis. *The Journal of pediatrics*. 2008 Mar 1;152(3):378-82.
- Ratcliffe JC, Wolf SM. Febrile convulsions caused by meningitis in young children. *Annals of Neurology: Official Journal of the American Neurological Association and the Child Neurology Society*. 1977 Mar;1(3):285-6.
- Samson JH, Apthorp J, Finley A. Febrile seizures and purulent meningitis. *JAMA*. 1969 Dec 8;210(10):1918-9.
- Joffe A, McCormick M, DeAngelis C. Which children with febrile seizures need lumbar puncture?: A decision analysis approach. *American journal of diseases of children*. 1983 Dec 1;137(12):1153-6.
- Offringa M, Beishuizen A, Derksen-Lubsen G, Lubsen J. Seizures and fever: can we rule out meningitis on clinical grounds alone?. *Clinical pediatrics*. 1992 Sep;31(9):514-22.
- Rosman NP. Evaluation of the child who convulses with fever. *Pediatric Drugs*. 2003 Jul;5:457-61.
- Batra P, Gupta S, Gomber S, Saha A. Predictors of meningitis in children presenting with first febrile seizures. *Pediatric neurology*. 2011 Jan 1;44(1):35-9.
- Ghotbi F, Shiva F. An assessment of the necessity of lumbar puncture in children with seizure and fever. *JPMA. The Journal of the Pakistan Medical Association*. 2009 May 1;59(5):292-5.
- Rayamajhi A, Mahaseth C. Children with first episode of fever with seizure: is lumbar puncture necessary?. *JNMA; Journal of the Nepal Medical Association*. 2008 Jul 1;47(171):109-12.
- Najaf-Zadeh A, Dubos F, Hue V, Pruvost I, Bennour A, Martinot A. Risk of bacterial meningitis in young children with a first seizure in the context of fever: a systematic review and meta-analysis. *PLoS One*. 2013 Jan 28;8(1):e55270.
- Casasoprana A, Hachon Le Camus C, Claudet I, Grouteau E, Chaix Y, Cances C, Karsenty C, Cheuret E. Value of lumbar puncture after a first febrile seizure in children aged less than 18 months. A retrospective study of 157 cases. *Archives de Pédiatrie: Organe Officiel de la Société Française de Pédiatrie*. 2013 Apr 30;20(6):594-600.
- Kimia A, Ben-Joseph EP, Rudleo T, et al. Yield of lumbar puncture among children who present

- with their first complex febrile seizure. *Pediatrics*.2010; 126: 62-69.
16. Hom J, Medwid K, The low rate of bacterial meningitis in children, ages 6 to 18 months, with simple febrile seizures. *AcadEmerg Med* 2011; 18(11):1114-1120.
 17. Fetveit A. Assessment of febrile seizures in children. *Eur J Pediatr* 1998; 167(1); 17-27.
 18. Subcommittee on Febrile Seizures. Febrile seizures: Guidelines for the neurodiagnostic evaluation of the child with a simple febrile seizure. *Pediatrics* 2011; 127(2):389-394.
 19. Duffner PK, Berman PH, Baumann RJ, Fisher PG, Green JL, Schneider S, et al. Clinical practice guideline- Neurodiagnostic evaluation of the child with a simple febrile seizure. *Pediatrics*. 2011;127(2):389-94.
 20. Mollah MAH, Rakshit SC, Anwar KS, Arslan MI, Saha N, Ahmed S, et al. Zinc concentration in serum and cerebrospinal fluid simultaneously decrease in children with febrile seizure: Findings from a prospective study in Bangladesh. *Acta Paediatr Int J Paediatr*. 2008;97(12):1707-11.
 21. Freeman JM. Febrile seizures: an end to confusion. *Pediatrics*. 1978;61(5):806-8.
 22. Joffe A, McCormick M, Deangelis C. Which Children With Febrile Seizures Need Lumbar Puncture?: A Decision Analysis Approach. *Am J Dis Child*. 1983;137(12):1153-6.
 23. Hoberman A, Wald ER. Urinary tract infections in young febrile children. Vol. 16, *Pediatric Infectious Disease Journal*. 1997. p. 11-7.
 24. Ehsanipour F, Khodapanahandeh F, Aslani Z. The prevalence of meningitis in children with febrile seizure hospitalized at Hazrat Rasoul hospital (1997-2002). *Journal of Iran University of Medical Sciences* 2004; 44; 907-912.
 25. Al-Eissa YA. Lumbar puncture in the clinical evaluation of children with seizures associated with fever. *PediatrEmerg Care* 1995; 11(6):347-350.
 26. Ghotbi F, Shiva F. An assessment of the necessity of lumbar puncture in children with seizure and fever. *J Pak Med Assoc* 2009; 59 (5):292-295.
 27. Casasoprana A, Hachon Le Camus C, Claudet I, et al. Value of lumbar puncture after a first febrile seizure in children aged less than 18 months. A retrospective study of 157 cases. *Arch Pediatr*, 2013. Pil: S0929-693X (13)00238-8.
 28. Chin RF, Neville BG, Scott RC. Meningitis is a common cause of convulsive status epilepticus with fever. *Archives of disease in childhood*. 2005 Jan 1;90(1):66-9.
 29. Kimia AA, Capraro AJ, Hummel D, Johnston P, Harper MB. Utility of lumbar puncture for first simple febrile seizure among children 6 to 18 months of age. *Pediatrics*. 2009 Jan 1;123 (1):6-12.