

Prevalence of Bacterial Meningitis in Children with Apparent Febrile Convulsion

Alireza Sargazi¹, Sepideh Bagheri², Hamidreza Hajirezaei³, Omid Rashidi⁴, * Anahita Ataran⁵

¹ Student Research Committee, Mashhad University of Medical Sciences, Mashhad, Iran.

² Faculty of medicine, Mashhad University of Medical Science, Mashhad, Iran.

³ Student Research Committee, Mashhad University of Medical Sciences Mashhad, Iran.

⁴ Kidney Transplantation Complications Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.

⁵ Kidney Transplantation Complications Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.

Abstract

Background: As a pediatric emergency, febrile convulsion is the most common form of seizure in children in the age range of four months to five years. Therefore, this study aimed to investigate the prevalence of bacterial meningitis among children with simple febrile convulsion.

Methods: In this retrospective study, all children aged 6 to 18 months presenting with the first episodes of simple febrile convulsions admitted to Dr. Sheikh and Imam Reza Pediatric Hospitals in Mashhad between 2011 and 2015 were tested for cerebrospinal fluid. Analysis of Age, Gender, cerebrospinal fluid, and cerebrospinal fluid culture was recorded.

Results: From among 1,164 patients, 305 children were enrolled in this study. Out of them, 16 patients (5.2%) reported positive Lumbar Puncture outcomes, one (6.3%) of whom was less than one year old, and 15 (93.7 percent) were more than one year old. Six of these patients had received the MMR vaccine one to three weeks before admission. One of the patients who tested positive for Lumbar Puncture and had a negative cerebrospinal fluid culture was admitted to the hospital with personal consent. Aseptic meningitis was diagnosed with non-positive culture in the other nine patients. No bacterial meningitis was confirmed between the evaluated patients.

Conclusion: It is confirmed that the incidence of bacterial meningitis in simple febrile convulsion is very low. Therefore, the results may recommend avoiding routine Lumbar Punctures in patients with simple febrile convulsion.

Key Words: Bacterial meningitis, Febrile convulsion, Lumbar puncture, Pediatrics.

* Please cite this article as: Sargazi A, Bagheri S, Hajirezaei H, Rashidi O, Ataran A. Prevalence of Bacterial Meningitis in Children with Apparent Febrile Convulsion. Int J Pediatr 2022; 10 (11):17014-17019. DOI: [10.22038/ijp.2022.67239.5024](https://doi.org/10.22038/ijp.2022.67239.5024)

*Corresponding Author:

Anahita Ataran, Kidney Transplantation Complications Research Center, Mashhad University of Medical Sciences, Mashhad, Iran. Email: anahita.attaran93@gmail.com

Received date: Aug.11,2022; Accepted date:Oct.20,2022

1- INTRODUCTION

Febrile Convulsion (FC) occurs typically in children aged six months to five years with fever greater than 38°C, without cerebral cause (e.g. trauma, infection), and another definable cause of seizure (e.g. hypoglycemia, drugs) (1, 2). Seizures also occur in 25-30% of children with bacterial meningitis (3). Bacterial meningitis is considered a pediatric emergency, because prompt diagnosis and antibiotics can reduce the infection's incidence of complications and mortality. Febrile Convulsions, however, are benign (4).

Given that meningitis at 18 months commonly occurs with focal neurologic symptoms, it is difficult to rule out brain infection, especially in this age range (5). In previous studies, patients reported no other findings of meningitis than febrile seizures. In those studies, meningitis was diagnosed after lumbar puncture (LP). Therefore, these researchers recommend that LP be performed in all children with fever and nausea (6). However, performing LP on every child with febrile seizures might not seem logical, as this procedure is aggressive and influenced by different variables.

First of all, there is always a possibility of contaminating the Cerebrospinal Fluid (CSF) by traumatic LP in any child with fever and seizure (7). Also, if the LP powder or skin disinfectant enters the CSF through the LP needle, the risk of meningitis increases.

On the other hand, one of the major concerns regarding performing LP is the failure to detect an increase in the intracranial pressure, followed by the risk of hernia after LP (8). There is no consensus in different studies on the indication for LP in children with fever (9).

The aim of this study was, then, to investigate the prevalence of bacterial

meningitis in children with simple febrile seizures.

2- MATERIAL AND METHODS

This cross-sectional study was conducted on infants aged 6 to 18 months who were admitted to Dr. Sheikh and Imam Reza Pediatric Hospitals in Mashhad with the first simple febrile seizure attack and also in all children diagnosed with CSF meningitis between 2011 and 2015. No intervention was performed in this study for patients and anonymous patient information was used. This study was approved by the Ethics Committee of Mashhad University of Medical Sciences (MUMS).

In this study, pleocytosis (White Blood Cell count $>5/\mu\text{l}$) in the CSF was called a positive LP, yet not considered as approved bacterial meningitis. Bacterial meningitis was assessed with the following criteria:

- a) Positive CSF Gram stain,
- b) CSF absolute neutrophil count $\geq 1000/\text{ml}$,
- c) CSF protein level $\geq 80 \text{ mg/dl}$, and
- d) Peripheral blood absolute neutrophil count $\geq 10,000/\text{ml}$.

In addition, pleocytosis in the lymphocyte-preferred spinal fluid was considered aseptic meningitis. These patients had negative cerebrospinal fluid and blood culture if the child had not received any antibiotics during the previous week.

Variables of age, gender, CSF analysis (number of polymorph nuclear cells, lymphocytes, sugar, and protein levels), and the result of CSF culture were examined. The diagnosis of meningitis was based on CSF cytology and positive culture.

2-1. Inclusion and Exclusion Criteria

The inclusion criteria encompassed Simple FC cases including children aged 6–60

months with seizures at temperatures above 38°C, no central nervous system (CNS) infection, acute electrolyte disturbance, or history of seizures. In simple FC patients, the neurological examination is also normal.

Exclusion criteria were as follows:

- a) Patients with complex seizures and epilepsy
- b) Non-LP patients
- c) Patients with underlying brain disorders (hydrocephalus and CP)

2-2. Data Analysis

Version 25 of the SPSS software was used for data analysis. Descriptive analysis was performed by mean \pm SD, and analytical analysis was done employing a mean comparison in the two groups of T or chi-square tests. Significance was considered to be less than 0.05.

3- RESULTS

From among 1,164 patients, 305 children were selected for the purpose of the study. Out of these cases, Sixteen patients (5.2%) were cell positive (more than five WBCs in the CSF sample). None of these patients had positive CSF culture or positive blood culture. None of bacterial meningitis' criteria was observed among these LP-positive patients. Six patients (1.9%) received the MMR vaccine one to three weeks before admission. One patient

left the hospital voluntarily, and nine (2.9%) had aseptic meningitis.

The mean age of the patients participating in the study was 358.15 ± 95.56 days (11.76 months), with the youngest child being at 171 days of age and the oldest at 566 days. The mean age in the positive LP group was 400.69 ± 56.65 days, and in the negative LP group was 355.88 ± 96.77 . According to t-test results, the age difference was not significant between the two two groups ($P = 0.067$).

A total of 156 patients were under one year of age, and 149 patients were over one year of age.

In the LP positive group, one patient (0.6 %) was less than one year of age, and 15 (10 %) aged more than one year. In the negative LP group, 155 patients (99.4%) were less than one year of age, and 134 patients (90%) aged more than one year. chi-square test results showed that the difference between the two groups was significant in terms of age distribution ($P < 0.001$).

The participants included 169 boys and 136 girls. Nine patients (5.3 percent) were LP-positive males, and seven were LP-positive females (5.1 %). In the negative LP group, 160 patients (94.7%) were male, and 129 (94.9%) were female. Using the chi-square test, we found no significant difference in sex distribution between the two groups ($p = 0.945$).

Table-1: comparing LP positive and negative patients in age and gender

Variable	LP		p-value
	Cell Positive	Cell Negative	
Age	400.69 ± 56.65	355.88 ± 96.77	0.067
1 y/o <	15 (10 %)	134 (90 %)	0.001
1 y/o >	1 (0.6 %)	155 (99.4 %)	
gender	Male	9 (5.3 %)	0.94
	female	7 (5.1 %)	

(More than five WBC in the CSF was considered as a positive LP)

Obtained laboratory results were evaluated for bacterial meningitis. Measurement of CSF absolute neutrophil count and protein level showed no CSF involvement by definition. In addition, there were neither records of positive CSF gram stain nor neutrophilia in the peripheral blood sample of the admitted and evaluated patients during that period of time. As a result, we did not observe any positive bacterial meningitis among the evaluated patients.

4- DISCUSSION

Seizure is one of the most common presentations of bacterial meningitis in infants and young adults (10). The preferred approach to the first seizure episode at this range of age has been an area of debate between clinicians. In this study, we particularly evaluated the risk of bacterial meningitis in children from 6 to 18 months of age who were admitted to the hospital with the first episode of fever and seizure. However, it seems unlikely that the only manifestation of bacterial meningitis is simple, short, and non-focal seizures (5).

In our study, despite the observed positive LPs in sixteen patients, there was no case of bacterial meningitis aligned with the definition. These findings confirm that the incidence of bacterial meningitis in simple fever and seizures is very low when there is no significant evidence of CSF involvement.

Findings of relevant studies, likewise, confirm this claim. For instance, Golestan et al. (11) stated that 3% of patients had aseptic meningitis, and no cases of bacterial meningitis were observed. Another study by Akpede et al. reported 4.2% incidence of bacterial meningitis among 522 children with fever aged from one month to 6-years (12).

Offinage et al. conducted a study on 309 children with febrile convulsion. They showed that meningitis could be diagnosed based on clinical signs of meningitis such

as petechiae, coma, ongoing convulsions, nuchal rigidity, persistent drowsiness, and paresis or paralysis in children with fever and seizures. They suggested that routine LP is not needed unless there is a significant sign of meningitis (13).

In a review of 493 patients, Carrol et al. (14) found no case of bacterial meningitis. This study illustrated that infants under one year of age who are not toxic and have no signs of meningitis or signs of an increased intracranial pressure might be monitored by a specialist on a daily basis without performing LP.

Casa soprana et al. (15) studied 157 children under 18 months of age with fever and seizures. LP was performed in 63 patients (40%). 8 cases of meningitis were diagnosed, 3 of which were aseptic, three were bacterial (*Streptococcus pneumoniae*), and two were non-herpes encephalitis. In their study, the incidence of bacterial meningitis was 1.9 percent. So they concluded that systematic LP is not necessary in children with simple febrile convulsion, if there are no suggestive signs of meningitis.

In another study by Hom et al., no case of meningitis associated with simple febrile seizure was observed. (16) Also, in the study by Barta et al., (17) the results showed that meningitis was not associated with simple febrile seizures.

In general, it appears that, for several reasons, it is necessary to reconsider the routine LP in children with simple febrile convulsion, and new criteria should be used to identify the risk of meningitis in patients before performing LP.

The number of LPs in children with fever and seizures has decreased significantly over the decades. Studies showed that almost all cases of febrile convulsion (96%) went under LP in 1970, (18) two-thirds (67%) in 1980, and 16 % in 1990 (19). The majority of the remaining patients were under 12 months of age.

Efforts to reduce LP cases in these patients should therefore be made, unless in younger children. In addition, many studies have shown an association between bacterial meningitis and certain risk factors, such as underlying disease or hazard signs and the type of seizure. Hospital admission and observation could be reasonable alternatives for a routine LP in such patients. We believe that these results could imply a noticeable impact on future guidelines. Moreover, clinicians should consider risk factors as red flags for the possibility of the present bacterial meningitis in this context.

5- CONCLUSION

In this study, we found that none of the patients with simple fever and seizures had bacterial meningitis despite their cell positive LPs. Therefore, if these findings are confirmed in studies with larger sample sizes, it may be recommended that routine LP in patients with simple fever and seizures be avoided and limited to cases with clinical evidence of CSF infection or underlying diseases. In other cases with no red flags, patients can be monitored in the hospital so that advanced measurement and treatment would be considered if the child's status changed.

6- CONFLICT OF INTEREST

None.

7- REFERENCE

1. Leung AK, Hon KL, Leung TN. Febrile seizures: an overview. *Drugs Context*. 2018; 7:212536. Published 2018 Jul 16.
2. Stafstrom CE. The incidence and prevalence of febrile seizures. *Febrile seizures*: Elsevier; 2002. p. 1-25.
3. Pomeroy SL, Holmes SJ, Dodge PR, Feigin RD. Seizures and other neurologic sequelae of bacterial meningitis in children. *New England Journal of medicine*. 1990; 323(24):1651-7.
4. Rosman NP, Peterson DB, Kaye EM, Colton T. Seizures in bacterial meningitis: prevalence, patterns, pathogenesis, and prognosis. *Pediatric neurology*. 1985; 1(5):278-85.
5. Green SM, Rothrock SG, Clem KJ, Zurcher RF, Mellick L. Can seizures be the sole manifestation of meningitis in febrile children? *Pediatrics*. 1993; 92(4):527-34.
6. Fetveit A. Assessment of febrile seizures in children. *European journal of pediatrics*. 2008; 167(1):17-27.
7. Klinger G, Chin C-N, Beyene J, Perlman M. Predicting the outcome of neonatal bacterial meningitis. *Pediatrics*. 2000; 106(3):477-82.
8. Straussberg R, Harel L, Nussinovitch M, Amir J. Absolute neutrophil count in aseptic and bacterial meningitis related to time of lumbar puncture. *Pediatric neurology*. 2003; 28(5):365-9.
9. Osman NM, Gai JPG. Assessment of the necessity of routine lumbar puncture among children with fever and convulsions. *Sudan Journal of Medical Sciences*. 2019; 14(3):162-71.
10. Hsu M-H, Hsu J-F, Kuo H-C, Lai M-Y, Chiang M-C, Lin Y-J, Huang HR, Chu SM, Tsai MH. Neurological complications in young infants with acute bacterial meningitis. *Frontiers in neurology*. 2018; 9:903.
11. Golestan M, Fallah R, Akhavan-Karbasi S. Evaluation of CSF in 100 children admitted with febrile seizures. *SSU_Journals*. 2009; 16(5):3-7.
12. Akpede GO, Sykes RM, Abiodun PO. Indications for lumbar puncture in children presenting with convulsions and fever of acute onset: experience in the Children's Emergency Room of the University of Benin Teaching Hospital, Nigeria. *Annals of tropical paediatrics*. 1992; 12(4):385-9.

13. Offringa M, Beishuizen A, Derksen-Lubsen G, Lubsen J. Seizures and fever: can we rule out meningitis on clinical grounds alone? *Clinical pediatrics*. 1992; 31(9):514-22.
14. Carroll W, Brookfield D. Lumbar puncture following febrile convulsion. *Archives of disease in childhood*. 2002; 87(3):238-40.
15. Casasoprana A, Le Camus CH, Claudet I, Grouteau E, Chaix Y, Cances C, Karsenty C, Cheuret E. Utilité de la ponction lombaire lors de la première convulsion fébrile chez l'enfant de moins de 18 mois. Étude rétrospective de 157 cas. *Archives de pédiatrie*. 2013; 20(6):594-600.
16. Hom J, Medwid K. The low rate of bacterial meningitis in children, ages 6 to 18 months, with simple febrile seizures. *Academic Emergency Medicine*. 2011; 18(11):1114-20.
17. Batra P, Gupta S, Gomber S, Saha A. Predictors of meningitis in children presenting with first febrile seizures. *Pediatric neurology*. 2011; 44(1):35-9.
18. Rutter N, Smales O. Role of routine investigations in children presenting with their first febrile convulsion. *Archives of Disease in childhood*. 1977; 52(3):188-91.
19. Lee P, Jones KV. Urinary tract infection in febrile convulsions. *Archives of disease in childhood*. 1991; 66(11):1287-90.