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Research Article

Factors predicting bacterial meningitis in children aged 6-18 months presenting with first febrile seizure

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ABSTRACT

Background: Febrile seizures are the most common form of childhood seizure disorder. Between 2% and 5% of children between the age of 6 and 60 months experience at least one febrile seizure. Most of these febrile seizures are benign and self-limiting. However, some may indicate an underlying pathology like bacterial meningitis. As bacterial meningitis can be the most serious etiology of febrile seizures, we performed a cross sectional study to assess the factors predicting the risk of bacterial meningitis among various subgroups of young children with a first febrile seizure.
Methods: In this cross sectional study, 571 infants aged between 6-18 months presenting with first simple seizure from September 2011 to September 2013 were enrolled. These patients were admitted to the neurology ward of Bahrami Children Hospital, a tertiary children hospital. All clinical data of the patients were analyzed.
Results: Lumbar puncture was performed in 458 out of 571 patients (80.2 %). Bacterial meningitis was evident in 1.1% of patients with first febrile seizures. Eighty percent of children with bacterial meningitis were presented with complex febrile seizures with focal features. Another risk factor predicting bacterial meningitis was duration of postictal drowsiness.
Conclusions: It seems that according to new data describing limited need of performing lumbar puncture in all children with febrile seizure, some predicting factors of bacterial meningitis can be used to prevent unnecessary lumbar puncture. Complex febrile seizures especially those with focal features are the most important predicting factors. Larger prospective studies are needed to assess the presumed conclusion.

Keywords: Febrile convulsion, Lumbar puncture, Bacterial meningitis

INTRODUCTION

Body temperature fluctuates in a defined normal range (36.6°C-37.9°C rectally), so that the highest point is reached in early evening and the lowest point is reached in the morning. Any abnormal rise in body temperature should be considered a symptom of an underlying condition. Fever is defined as a rectal temperature >38°C.[1] Fever is the most common presenting complaint among infants aged 90 days or younger at paediatric emergency departments.[2] Consequently, febrile seizures are the most common seizure disorder in childhood. Febrile seizures occur in 2-5% of children aged 6 months to 5 years. Among children with febrile seizures, about 70-75% has only simple febrile seizures, another 20-25% has complex febrile seizures with focal features, and about 5% have symptomatic febrile seizures.[3] Febrile seizures are classified as either simple or complex. Simple febrile seizures have an excellent prognosis, with no effects on IQ, academic performance, neurocognitive or behavioural abnormalities, even with recurrences.[4] Focal seizures, seizures lasting for >15 minutes, and the

occurrence of more than one episode within 24 hours characterize complex febrile seizures.[5]

Most febrile seizures are triggered by fevers from viral upper respiratory infections, ear infections, or roseola. However, meningitis, if bacterial in etiology, can also present with fever and a single, self-limited seizure. Therefore it is a priority to diagnose or exclude bacterial meningitis.[5] According to AAP guidelines in a child who presents with a febrile seizure, a lumbar puncture should be performed in a child who has obvious meningeal signs and symptoms (such as neck stiffness, Kernig or Brudzinski signs) or other clinical signs that are indicative of meningitis or intracranial infection. Additionally lumbar puncture should be considered in any infant between 6 and 12 months of age who is not up to date with Hib or Streptococcus pneumoniae immunizations, or whose immunization status cannot be determined, especially because symptoms and signs of meningeal irritation can be absent in this age group. And the last indication for performing lumbar puncture is in any infant between 6 and 12 months of age who has received systemic antibiotic therapy by any route in the days preceding the seizure, because of a risk that signs of meningitis are masked.[6]

However, it seems that current guidelines are not followed strictly and in practical medicine. Recent studies showed variable predicting factors of bacterial meningitis in children presenting with febrile seizure. Thus, the fundamental aim of this study was to assess the clinical predictors of bacterial meningitis in Iranian children aged 6 to 18 months presenting with febrile convulsion with the eventual purpose of achieving probable changes in the management guidelines of these patients.

METHODS

In this cross sectional retrospective study all children aged 6 to 18 months presenting with first episode of febrile seizure were enrolled. These patients were admitted in neurology ward of Bahrami children Hospital, a tertiary children hospital, in Tehran, Iran from September 2011 to September 2013.All clinical and investigative profile of children was analysed. Age, sex, duration of fever, degree of fever, type of seizures, presence of simple or complex seizures, duration of postictal drowsiness, incidence of focal complex seizure and cell count, glucose and protein levels, gram stain and cultures of cerebrospinal fluid were analysed. We gathered the above information from the written notes in medical records documents by the medical staff including neurology ward's doctors and nurses. Most of these records were obtained from parents or other caregivers of the patients.

Those who had CSF analysis features, including glucose level lower than 50 mgr /dl, protein level more than 100 mgr/dl, leukocytes count 100-10000 or more with neutrophil dominancy, with or without positive CSF cultures were supposed to have bacterial meningitis.

Children with a known seizure disorder (one or more previous seizures without fever), underlying chronic neurologic condition (hydrocephalus, brain tumour, neurocutaneous syndrome, or cerebral palsy), metabolic abnormalities (hypoglycemia or hypocalcemia), and incomplete records were excluded. The patients with CSF analysis compatible with aseptic meningitis were also excluded from the study.

All the collected data were analysed and assessed by SPSS software version 20. (SPSS, Inc., Chicago, IL).

RESULTS

Five hundred and seventy one patients aged 6 to 18 months with first episode of febrile seizure were included in this study from September 2011 to September 2013.Lumbar puncture was performed in 458 patients (80.2%). For the remaining 20 percents of patients in whom lumbar puncture were not performed, the children were closely monitored and were discharged with uneventful recoveries. In 458 patients with first episode of febrile seizure who lumbar puncture was performed 45.9% were male and 54.1% were female. About sixty percent of them were between 6 to 12 months old and 41.3% were between 12 to 18 months.

Among the patients whom lumbar puncture were performed, twenty percent had complex febrile seizures and the rest had experienced simple febrile seizure. One out of 366 patients with simple febrile seizure and four out of ninety two patients with complex febrile seizures were diagnosed with bacterial meningitis (Figure 1).

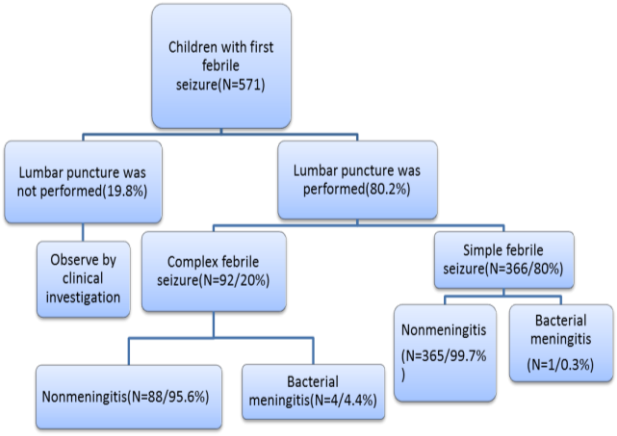

Figure 1: Prevalence of bacterial meningitis in children presenting with first febrile seizure.

Approximately forty percent of patients with CSF analyses compatible with bacterial meningitis had positive CSF cultures and those patients whom the CSF

analyses were compatible with viral meningitis where excluded from the study.

Clinical features including gender, age, degree of fever, duration of fever, type of seizure, duration of seizure, postictal drowsiness, and presence of complex focal seizure were compared in patients with meningitis and those without meningitis (Table 1).

According to our findings, type of seizure (simple or complex) (P =0.007) and presence of focal complex seizures (P ≤0.001) were statistically significant predictors of bacterial meningitis in children with first episode of febrile seizure.

Further statistical evaluation revealed that postictal drowsiness has the maximum sensitivity (100%) and negative predictive value (100%) in predicting bacterial meningitis. Furthermore, focal complex seizure has the maximum specificity (100%) and positive predictive value in predicting bacterial meningitis (Table 2).

Table 1: Comparison of different clinical features between meningitis and nonmeningitis groups.

Clinical features		Bacterial meningitis		P value (fisher exact test)
		Present (N=5)	Absent (N=453)	
Gender	Male	2 (40%)	208 (45.9%)	1.00
	female	3 (60%)	245 (54.1%)	
Age	6-12 months	4 (80%)	265 (58.5%)	0.0653
	12-18 months	1 (20%)	188 (41.5%)	
Degree of fever	38-38.9 ċ	4 (80%)	411 (72.6%)	0.911
	39-39.9 ċ	1 (20%)	145 (25.6%)	
	Above 40 ċ	0 (0%)	10 (1.8%)	
Duration of fever	Less than 1 hour	0 (0%)	31 (5.5%)	0.824
	1 to 24 hours	1 (20%)	139 (24.6%)	
	More than 24 hours	4 (80%)	396 (70%)	
Type of seizure	Simple	1 (20%)	365(80.6%)	0.007
	Complex	4 (80%)	88 (19.4%)	
Duration of seizure	Less than 15 minutes	5 (100%)	432 (95.4%)	0.886
	15-30 minutes	0 (0%)	16 (3.5%)	
	Longer than 30 minutes	0 (0%)	5 (1.1%)	
Complex seizure with focal features	Present	4 (80%)	0	≤0.001
	Absent	1 (20%)	453 (100%)	
Post ictal drowsiness	Present	5 (100%)	371 (81.9%)	0.591
	Absent	0	82 (18.1%)	

Table 2: Comparison of characteristics of seizures between the meningitis and nonmeningitis groups according to statistical data.

Clinical features	Bacterial meningitis						
	Present (N=5)	Absent (N=453)	P value	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Complex seizure	4 (80%)	88 (19.4%)	0.007	80%	80.5%	4.3%	99.7%
Duration of seizure (≥30 minutes)	0 (0%)	5 (1.1%)	0.886	0%	98.8%	0%	98.8%
Postictal drowsiness	5 (100%)	371 (81.9%)	0.591	100%	18.1%	1.3%	100%
Complex focal seizure	4 (80%)	0	≤0.00	80%	100%	100%	99.7%

DISCUSSION

I According to our study, five hundred and seventy one patients aged 6 to 18 months with first episode of febrile seizure was enrolled. .Lumbar puncture was performed in 458 patients (80.2%). The rate of performing lumbar puncture was between 25 to 50 percents in other studies.[7,2] Our hospital policy for performing LP is to

perform LP for all patients with febrile seizures who are between less than 12 months. And for patients between 12 to 18 months LP is performed according to clinical sign and symptoms of the patient and is done according to the doctor's experience. That is why the number of lumbar puncture performance in our study may seem fairly high.

According to our study, the incidence of bacterial meningitis was 1.1% among the children whom lumbar puncture was performed. The most common etiologic factor in patients with meningitis was streptococcus pneumonia. In Batra and et al study the prevalence of meningitis was 2.4% in children with first febrile seizures.[5] Batajoo and his colleagues conducted a prospective study in children who presented with first episode of fever and seizure in the age group of 6 months to 5 years. Of the 175 children included, 17% were diagnosed to have meningitis.[8] However the high incidence of bacterial meningitis in mentioned study was almost unique in the literature.

According to our study, out of 458 patients with first episode of febrile seizure who lumbar puncture was performed 45.9% were male and 54.1% were female. About sixty percent of them were between 6 to 12 months old and 41.3% were between 12 to 18 months. There was no statistically difference in gender and age in children with and without meningitis. In Batra and et al study the incidence of meningitis was slightly higher in the age group of 12-18 months (2.9% vs. 2.08%), and all cases of meningitis were reported in girls.[5]

According to our study in children whom lumbar puncture was performed and were diagnosed with meningitis 40% had positive cerebrospinal fluid culture and none had positive blood culture. In Teach and Geil study out of 243 children with febrile seizures, lumbar puncture was performed only in 66 patients and all CSF cultures were negative. Blood cultures were performed in 206/243 encounters and 2.9% of blood cultures were positive, all for Streptococcus pneumonia.[9] Kimia and Capraro performed a retrospective cohort review in 704 cases with simple febrile seizure, and lumbar puncture was performed in 38% of the children, the CSF cultures of all patients were negative, except for 10 cases of contamination cultures.[2,10] In Batajoo et al study cerebrospinal fluid was positive for a bacterial pathogen in 4.5% of the cases.[8] So it seems that the prevalence of positive CSF or blood cultures in children with bacterial meningitis is variable in different studies. The probable rational of this phenomenon may be receiving outpatient antibiotics before hospital admission or laboratory accuracy.

According to our data, 4.6% of patients without bacterial meningitis had experienced seizures more than 15 minutes while all the patients with bacterial meningitis had short seizures. This finding was in contrary to findings in Chin and et al study in north London that showed prolonged seizures can increase the possibility of bacterial meningitis in patients.[15]

Our analytic data revealed that in patients with febrile convulsions who had meningitis the temperature of patients were mostly between 38-38.9 ċ and duration of fever more than 24 hours .Similar results were obtained for the no meningitis group. So it seems that degree and duration of fever in not a prominent predicting factor for bacterial meningitis in patients with febrile convulsion. However there are few studies investigating above factors as the predicting factors and additional studies are needed.[12,13]

Ultimately, according to our data, complex febrile seizures with focal features were the most significant predictors of bacterial meningitis. In our study eighty percent of patients with proved bacterial meningitis experienced complex febrile seizures and specifically had seizures with focal features. Postictal drowsiness was another factor that was significantly more prevalent in children with bacterial meningitis, though administration of antiepileptic drugs is a disturbing factor in interpretation of the true effect of this factor.

This entity that there may be increased chance of manifesting meningitis if a patient exhibits complex febrile seizures with focal features has been approved in the guidelines of the American Academy of Pediatrics.[6]

Additionally, Tinsa and his colleagues performed a study in 2010 that revealed factors such as young age, partial seizure, duration of seizure more than 5 minutes and existence of underlying neurologic disorder can be considered as predicting factors of bacterial meningitis.[14]

Casasoprana and his colleagues had similar results in 2013, including the presence of complex febrile seizures with focal features as an important predicting factor of bacterial meningitis in patients younger than 18 months presenting with first febrile seizure.[10]

Eventually, the results of a review article conducted by Hom et al. performed on 2011 showed that risk of existence of bacterial meningitis as the etiology of fever in patients with simple febrile convulsions is very low.[15]

However there are few studies that do not approve the mentioned results.

In Batra et al study complex febrile seizure with focal features was not a risk factor of bacterial meningitis. According to their study the presence of neurologic deficit seems the best predictor of meningitis because of its good sensitivity, specificity, positive predictive value.[5]

CONCLUSION

Although the current guidelines in management of children presenting with first episode of febrile seizure

aged 6 to 18 months has a great tendency in performing lumbar puncture for all patients, it seems that these guidelines can be modified according to recent studies.

As the risk of bacterial meningitis is very low in patients with simple febrile seizures, lumbar puncture can be performed in children whom experienced prolonged postictal drowsiness, those presenting with complex febrile seizures and focal convulsions. Definitely in order to confirm these results larger prospective studies need to be performed.

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