Valeology: International Journal of Medical Anthropology and Bioethics
(ISSN 2995-4924) VOLUME 02 ISSUE 07, 2024

EVALUATION OF SERUM SODIUM LEVELS IN SIMPLE AND RECURRENT FEBRILE CONVULSIONS

Dr. Shaimaa Hamid Kareem
M.B.Ch.B., F.I.C.M.S. \ (Pediatrics), D.C.H., Iraqi Ministry of Health, Al-Karkh Health Directorate, Child's Central Teaching Hospital in Baghdad, Iraq

Dr. Mukhalad Abdul-Kareem Ghani
M.B.Ch.B., F.I.C.M.S. \ (Pediatrics), F.I.C.M.S. \ (Pediatric Endocrinology), Iraqi Ministry of Health, Al-Karkh Health Directorate, Child's Central Teaching Hospital in Baghdad, Iraq

Dr. Zainab A. Razak Twfeek
M.B.Ch.B., C.A.B.P., F.I.M.B.M.S. \ (Pediatric Endocrinology), Iraqi Ministry of Health, Al-Karkh Health Directorate, Child's Central Teaching Hospital in Baghdad, Iraq

Abstract:

Febrile convulsion is the predominant seizure disorder in the pediatric population. Approximately 2-4% of children undergo a febrile convulsion within the initial six years of their lives, and around 33% will experience repeated episodes. Hence, it is crucial to identify predisposing conditions in order to prevent recurrent episodes. Where the objective of this study is to evaluate the serum sodium level in patients experiencing febrile convulsions and determine the potential risk of developing hyponatremia for subsequent attacks within the next 24 hours.

The study was conducted at the Pediatric Department of Raparin Teaching Hospital in Erbil City from February 1st, 2013, until September 30th, 2013. The study included a sample of 100 children, ranging in age from six months to 6 years, who were admitted to the Pediatric Emergency unit. All of these children were diagnosed with febrile convulsions, which might be either generalized or focal. The control group comprised 100 medically stable, non-febrile toddlers without convulsions who were visiting the hospital for elective reasons (surgery or diagnostic procedures). The control group was selected to match the experimental group in terms of gender and age (rounded to the nearest six months). Patients were monitored in the In-Patient

Department for 24 hours to detect any instances of seizure recurrence. Individuals with febrile seizures can be categorized into two groups: those who experience a single seizure and those who have recurrent seizures. The study examined the risk factors of sex, age, family history of febrile convulsion, family history of epilepsy, and degree and cause of fever in both the case group and control group. Additionally, serum sodium levels were tested in both the case group and control group.

Findings: The study revealed that the highest occurrence of febrile convulsions (48% of cases) was observed in children aged between 12 and 23 months. There was a notable disparity between the cases and control groups. Furthermore, there was a substantial disparity in the average serum sodium levels between the study group and the control group. The average serum sodium level in children with single and recurrent seizures is significantly lower compared to the average serum sodium level in the control group (133.8 mmol/L (SD 2.55) for patients with single febrile convulsion versus 132.26 mmol/L (SD 2.64) for patients with recurrent febrile convulsion and 138.15 mmol/L (SD 8.05) for control, $p<0.01$).

In this study, we conclude the findings indicate that both age and hyponatremia could potentially increase the chance of developing and experiencing a repeat of febrile convulsions within 24 hours. Consequently, assessing the levels of sodium in a child's blood after a febrile seizure can aid in predicting the likelihood of seizure recurrence during the same fever-related illness

Keywords: *Serum sodium, Recurrent febrile convulsions, Seizure, Epilepsy, Herpesvirus.*

Introduction

Introduction

Febrile convulsion (FC) is the predominant epilepsy syndrome, impacting around 2-4% of children between the ages of 6 and 60 months. Febrile seizures are characterized by convulsions occurring when the body temperature reaches 38°C or greater. These seizures are not caused by infection or metabolic imbalance in the central nervous system [1,2,3], and there is no previous history of seizures without fever. The majority of febrile seizures often occur in children aged between 6 months and three years, with the highest occurrence observed around 18 months. Animal models provide evidence that the maturing brain's vulnerability to fever is particular to certain age groups, [4,5,6] indicating that normal brain development is associated with increased neuronal excitability. Children experiencing a mild temperature of 38.9°C frequently exhibit focal seizures or experience recurring seizures during the same febrile illness. There is no evidence to support the idea that antipyretics can lower the chances of experiencing febrile seizures. [7,8,9] This suggests that fever and seizure activity may be connected through naturally occurring substances that cause fever.

Febrile seizures can be classified into three categories: basic, complicated, and febrile myoclonic. Simple seizures are generalized convulsions accompanied by fever that persist for 15 minutes. Complex seizures, on the other hand, are lengthy, focal, and occur repeatedly during 24 hours. Febrile myoclonic seizures are a more recently acknowledged type of seizure. The global prevalence ranges from 2% to 5%, with variations based on geographic location [10,11].

A study has identified numerous characteristics that elevate the likelihood of a child experiencing their first febrile seizure. These factors include a family history of seizures, attending daycare, being discharged from the neonatal unit, and parental assessment of delayed development. [12,13,14] Nevertheless, more than 50% of youngsters that are impacted do not possess any risk factors. The specific type of infection, such as gastroenteritis, is also a crucial factor to consider. HHV-6 and HHV-7, which are types of human herpesvirus, are frequently responsible for febrile seizures. These seizures occur in approximately 25% of cases where it is the first seizure experienced and in about 33% of infants under the age of two [15,16].

Patients and method

A case-control study was undertaken at the Department of Pediatric Medicine in Raparin Teaching Hospital from February 1st, 2013, to October 1st, 2013. The study included a cohort of 100 children, ranging in age from 6 months to 6 years, who experienced febrile seizures and were admitted to the pediatric emergency department. Additionally, 100 healthy children without convulsions who were not experiencing a fever were also included in the study. The study did not include patients with gastroenteritis, insufficient fluid consumption, central nervous system infection/malformations, birth asphyxia, previous unprovoked seizures, metabolic reasons, persistent neurological deficiency, or pneumonia. The data was gathered via a questionnaire that encompassed many factors such as age, kind and length of convulsion, fever, developmental milestones, neurological tests, body temperature, family history of febrile convulsion, family history of epilepsy, and presence of symptoms associated with the infection site.

The study entailed collecting blood samples from children having febrile seizures through venipuncture. These samples were subsequently examined using an electrolyte autoanalyzer. The typical serum levels ranged from 134 to 144 mmol/L, while hyponatremia was defined as sodium levels below 135 mmol/L. The study was constrained by the restricted number of participants and the intrusive technique of extracting blood samples from both the patients and the control group, potentially impacting the accuracy of the findings.

The data were analysed using the statistical package for social sciences (SPSS, version 19). One-way analysis of variance (ANOVA) was employed to compare the means of the three groups. A two-sample t-test was employed to assess the statistical significance of differences between two means.

The chi-square test of association was employed to compare between proportions when the expected count of more than 20% of cells in the table was exceeded, with the cells less than five being subjected to Fisher's exact test. A p-value of ≤0.05 was considered significant.

Results

Table 1. Correlation between children with single and recurrent F.C according to age

	Pt. with single febrile convulsion		Recurrent F.C in the same illness		Total		P-value
	No.	%	No.	%	No.	%	
Age (months)							
<12	8/11	72.7%	3/11	27.3%	11	11.0%	0.117
12-23	29/48	60.4%	19/48	39.6%	48	48%	
24+	33/41	80.5%	8/41	19.5%	41	41.0%	

Table (3.2) Shown the mean age for total cases is 23.01 (SD±12.84) months, while the mean age for single F.C is 23.91 months (SD ±13.4) and 20.9 months (SD±11.11) for recurrent F.C and 32.38 months (SD ±16.79) for control.

The P-value is significant for both groups A and B in relation to the control group.

Table 2. Shows the correlation between children with single and recurrent F.C and control according to age (months)

Groups	No.	Age (mean)	SD	p (ANOVA)	Significance by LSD
A	70	23.914	13.487	< 0.001	A X C
B	30	20.900	11.115		B X C
C	100	32.380	16.794		

Tables (3.3) and (3.4) shown fifty-seven of the cases (57%) were male, and forty-three (43%) were female; of them, 15 (26.3%) of males and 15 (34.9%) of females developed another attack (s), sex distribution was comparable with the control group in which 61 (61%) were male and 39 (39%) females. (P-value not significant)

Table 3. The distribution of children with single and recurrent febrile convulsion according to sex

	Pt. with single febrile convulsion		Recurrent F.C in the same illness		Total		P-value
	No.	%	No.	%	No.	%	
Sex							
Male	42/57	73.7%	15/57	26.3%	57	57.0%	0.355
Female	28/43	65.1%	15/43	34.9%	43	43.0%	

Table 4. The distribution of children with first and recurrent febrile convulsion and control according to sex

	Pt. with single febrile convulsion		Recurrent F.C in the same illness		control		P-value
	No.	%	No.	%	No.	%	
Sex							
Male	42/61	73.7%	15/61	26.3%	61	61%	0.549
Female	28/39	65.1%	15/39	34.9%	39	39%	

Table 5. Family history of epilepsy among single and recurrent F.C

	Pt. with single febrile convulsion		Recurrent F.C in the same illness		Total		P-value
	No.	%	No.	%	No.	%	
Family History of epilepsy							
+ve	2/3	66.7%	1/3	33.3%	3	3.0%	1
-ve	68/97	70.1%	29/97	29.9%	97	97.0%	

Table 6. Degree of the temperature at the admission of the single F.C and recurrent F.C

	Pt. with single febrile convulsion		Recurrent F.C in the same illness		Total		P-value
	No.	%	No.	%	No.	%	
Temperature							
<38	2/2	100%	0/2	0.0%	2	2.0%	0.916
38-38.9	25/38	65.8%	13/38	34.2%	38	38.0%	
39-39.9	34/47	72.3%	13/47	27.7%	47	47.0%	
40 +	9/13	69.2%	4/13	30.8%	13	13.0%	

Table 7. Family history of F.C among cases (single and recurrent F.C)

	Pt. with single febrile convulsion		Recurrent F.C in the same illness		Total		P-value
	No.	%	No.	%	No.	%	
Family history of F.C							
+ve	20/33	60.6%	13/33	39.4%	33	33.0%	0.150
-ve	50/67	74.6%	17/67	25.4%	67	67.0%	

Table 8. Degree of relation in +ve family history among cases (single and recurrent F.C)

	Pt. with single febrile convulsion		Recurrent F.C in the same illness		Total		P-value
	No.	%	No.	%	No.	%	
Degree of relation in +ve family history cases							
None	50/67	74.6%	17/67	25.4%	67	67.0%	0.111
1st degree	14/26	53.8%	12/26	46.2%	26	26.0%	
2nd degree	6/7	85.7%	1/7	14.3%	7	7.0%	

Table 9. Type of convulsion among cases (single and recurrent F.C)

	Pt. with single febrile convulsion		Recurrent F.C in the same illness		Total		P-value
	No.	%	No.	%	No.	%	
Type of convulsion							
Generalized	60/85	70.6%	25/85	29.4%	85	85.0%	0.766
Focal	10/15	66.7%	5/15	33.3%	15	15.0%	

Table 10. History of previous F.C among cases (single and recurrent F.C)

	Pt. with single febrile convulsion		Recurrent F.C in the same illness		Total		P-value
	No.	%	No.	%	No.	%	
History of previous F.C							
+ve	34/48	70.8%	14/48	29.2%	48	48.0%	0.861
-ve	36/52	69.2%	16/52	30.8%	52	52.0%	

Table 11 Shown the duration of convulsion in the cases, 91 (91%) of cases had a convulsion < 15 min., 65 (71.4%) of them had a single attack, and 26 (28.6%) had a recurrent attack (s), there are no significant differences between single and recurrent F.C regarding the duration of F.C (P-value=0.446).

Table 11. Duration of F.C among cases (single and recurrent F.C)

	Pt. with single febrile convulsion		Recurrent F.C in the same illness		Total		P-value
	No.	%	No.	%	No.	%	
Duration of convulsion							
<15 Min.	65/91	71.4%	26/91	28.6%	91	91.0%	0.446
>15 Min.	5/9	55.6%	4/9	44.4%	9	9.0%	

Table 12 Shown fever duration before convulsion in the cases, 68 (68%) of cases had a fever duration ≤ 24 hours, 50 (73.5%) of them had a single attack, and 18 (26.5%) had a recurrent attack (s), there are no significant differences between single and recurrent F.C regarding the duration of fever before of convulsions (P-value=0.262).

Table 12. Duration of fever before convulsion among cases (single and recurrent F.C)

	Pt. with single febrile convulsion		Recurrent F.C in the same illness		Total		P-value
	No.	%	No.	%	No.	%	
Fever duration before convulsion							
≤24 hours	50/86	73.5%	18/86	26.5%	68	68%	0.262
>24 hours	20/32	62.5%	12/32	37.5%	32	32%	

shown causes of fever in a patient with F.C which mostly was respiratory tract infections which, include (pharangitis, tonsillitis, otitis media, and lower R.T.I) and accounted for about 91 (91%) of cases, 62 (68.1%) had one attack and 29 (31.9%) had recurrent attack (s). And this relationship between single F.C and the recurrent F.C with the source of infection was statistically not significant (P-value =0.786).

Table 13. Causes of fever in single F.C and recurrent F.C group

	Pt. with single febrile convulsion		Recurrent F.C in the same illness		Total		P-value
	No.	%	No.	%	No.	%	
Causes of febrile convulsion							
R.T.I	62/91	68.1%	29/91	31.9%	91	91.0%	0.786
G.E	5/6	83.3%	1/6	16.7%	6	6.0%	
Both	2/2	100%	0/2	0.0%	2	2.0%	
Post vaccine	1/1	100%	0/1	0.0%	1	1.0%	

Table 14. Correlation between cases (single and recurrent F.C) and control according to serum sodium level (mmol/l)

Groups	No.	Na^+ (mean)	SD	p (ANOVA)	Significance by LSD
A	70	133.800	2.557	< 0.001	A X C
B	30	132.267	2.690		B X C
C	100	138.150	8.057		

Table 15. Correlation between the mean of serum sodium and sex in the cases group (single and recurrent F.C)

Groups	No.	Na^+ (mean)	SD	P-value
Male	57	133.33	2.579	0.865
Female	43	133.34	2.835	

Discussion

Febrile convulsions are the most frequent cause of convulsions in children who are younger than six years old. Parents are apprehensive about the possibility of a relapse.

Both febrile groups in our study had hyponatremia, which was significantly different from the control group. This finding is consistent with the results reported by Hugen et al. Kiviranta et al Chiarelli et al. [17], Nadkarni et al. [18] Nickavar et al. [19] and Heydarian F (50). These investigations found that decreased levels of sodium in the blood were a major factor in both initial and recurring febrile seizures within the first 24 hours after a seizure. In contrast to other research, Thoman et al. (59), Fallah R (61), and the American Academy of Pediatrics [20] have advised

against routinely obtaining electrolytes unless there is a clinical indication. In this study, there are three groups of patients: those with a single febrile seizure, those with febrile seizure recurrence, and a control group consisting of afebrile children. Thoman et al. [19] used a control group consisting of patients with afebrile seizures, which may have influenced the results. In Fallah R's (61) study, there is no control group, but there are three groups of convulsions: one with febrile seizures, another with recurrent febrile seizures within one year, and a third group with multiple febrile seizures within the same illness.

Out of the youngsters included in our study, 30% experienced a recurring seizure. This is similar to the 28% occurrence documented by Hugen et al.

The mean age of all children studied with FC was 23.01 ±12.84 months. The frequency of FC was 48% among children aged between 12 and 23 months. These findings are consistent with the research conducted by AL-Atrushi and Al-Shamma'a (63), who discovered that 63.5% of patients experienced FFC between the ages of 13 and 24 months. Additionally, our results align with Bidabadi et al. [21], who reported a mean age of 22.86 ±12.86. The p-value was statistically significant for age in both the single and recurrent febrile convulsion groups compared to the control group. This suggests a strong association between age and febrile convulsions, with the majority of seizures occurring between 6 months and three years of age. The peak incidence of febrile convulsions globally is typically observed at 18 months.

The findings of this study indicate that there was a higher proportion of male cases (57%) compared to female cases (43%). This aligns with the results of AL-Atroshi's study (62) and Al-Shamma'a's study (63), which reported a distribution of 59.8% boys and 40.2% girls. The p-value did not reach statistical significance for the variable of sex in both the single and recurrent F.C. groups when compared to the control group.

However, in our investigation, gender did not have a significant impact as a risk factor for recurrent FC. The investigations conducted by Berg AT et al. (6) and Berg AT, Shinnar S et al. [7] yielded consistent findings. However, Bassissco MS et al. (69) found that being male was identified as a risk factor in several studies. The lack of a definitive explanation for the variation observed in these research may be attributed to the modest character of the society, which could potentially minimize or eliminate the influence of gender on the risk of recurrence.

Martin-Fernandez and colleagues discovered that individuals who experience their first febrile convulsion before the age of 16 months are more likely to have a recurrence of febrile convulsions. Our study revealed that children between the ages of 12 and 24 months who experience an initial seizure had a significantly higher chance of recurrent febrile convulsions (FC) within 24 hours. This finding contradicts the results of Offringa M et al., who indicated that children under 30 months of age have a lower risk of recurrence.

Our research revealed that 33% of patients with febrile seizures have a positive family history for F.C. Various studies, such as Bassissco MS et al (69) and Tsuboi (70), have reported an incidence rate of 17-22%.

The study revealed that 26% of individuals who were closely related to each other experienced seizures, which deviates from the findings of prior studies. The seizure length was 91%, with an additional 9% lasting longer than 15 minutes. Within 24 hours of the initial seizure, 30% of individuals experienced repeated convulsions. In 68% of instances, the duration of fever prior to convulsion was less than 24 hours. There was a correlation between having a high-grade fever and a lower likelihood of recurrence, although having a family history of epilepsy did not result in an increased risk. 42% of individuals experienced complex febrile convulsions, while 58% experienced simple febrile convulsions. According to the study, the quantity of salt in the blood can be used to forecast the likelihood of a recurrence of seizures in the same event. This information can be helpful

in determining whether a child should be admitted to the hospital or allowed to go home, as well as in informing parents about the risk of more convulsions.

Conclusions

The study revealed that toddlers between the ages of 12 and 24 months who experienced febrile seizures had a higher likelihood of having low levels of sodium in their blood (hyponatremia) and being at risk of experiencing more seizures. Age, hyponatremia, respiratory tract infection, and family history of F.C. were identified as factors that significantly enhanced the probability of experiencing seizures.

References

1. Mikati MA, Rahi A: Febrile seizures. In: Robert M. Kliegman, Bonita F. Stanton, Joseph W. St. GemeIII, Nina F. Schor and Richard E. Behrman. Eds. Nelson Textbook of Pediatrics.19th Edition. Philadelphia: Saunders Elsevier; 2011; 586:2017-2018.
2. Annegers JF, Hauser WA, Shirts SB, et al. Factors prognostic of unprovoked seizures after febrile convulsions. N Engl J Med 1987; 316:493–8.
3. Hauser WA. The prevalence and incidence of convulsive disorders in children. Epilepsia 1994; 35 (2):S1–6.
4. Offringa M, Hazebroek-Kampschreur AAJM, Derksen-Lubsen G. Prevalence of febrile seizures in Dutch school children. Paediatr Perinat Epidemiol 1991; 5:181–8.
5. Jensen FE, Sanchez RM. Why does the developing brain demonstrate heightened susceptibility to febrile and other provoked seizures? In: Baram TZ, Shinnar S, eds. Febrile seizures. San Diego: Academic Press, 2002:153–68.
6. Berg AT, Shinnar S, Darefsky AS, et al. Predictors of recurrent febrile seizures. Arch Pediatr Adolesc Med 1997; 151:371–8.
7. Berg AT, Shinnar S, Hauser WA, et al. A prospective study of recurrent febrile seizures. N Engl J Med 1992; 327:1122–7.
8. Berg AT. Are febrile seizures provoked by a rapid rise in temperature? Am J Dis Child 1993; 147:1101–3.
9. Minchom PE, Wallace S. Febrile convulsions: electroencephalographic changes related to rectal temperature. Arch Dis Child 1984; 59:371–3.
10. Shinnar S, Glauser TA. Febrile seizures. J Child Neurol 2002; 17 (11): S44–52.
11. El-Radhi AS, Withana K, Banajeh S. Recurrence rate of febrile convulsion related to the degree of pyrexia during the first attack. Clin Pediatr 1986;25:311–13.
12. Berg AT, Shinnar S. Complex febrile seizures. Epilepsia 1996;37:126–33.
13. Camfield PR, Camfield CS, Shapiro SH, et al. The first febrile seizure—antipyretic instruction plus either phenobarbital or placebo to prevent recurrence. J Pediatr 1980;97:16–21.
14. Bethune P, Gordon K, Dooley J, et al. Which child will have a febrile seizure? Am J Dis Child 1993;147:35–9.
15. Gatti S, Vezzani A, Bartfai T. Mechanisms of fever and febrile seizures: putative role of the interleukin-1 system. In: Baram TZ, Shinnar S, eds. Febrile seizures. San Diego: Academic Press, 2002:169–88.
16. Virta M, Hurme M, Helminen M. Increased plasma levels of pro- and anti-inflammatory cytokines in patients with febrile seizures. Epilepsia 2002;43:920–3.

17. Nadkarni J, Binaykiya I, Sharma U, Dwivedi R. Role of serum sodium levels in the prediction of seizure recurrence within the same febrile illness. Neurology Asia 2011; 16 (3): 195 – 197.

18. Nickavar A, Hasanpour H, Sotoudeh K. Validity of Serum Sodium and Calcium Screening in Children with Febrile Convulsion. Acta Medica Iranica 2009; 47 (3): 229-231.

19. Thoman JE, Duffner PK, Shucard JL. Do Serum sodium levels predict febrile seizure recurrence within 24 hours? Pediatric Neurology 2004; 31:342-344.

20. American Academy of Pediatrics, Provisional Committee on Quality Improvement and Subcommittee on Febrile Seizures. Practice parameter: the neurodiagnostic evaluation of a child with a first simple febrile seizure. Pediatrics. 1996; 97 (5):769–772; discussion 773–775

21. Bidabadi E, Mashouf M. Association between iron deficiency anemia and first febrile convulsion: A case-control study. Elsevier 2009; 18:347-351.