The serum sodium levels and recurrence of simple febrile seizure during the first 24 hours in children

Original Article

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Abstract:

Background: Febrile seizure (FS) is one of the most common neurologic disorders in children. Electrolyte imbalance especially hyponatremia may have an important role in triggering the febrile seizure. The measure of serum electrolytes will be useful in predicting the further seizure. The aim of this study was to investigate the effect of relative hyponatremia (RH) on the risk of recurrent febrile seizures.

Methods: This prospective study was performed on 334 children (6-60-month) with convulsions, referred to Amirkola children's Hospital. The patients were divided into three groups: simple febrile seizure (SFS), complex febrile seizure (CFS) and seizure without fever. In each group, the serum sodium was measured at the beginning of the admission and followed for 24 hours, and electrolyte imbalance was evaluated in seizure recurrences. Data were analyzed using SPSS-16 (student's t-test and logistic regression).

Results: Of the 334 children, 105 (31.7%) and 229 (68.3%) patients were female and male, respectively. The mean serum sodium levels in patients with SFS, CFS and control group were 136.64, 134.91 and 137.38 meq/l, respectively ($p<0.05$), but potassium and calcium levels were in the normal range. CFS group had a significant RH in comparison to SFS group ($p<0.05$).

Conclusions: The serum sodium level was significantly lower in simple and complex seizures compared to the control group. Measurements of serum sodium levels and hyponatremia diagnosis have a key role on predicting the FC occurrence and recurrence. Therefore, physicians should be careful to administer the serums and inject the solutions for children with fever.

Keywords: Children, Febrile Seizure, Fever, Hyponatremia, Seizures

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Introduction:

Febrile convulsion (FC) or febrile seizure (FS) is the most common type of seizures it occur in children between the ages of 6 months to 5 years with body temperature over 38 ° C and without any infection such as meningitis and encephalitis in the central nervous system. The incidence of FC is 5 cases per 1000 children annually [1]. Two-four percent of children experiences FC during the first 6 years of life and almost one third of them have been experienced recurrent episodes. Therefore, identification of these risk factors appear to be necessary to prevent recurring attacks [2]. Febrile seizures are classified into two groups including simple and complex seizures. Simple seizures happen

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with generalized tonic-colonic movements for less than 15 minutes without recurrence in the first of 24 hours [3]. Complex seizures occur more than once in 24 hours for more than 15 minutes and are focal [4]. The mechanism of seizures is still unknown; however, many etiologic factors are responsible for it [5].

In recent decades, many studies have been done on pathophysiology of FC, but, so far, it has not been demonstrated conclusively [6, 7]. However, various risk factors have been considered as independent predisposing factor. Many studies have indicated that measurement of serum sodium, calcium, phosphorus, magnesium, zinc and iron levels in children with FC could be helpful [8]. It was suggested that variations in serum electrolyte levels will increases the susceptibility to seizures and recurrent of FC during childhood [9]. Relative low sodium level as a significant factor in the depolarization of nerve cells and electrical discharge can be cause of convulsions [8]. Nevertheless, consensus exists in the role of serum sodium deficiency as a higher risk of recurrence of febrile seizure or convulsion in the first 24 hours of simple FC. In contrast, some studies have shown that a relative hyponatremia (RH) can be a predictor of the likelihood of FC in children [10, 11].

Therefore, it is necessary to consider the importance of occurring the seizure and the possibility of its recurrence in the first 24 hours following fever. This study designed to find out the effect of serum sodium level on simple febrile seizures (SFS) and complex (recurrence) febrile seizure (CFS) during first 24 hours of admission.

Methods:

This prospective study was performed on 334 children between 6 to 60 months in Amirkola children hospital in 2014-2015. A written informed consent was obtained from the parents. All children with fever (axillary temperature >38 °C) and convulsions were enrolled to the study and divided into two groups. First group was children with first febrile seizure after ruling out central nervous system infection or any other defined cause of seizure. Second group consisted of children with recurrent FC (complex) and another group as control group was children with seizure disorder without fever during the same period. The exclusion criteria were children with neurodevelopment delay, encephalitis and meningitis, malabsorption syndrome, severe malnutrition, gastroenteritis, previous history of seizures without fever and in severe electrolyte imbalance. The demographic characteristics such as sex, age, body temperature, convulsion time, seizure frequency, family history of seizures, history of previous seizures, underlying diseases (upper respiratory tract infections, otitis media, lower respiratory tract infection, upper and lower urinary tract infection, gastroenteritis, etc.) and serum electrolyte status were documented for each patient. In each group, the sodium, calcium and potassium levels were determined at the beginning of admission.

Serum sodium measurement between 130-135 mEq/mL was considered as RH. Patients were monitored after hospitalization within 24 hours for seizure recurrence. The collected data were analyzed using SPSS 16 and Student's t-test was used to determine the differences in mean serum sodium levels between the control and study groups and also between those with a single seizure and recurrent seizures. The relationship between the probability of a recurrent seizure and serum sodium level was assessed using logistic regression. The level of significance was $p<0.05$.

Results:

Totally, 334 children consisting of 229 (68.3%) boys and 105 (31.7%) girls aged between 6 months to 5 years old participated in the present study. Minimum and maximum ages of our cases were 7 and 60 months related to SFS group and these criteria in CFS group was 8 and 60 months, respectively. The mean age in SFS was 28.8±15.3, in CFS was 23.06±12.26 and in control was 35.65±16 months.

There were 208 children in simple group and 63 patients in each of two other groups. The mean of serum sodium level in SFS, CFS and control group was 136.65, 135 and 137.38 mg/dl, respectively. As shown in table 1, potassium and calcium levels were in the normal range.

The serum sodium level in SFS and CFS was significantly lower than that in control group ($p<0.05$); however, there was no significant differences between two former groups.

Among 271 children with FC, 63 (23.2%) patients had recurrent seizure in first 24 hours of admission with 7.3% RH prevalence. In SFS and CFS groups, hyponatremia had a significant effect on seizure occurrence ($P< 0.05$). In addition, hyponatremia was significantly responsible for seizure recurrence in first 24 hours of admission ($P= 0.016$). There were no

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significant differences between serum sodium, calcium and potassium level in females and males (p> 0.05).
With increasing the body temperature, the serum sodium level was enhanced without any significant difference between two groups (table 2). Serum sodium level had no statistically significant effect on seizure frequency. Table 2 indicates the frequency of underlying disease. The serum sodium level was less in children with otitis media and lower urinary infection

Table 1: Comparison of the mean±SD of serum electrolyte between groups

Electrolyte (mg/dl)	SFS	CFS	Control	P Value
Sodium	136.65±2.3	135±3	137.4±1.76	0.000
Potassium	4±0.38	4.17±0.4	3.97±0.4	0.001
Calcium	9±0.41	9±0.65	8.87±0.62	0.182

Table 2: Comparison of body temperature and frequency of underlying disease following FC

Variables		SFS	CFS	Control
		N/ mean of Na		
Temperature (°C)	37.5	--	--	63
		--	--	137.38
	37.8 – 38.5	157	31	--
		136.73	134.55	
	38.5 – 39.5	41	31	--
		136.05	135.54	
	39.5- 41	9	1	--
		137.94	137	--
	P-value	0.073	0.25	--
Underlying disease (n)	upper respiratory tract infections	59	16	--
		136.5	135.15	
	lower respiratory tract infection	33	4	--
		136.43	135.87	
	upper urinary tract infection	9	1	--
		136.54	133	
	lower urinary tract infection	1	1	--
		138.8	132	
	otitis media	37	17	--
		136.3	134.37	
	none	68	24	63
		137	135.2	
	P-value	0.461	0.647	--

Discussion:

In this study, CFS group had a significant RH in comparison to SFS group. FCs which requires emergency medical care are a terrible event for parents in [12]. A variety of factors have been proposed the incidence of febrile seizures including reduction of serum levels as trace elements stimulating the seizure accompanied by fever [13]. Despite the higher number of boys with seizure, in generally, there was no significant effect of gender on the occurrence of FC. Similarly, Maksikharin et al. reported the frequency of febrile seizures was occurred in 57.5% of boys, but without any significant difference [14]. In the current study, the mean serum sodium level was significantly lower in SFS and CFS groups than control group and the presence of RH was observed in 37 (17.78%) children with SFS and 20 (31.7 %) children with CFS. Thus, the RH and low serum sodium level indicated the significant relationship with febrile seizure occurrence. Many investigations have been consistent with our study, for example, Thoman et al. [15], Heydariyan et al. [16] and Nickavar et al. [17] demonstrated that there was a significant difference between the mean serum sodium level and SFS or CFS in children. We also found that RH had a significant effect on seizures recurrence in CFS group as well as seizure occurrence [15, 16], while no significant difference was observed in the mean serum sodium between children with febrile seizure and seizures without fever [17].

In two other studies,From Nickavar et al and hugen et al 30 % and 28 % of children had recurrent seizures [17, 18].

Various studies suggested that serum sodium level was significantly lower in children with recurrent seizures compared to pediatrics without recurrence [8, 17, 18]

Thoman et al.'s and Heydariyan et al.'s illustrated that serum sodium level was lower in the group with recurrence, which was not statistically significant. The difference of these two studies was due to the small sample size [15, 16].

Kiviranta et al. showed that the sodium levels were lower in children with complicated convulsions compared to those having simple convulsions. The sodium concentrations were lower in children with repeated seizures than children having simple or other complicated types of febrile convulsions [8].

Moreover, Hugen et al. suggested that the probability of a repeat convulsion within the same febrile period appeared to be significantly related to the serum sodium level. The lower the serum sodium level is, the higher the probability of a repeat convulsion is [18].

Maksikharin et al. established that 47 episodes of recurrent febrile seizures occurred in 39 of 276 children (4.12 %) within 24 hours and stated that the serum sodium level had no significant difference between SFS (134.94 mg/dl) and CFS children (134.49 mg /dl) [14].

There is a disagreement among researchers according to three studies that assess the serum sodium levels as a predictor of recurrent seizures [8, 9, 18].

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Otherwise, some researchers have been reported evaluation of serum sodium level has a successful role in FC prediction among children. The results of the present study were in contrary to the other studies, which can be attributed to the limited size of the study population and targeted groups. Serum sodium levels were compared between the children with febrile seizure and normal children, and the significant reduction in serum sodium levels was found in children with febrile seizures [14]. The advantage of this study was to evaluate serum sodium levels in healthy children in addition to children with febrile seizures. Although the family history of seizure had no significant effect on recurrence and occurrence of febrile seizure of children in the current study, in the study of Maksikharin et al. it was significantly effective in predicting the recurrence [14].

In conclusion, the serum sodium level was significantly lower in simple and complex seizures than the control group. Measurement of serum sodium levels on predicting the recurrence of FC was successful, so the level of sodium serum has a significant role in the creation of FC. Thus, administration of injectable solutions for children with fever should be considered carefully.

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Conflict of Interest: There was no conflict of interest.

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