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Comparative Study of Serum Potassium Levels in Children with Febrile Seizures and Febrile Children without Seizures

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Abstract

Background
Febrile Seizure is considered as one of the most common seizure disorders during childhood. The purpose of this study is to compare serum potassium levels in children with febrile seizures and febrile children without seizures.

Materials and Methods
In this case study, 320 children admitted to Ghaem Hospital (Mashhad, Iran) aged six to 60 months were selected. In the case group, there were 160 children with febrile seizures, and in the control group, there were 160 febrile children without seizures. Potassium serum levels at the time of hospitalization as well as age, gender, duration and cause of fever, duration of hospital stay, and family history of seizures in both groups were investigated and compared.

Results
Potassium serum levels were significantly higher in children with seizures than in those without seizures (P=0.007). Among children with seizures, those with complex seizures had significantly higher potassium levels (P=0.024). The binary regression test showed that the level of potassium was a risk factor for febrile seizures (P = 0.025).

Conclusion
Based on the results, higher potassium serum levels can be a risk factor in febrile seizure.

Key Words: Children, Potassium Level, Seizures, Fever.

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1- INTRODUCTION

The most common form of seizures in children is febrile seizure (FS), which occurs in 2-5% of children under five years of age (1-3). By definition, FS occurs with a temperature of more than 38 °C in children six months to 60 months of age who are neurologically healthy, with no infections of the central nervous system or acute disorders or a history of seizures without fever (4). Age is an important risk factor for recurrence of FS, and the younger the age of the first seizure, the greater the risk of recurrence (1). The exact cause of FS is not known, but various factors such as genetic factors and micronutrient deficiency (e.g., zinc and iron) can be involved in its development (5, 6). A study (2012) conducted in Turkey on 48 children with FS and 55 healthy children found that serum levels of calcium, magnesium, and potassium were lower in the FS group than in the control group (7). The study results of Tarvij-Eslami et al. (2015) showed that in children with FS, potassium levels were significantly lower than those with fever without seizures (8). Since seizures in children is always a distressing experience for parents, preventing the recurrence of seizures is very important. On the other hand, anticonvulsant medication has side effects; therefore, recognizing the factors influencing recurrence seems to be the best strategy. Considering the importance of FS in childhood as well as recognizing the factors influencing its development and lack of studies on the relationship between FS and potassium levels, this study was conducted to compare the serum levels of potassium in children with FS to febrile children without seizures.

2- MATERIALS AND METHODS

2-1. Study design and population

In this case-control study, a total of 320 hospitalized children in two groups of case (children with FS), and control (febrile children without seizures) were selected. The records of patients admitted at Ghaem Training Hospital affiliated to Mashhad University of Medical Sciences (Mashhad, Iran) between 2010 and 2015 were studied. By definition, generalized seizures due to fever that occur only once in 24 hours and for less than 15 min are considered as simple, and focal seizures or those that occur more than once in 24 hours or for more than 15 min are considered as complex (9). The body temperature was measured and recorded using the standard auxiliary temperature measurement protocol. Blood potassium levels were measured and compared in both groups. Each child's weight was measured by a digital scale with minimal clothing and an accuracy of 0.1 kg by Seca scale. After explaining to the parents and obtaining written consent, serum potassium levels of the blood samples normally sent to the laboratory immediately after the child's hospitalization were examined and compared in order to investigate the serum electrolytes in both groups. The patients' profile, including age, gender, type of seizure (simple or complex), history of previous FS, and FS in first-degree relatives were recorded in the data collection form.

2-2. Inclusion and exclusion criteria

Inclusion criteria were the age of six to 60 months, FS, and having been admitted to Ghaem hospital in Mashhad city, Iran. Exclusion criteria were infection of the central nervous system (meningitis and encephalitis), developmental disorders, dehydration, malnutrition, and metabolic, renal and endocrine disorders.

2-3. Ethical consideration

This study closely followed Helsinki instructions and guidelines for medical research on children. The study is registered in Iranian Registry in Clinical Trials (IRCT 20111024007892N8). A

parental consent form for each patient was obtained after complete explanations. The patients' confidentiality was assured until the end of the study.

2-4. Data Analysis

The data were analyzed after collection and coding by SPSS software version 16.0. For describing the data, appropriate tables and statistical indices such as mean were used. For data analysis, normality of the data was first investigated using Kolmogorov-Smirnov test and statistical methods such as T-test, Mann-Whitney test, and Binary Logistic Regression analysis were used. For data analysis on the nominal scale, chi-square test was used. The level of significance level in tests was considered less than 0.05.

3- RESULTS

In this study, 320 hospitalized children were investigated in two case (children with FS, n = 160) and control (febrile children without seizures, n = 160) groups in terms of serum potassium levels. The mean age in the case group was 23.2 ± 13.2 months and 22.3 ± 18.8 months in the control group (P> 0.05). The case group consisted of 61.9% (n = 99) boys and the control group of 55.6% (n = 89) boys (P> 0.05). In general, in the case group, 118 cases (72.8%) had simple seizure and 42 cases (27.2%) had complex seizure. As **Table.1** shows, most cases with simple and complex seizures are males (P = 0.19).

Table-1: Frequency of simple and complex seizures by gender in participants.

Gender	Groups		P-value*
	Simple seizures Number (%)	Complex seizures Number (%)	
Boy	69 (58.9)	30 (71.6)	0.19
Girl	49 (41.1)	12 (28.4)	
Total	118 (100)	42 (100)	
Total (%)	Boy	99 (61.9)	
	Girl	61 (38.1)	

*Chi-square test.

Table.2 shows the relationship between anthropometry and potassium levels as well as the number of hospitalization days of patients in the two groups. As shown, serum potassium levels at hospitalization in the case group were significantly higher than the control group (P<0.05). As shown in **Table.3**, fever degrees above 38.5 ° C were more frequent in patients without seizures than in the other group (P = 0.007). The results showed no significant statistical relationship between the presence of seizures in first-degree relatives and patients in both groups (p = 0.32).

Table-2: Comparison of weight, potassium level, and number of hospital days in two groups with fever and seizure and fever without seizures.

Variables	Groups, Number (%)		P-value*
	Fever and seizure	Fever without seizures	
Weight when referring, gr	11519.69 (2546.09)	11069.38 (4008.78)	0.04
Potassium levels at the time of admission, (meq/L)	4.47 (0.54)	4.39 (0.49)	0.007
Number of hospitalization days	2.9 (1.68)	4.35 (2.38)	<0.001

*Independent t-test.

Table-3: The frequency of seizures in first-degree relatives and fever above 38.5°C in the two groups.

Variables	Groups, Number (%)		P-value*
	Fever and seizure	Fever without seizures	
Existence of seizures in first-degree relatives of patients	28 (17.5)	24 (15)	0.32
Fever above 38.5 ° C	60 (37.5)	74 (46.3)	<0.001

*Chi-square test.

As shown in **Table.4**, in those with FS, upper respiratory tract infection was the most common underlying infection, seen in 101 cases (63.1%) (P<0.001). As shown in **Table.5**, the number of hospitalization days in those with complex seizures was significantly higher than in those with simple seizures (P = 0.001).

Table-4: Comparison of the type of underlying infection in the two groups with fever and seizure and fever without seizures.

Variables	Groups, Number (%)		P-value*
	Fever and seizure	Fever without seizures	
Upper respiratory system	101 (63.1)	44 (27.5)	<0.001
Lower respiratory system	22 (13.8)	52 (32.5)	
Urinary tract infection	3 (1.9)	10 (6.3)	
Gastrointestinal infection	20 (12.5)	25 (15.6)	
Hidden bacteremia and focal fever etc.	14 (8.7)	29 (18.1)	

*Chi-square test.

Table-5: Comparison of number of hospitalization days in the two groups with simple seizures and complex seizures.

Groups	Hospitalization days, (mean ± SD)	*P-value
Simple seizures	2.63 ± 1.50	<0.001
Complex seizures	3.67 ± 1.63	

* Mann-Whitney test, SD: Standard deviation.

As shown in **Table.6**, potassium levels were significantly different between case and controls, those with simple and complex seizures, those with simple seizures and without seizures, and those with complex seizures and without seizures. Another important point is that in those who have had seizures more than once in the first 24 hours of hospitalization, potassium levels are significantly higher than in the group that had seizures only once (P = 0.009). As shown in **Table.7**, binary regression test was used to identify the factors affecting and confounding the prediction of FS. After a separate evaluation of the variables to enter into the model, the level of potassium at hospitalization was finally determined as a risk factor (P = 0.025). The value of the coefficient of determination based on Cox and Snell criteria is 0.143, which shows that 14.3 changes in the seizure rate can be predicted by the variables in the model. Also, no significant relationship was observed between age, weight, family history of seizures, and epilepsy with fever and seizures.

Table-6: Comparison of potassium levels in patients participating in the study.

Groups	Potassium levels at the time of admission, (meq/L), (mean ± SD)	*P-value
Fever and seizure	4.68 ± 0.54	0.007
Fever without seizures	4.39 ± 0.48	
Simple seizures	4.41 ± 0.50	0.024
Complex seizures	4.62 ± 0.63	
Fever without complex seizures	4.39 ± 0.48	0.011
Fever and complex seizures	4.62 ± 0.63	
Fever without simple seizures	4.39 ± 0.48	0.035
Fever and simple seizures	4.41 ± 0.50	
One seizure in the first 24 hours of hospitalization	4.43 ± 0.51	0.009
More than one seizure in the first 24 hours of hospitalization	4.57 ± 0.49	

* Mann-Whitney test, SD: Standard deviation.

Table-7: Regression analysis to investigate the factors affecting the occurrence of fever and seizures.

Variables in the Equation							
Parameters		B	S.E.	Wald	DF	P-value	Exp (B)
Step 1[a]	Potassium	-.553	.247	5.011	1	.025	.575
	Weight	.000	.000	1.929	1	.165	1.000
	Age	.022	.017	1.592	1	.207	1.022
	FHFC	.549	.344	2.544	1	.111	1.731
	FHE	.236	.406	.338	1	.561	1.266
	Constant	.361	1.711	.044	1	.833	1.434
a. Variable (s) entered on step 1: Potassium, Weight, Age, FHFC, and FHE.							

Exp (B): The exponentiation of the B coefficient, DF: Degree of freedom, FHFC: Family history of fever convulsion, FHE: Family history of epilepsy.

4- DISCUSSION

This study aimed to compare the serum levels of potassium in children with FS to febrile children without seizures. Our results showed that potassium levels were significantly different between those with and without seizures. Children who had complex seizures had significantly higher potassium levels. The most common underlying infection in the group of children with FS was upper respiratory tract infection and lower respiratory tract infection in the group with fever without seizures. In children who had seizures more than once in the first 24 hours of hospitalization, potassium levels were significantly higher than in those who had seizures only once. The binary regression test showed that potassium levels at hospitalization was a risk factor for FS. A study conducted in Turkey on 48 children with FS and 55 healthy children found that potassium levels in the group with FS were lower than the control group (7). Tarvij-Eslami et al. (2015) investigated the role of potassium deficiency and some risk factors for seizures due to fever in a population of children in Mashhad. The results showed that in the FS group, potassium levels were significantly lower than in the group with fever without seizures. Falah et al. showed that the level of potassium had no significant difference in the group with recurrent seizures and the group without recurrence (10), which is not consistent with the present study. Khalaf et al. (2018) evaluated the relationship between serum electrolytes and febrile seizures in a case-control study. Their study included 30

children with febrile seizures and 30 healthy children as the control group. There was a significant association between serum electrolytes (sodium, (11). Changes in potassium levels may contribute to initiation of seizure activity. It has been suggested that any rising in extracellular potassium levels may lower inhibitory mechanisms of interneurons and, consequently, neuron depolarization lead to seizures activity (12).

5- CONCLUSION

Most of the cases with simple and complex seizures were males. Serum potassium levels at hospitalization in the children with febrile seizures were significantly higher than the control group. Based on the results, higher potassium serum levels can be a risk factor in febrile seizure.

6- CONFLICT OF INTEREST: None.

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