Original Article

Comparison of serum biochemical parameters in children with febrile seizures

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ABSTRACT

Background: Febrile convulsions are the most common provoked seizures affecting children. Low magnesium level leads to cell and membrane excitability thereby causing seizures. **Objective:** The objective of the study was to determine the role of serum sodium, calcium, magnesium, and zinc in children with simple febrile seizures (SFSs). **Materials and Methods:** This was a case–control study done in children admitted in the pediatric ward. Children with SFSs were taken as cases while children with fever but without seizures served as controls. After obtaining informed consent, details of each child were recorded, which included age, sex, seizure details (duration, type), nature of the febrile illness, and history of febrile seizures (FSs). Estimation of serum sodium, zinc, magnesium, and calcium was done. **Results:** The present study included 120 subjects, out of which 60 were cases and 60 were controls. The male-to-female ratio was 2:1. In our study, there was no significant difference in the levels of calcium, magnesium, and zinc in cases with FSs and controls. Although the serum zinc levels were in the normal range, majority of the children with SFS had serum zinc levels toward the lower range of normal which was statistically highly significant. **Conclusion:** Our study found that SFSs occurred more frequently in boys. The levels of serum calcium and magnesium were normal and did not correlate with SFS. Low serum zinc level had a direct correlation with SFS, although this level was within the defined normal range.

Key words: Biochemical Parameter, Seizures, Serum level

A seizure is a transient occurrence of signs and/or symptoms resulting from abnormal excessive or synchronous neuronal activity in the brain. Febrile convulsions are the most common provoked seizures affecting children [1]. The incidence of these convulsions varies between 3% and 10%. Studies from the developed world report 2–5% of all children between the ages of 6 months and 5 years being affected [2].

Febrile seizure (FS) is a very common neurological problem in childhood. Approximately 2–5% of children are estimated to undergo at least one seizure during a febrile illness before the age of 5 years, accounting for 30% of all seizures among children [3]. Seizure is associated with fever, although there is no evidence of intracranial infection or a definite cause for it. The mechanisms underlying FS have a multifactorial etiology, complicated by the fact that the pathogenesis of FS is unknown in most cases. FS represents the point between a low seizure threshold and genetic components [4].

Although 6 months are considered as the lower age limit by many pediatricians, the National Institute of Health and International League Against Epilepsy definitions on FSs use a lower age limit of 3 months and 1 month, respectively. Most FSs occur between 6 months and 3 years of age with the peak incidence at 18 months. Nearly 6%–15% of FS occurs after 4 years. The mechanism of this increased susceptibility is not clear, however, few animal models suggest that there is increased neuronal excitability during the normal brain maturation [5,6].

Febrile convulsions are defined as seizures that occur between the age of 6 and 60 months, with a temperature of 38°C (100.4°F) or higher, that are not the result of central nervous system infection or any metabolic imbalance, and that occur in the absence of a history of prior afebrile seizures [7]. During routine electrolyte studies in patients with febrile convulsions, some researchers found that serum electrolytes and zinc play a role in cause of FSs [5]. Hence, our study was an attempt to evaluate the association between these serum biochemical parameters and simple FS (SFSs).

MATERIALS AND METHODS

The present study is a case–control study, conducted in 120 children in the age group of 6 months–5 years, admitted to the pediatric ward of a tertiary care institute of Gujarat. The children were divided into two groups: 60 children with SFSs were

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enrolled as case group and 60 febrile children without seizures were taken as control group.

Children aged between 6 months and 5 years admitted to pediatric ward/pediatric intensive care unit with SFS and had normal development, which were included in the study. For every case included in the study, the next child aged between 6 months and 5 years and admitted to the pediatric ward with any febrile illness without seizures was taken as control. Children admitted with complex FS or had a history of complex FSs, afebrile seizures, developmental delay, proven neurological infections, persistent neurological deficit, children with diarrhea, renal diseases, metabolic encephalopathy, and severe acute malnutrition, were excluded from the study.

After taking informed written consent, cases and controls were enrolled in the study as per the inclusion and exclusion criteria. Detailed history including age, sex, seizure details (duration, type and recurrence), nature of febrile illness, and family history of epilepsy/FSs was taken and recorded in a prepared pro forma. Physical examination findings including temperature at admission, anthropometry, and nutritional status (according to IAP 24 classification) were recorded. Serum sodium, zinc, magnesium, and calcium levels were estimated along with other investigations at the time of admission.

Sodium was estimated by indirect ion selective electrode using autoanalyzer, calcium by O-Cresolphthlein complex one using autoanalyzer, magnesium by colorimetric method with chlorophosphonazo using autoanalyzer, and zinc by colorimetric method using nitro-PAPS reagent using spectrophotometer.

The recorded data were compiled and entered into a spreadsheet computer program (Microsoft Excel 2007) and then exported to data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). For all tests, confidence level and level of significance were set at 95% and 5%, respectively.

RESULTS

In our study, 60 children with SFS were taken as the cases while control group consisted of 60 children admitted with a history of febrile illness without seizures. Out of 120 subjects, 74 were male and 46 were female. In the case group, there were 40 males and 20 females. Out of the 60 controls, there were 34 males and 26 females. The male:female ratio of children with SFSs was 2:1.

Out of the 120 subjects, 12 children were aged <1 year, 108 children were aged between 1 and 5 years. Out of the 60 cases, 8 were within the age group of 6–12 months, and 52 children were between 1 and 5 years. Out of the 60 controls, 4 children were between the age group of 6 and 12 months, and 56 children were between 1 and 5 years. Mean age of children was 25.63±6.05 months. Out of the 60 cases, 34 cases had seizures for <5 min while 14 cases had seizures between 5 and 10 min and 12 cases had it for more than 10 min. Out of 60 cases, 14 had a history of febrile convulsion, whereas 46 cases presented for the 1st time with febrile convulsions.

Out of the 60 cases, 20 children had serum sodium levels <135 mEq/L and 40 cases had normal sodium levels. There were no cases with hypernatremia. Out of the 60 controls, only two children had sodium <135 mEq/L, and majority of controls had normal sodium values. Fifty-eight out of 60 children had normal calcium levels and only two children had serum calcium <8.8 mg/dl. Out of the 60 controls, 58 children had normal calcium values and two children had hypocalcemia. None of the cases or controls had calcium more than 11 mg/dl (Table 1).

Out of the 60 cases, 58 had normal magnesium levels and only two children had serum magnesium <1.7 mg/dl while all the controls had normal magnesium levels. None of the cases or controls had hypomagnesemia. Out of 60 cases and 60 controls, none had abnormal zinc levels (below 60 mcg/dl). Thirty-four cases had serum zinc levels between 60 and 80 mcg/dl, which is toward the lower range of normal and 26 had serum zinc levels greater than 80 mcg/dl (Table 1).

DISCUSSION

In our study, there were 74 males and 46 females with a gender ratio of 2:1. Similarly, a study done by Gayatri *et al*. [8] found that the male-to-female ratio was 2:1 in children with SFS. Out of 120 subjects, majority of the cases were aged between 1 and 5 years. Gayatri *et al*. [8] found that 58% were in the age group of 1–5 years and 42% were <1 year in their study. In our study, out of the 16 children aged 6–12 months, all had first episode of FSs whereas 14 out of 52 children, in the 1 year–5 years group, had a history of FSs.

Majority of the children had seizures <5 min. In a similar study by Gayatri *et al*. [8], 14 out of 50 cases (28%) had seizures lasting for <5 min, 28 cases (44%) had seizures ranging between 5 and 10 min and 14 cases (28%) had seizures ranging between 10 and 15 min. Among 60 cases, only 2 children (3%) had family history of FSs, 58 cases children did not have a family history of FSs. Out of 60 cases of FSs, only 10 children had malnutrition.

Out of 60 cases in our study, there were no cases with hypernatremia. Out of 60 controls, only two children had sodium <135 mEq/L (p=0.026). The average calcium level was 9.6 mg/dl in children with SFS and 9.63 mg/dl in the control group. Similar to our findings, a study by Rutter *et al*. found that the mean blood

Table 1: Level of serum sodium in case group and control group

Laboratory parameters	Case group	Control group
Serum sodium levels		
<135 mEq/L	20	2
134–145 mEq/L	40	58
>145 mEq/L	0	0
Serum calcium levels		
<8.8 mg/dl	2	2
8.9–11 mg/dl	58	58
>11 mg/dl	0	0
Serum magnesium levels		
<1.7 mg/dl	2	0
1.8–2.7 mg/dl	58	60
>2.7 mg/dl	0	0
Serum zinc levels		
60–80 mcg/dl	2	0
>80 mcg/dl	58	60

calcium in 82 patients with FS was 9.6±0.82 mg/dl. Only three patients had calcium levels below 8.5 mg/dl [9]. Abdelrahman *et al*. found that the calcium concentrations in children with SFS were lower than in the control group [9] ($p<0.05$).

None of the cases or controls had hypermagnesemia. Average magnesium level was 2.19 mg/dl in cases and 2.24 mg/dl in the control group. Rutter *et al*. found that the mean blood magnesium in 75 children with SFS was 2.3±0.2 mg/dl. No patient in their study had hypomagnesemia, which was similar to our study. Studies done by Abdelrahman *et al*. found that the serum level of magnesium in children with febrile convulsions was significantly lower than the control group [10].

All 60 cases and 60 controls in our study had normal zinc levels. Average zinc level was 78.9 mcg/dl in cases and 96.7 mcg/dl in control group. Although all the 60 children with SFS had serum zinc levels in the normal range of 60–120 mcg/dl, 17 children (56.6%) had serum zinc levels between 60 and 80 mcg/dl, 10 children between 80 and 100 mcg/dl, and 3 children had serum zinc levels in the range of 100–120 mcg/dl ($p=0.000434$). In the study by Gayatri *et al*., 31 (62%) cases had low serum zinc levels and only 5 (10%) controls had low serum zinc levels. In our study, all children had normal zinc levels, but majority of the children in the study group had zinc levels in the lower range of normal (60–80 mcg/dl) [11].

CONCLUSION

The levels of serum calcium and magnesium were normal and had no correlation with SFS. Low serum zinc level had direct correlation with SFS, although this level was within the defined normal range.

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