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Original Research Article

Reduced serum calcium is a risk factor for febrile seizures

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ABSTRACT

Background: Febrile seizure (FS) is the most common cause of convulsions in children. The objective of present work was to study the association between serum electrolytes and febrile seizures.
Methods: Children in the age group of 6 month to 6 years with febrile seizures satisfying inclusion criteria and equal number of age and sex matched controls were subjected to estimation serum electrolytes and compared using appropriate statistical methods.
Results: Serum Calcium levels in children with febrile seizures were reduced and this observation was statistically significant.
Conclusions: Definite association was found between serum calcium levels and the occurrence of febrile seizures. Although serum calcium levels were not in the hypocalcemic range, they were decreased enough to cause a statistical significance in precipitating febrile seizures.

Keywords: Electrolytes, Febrile seizure, Risk factor, Serum calcium

INTRODUCTION

Febrile seizure (FS) is the most common cause of convulsions in children.[1] Incidence of FS in India is around 5-10%.[2] Many studies have been conducted to identify the risk factors due to its association with later development of epilepsy but the risk factors remain largely unknown.[3]

Studies have shown different (often inconclusive) results for an association between reduced serum electrolytes (including low serum Calcium) and Seizures. Excitatory post synaptic transmissions that occur with very low calcium state lead to uncontrolled epileptiform discharges.

In the brain, hundreds of intracellular processes are known to depend on calcium influx.[4] Hence this study was conducted with an objective to study the association between serum electrolytes and febrile seizures.

METHODS

This case control study was conducted from June 2013 to May 2014 at Cheluvamba Hospital attached to Mysore medical college and Research Institute, Mysore.

Inclusion criteria

- Cases included 60 children aged between 6 months to 5 years admitted with febrile seizures
- Controls included 60 children aged 6 months to 5 years who got admitted with simple febrile illness.

Exclusion criteria

- Children with unprovoked seizures, neurological infections
- Developmental delay
- History of birth asphyxia

- Persistent neurological deficit and gastro-enteritis or pneumonia.

Data collection

Demographic data, seizure details, nature of febrile illness, family history of epilepsy/ febrile seizures were collected.

Investigations done

- Serum calcium and magnesium by calorimetric method
- Serum sodium by ion electrode method.

Statistical analysis

Pearson chi-square test was used to compare the baseline characteristics. Student's t-test was used to calculate the statistical significance of continuous variables. P-values <0.05 is considered significant. Data was analyzed by SPSS software version 20.0.

RESULTS

Mean age of presentation of cases and controls were 25 and 18 months respectively. Male to female ratio was almost similar in both the groups. 44 out of 60 (74%) cases presented with first episode and 8 (14%) cases had family history of FS. Mean (SD) values for serum Calcium, Magnesium and Sodium were 8.877 (0.556), 1.848 (0.254) and 138.18 (5.23) for cases; 9.277 (0.556), 1,792 (0.219) and 138.57 (4.79) for controls respectively. Reduced Serum Calcium in cases as compared to controls was statistically significant (p 0.0001).

Table 1: Showing clinical profile.

Parameters	Cases (n-60)	Control (n-60)
Mean age	25 months	18 months
Sex ratio (male/female)	35/25	34/26
First episode	44(74%)	-
Family history of FS	8(14%)	-

Table 2: Showing mean (SD) values of serum electrolytes (meq/L).

Serum electrolyte	Cases (n=60)	Control (n=60)	P value
Calcium	8.877(0.556)	9.277(0.556)	0.0001
Magnesium	1.848(0.259)	1.792(0.219)	0.1978
Sodium	138.18(5.23)	138.57(4.79)	0.6761

DISCUSSION

Serum Calcium level in children with febrile convulsions was significantly lower than the control group (P=0.0001). This observation is similar to studies by Chiarelli F et al. where Serum levels of sodium and calcium were significantly lower in children with FS and Akbayram S et al. where Calcium, magnesium and potassium concentrations in the febrile seizure group were lower than in the control group.[5,6] There was no association between low Serum calcium and FS in studies by N. Rutter et al, Sakha k et al and Sayedzadeh S A et al.[7-9] In our study, the mean levels of Serum magnesium and sodium were similar in both the case and control groups and similar observations were made by Papierkowski A et al, Fallah Razieh, and Jayashree Nadkarni et al.[10-12]

Reduced serum Calcium causes increased neuroexcitability. Low ionized Calcium levels in the extra cellular fluid, by binding to the exterior surface of the Sodium channel protein molecule in the plasma membrane of nerve cells, increasing the permeability of neuronal membranes to sodium ions, causing a progressive depolarization thus increases the possibility of action potentials. When Calcium ions are absent, the voltage level required to open voltage gated Sodium channels is significantly altered (less excitation is required). With hypocalcemia, action potentials may be spontaneously generated causing contraction of peripheral skeletal muscles resulting in clinical seizures.[13]

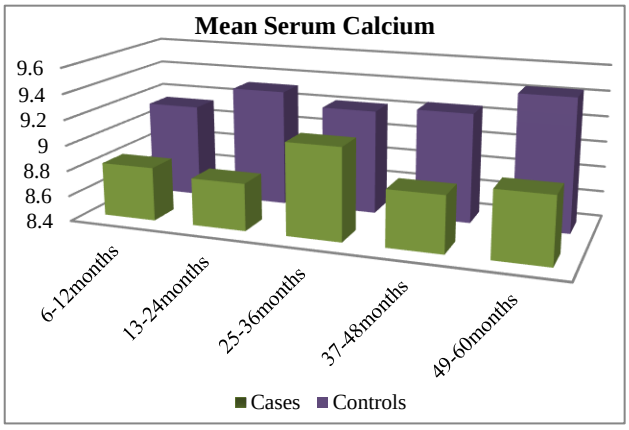

Figure 1: comparison of mean serum calcium levels among different age group.

Fever is the purposeful elevation of body temperature. It specifically releases stored Calcium from bone reserves.[14] How fever and reduced calcium act in conjunction or in synergy needs to be studied. Hence, studies and animal models need to be designed to correlate fever and hypocalemia; and to explain their probable mechanism in producing clinical seizures. Limitations of the study included a small sample size, hence further multi-centric trials involving larger sample size is warranted.

CONCLUSION

Definite association was found between serum calcium levels and the occurrence of febrile seizures. Although

calcium levels were not in the hypocalcemic range, they were decreased enough to cause a statistical significance in precipitating febrile seizures. In future, studies with large sample size are needed to confirm the definitive role of serum calcium in febrile convulsions especially in developing countries like India where the prevalence of hypocalcemia is high. This observation also warrants the need to provide calcium rich food or supplements to infants and young children.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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