

## ORIGINAL ARTICLES

# Role of serum sodium levels in prediction of seizure recurrence within the same febrile illness

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### Abstract

**Background & Objective:** Febrile seizure is the most common seizure disorder in the paediatric age group and often recurs within the first twenty four hours. It has been observed that children with recurrent febrile seizure have lower serum sodium levels.

The study was conducted to ascertain the role of serum sodium as a predictor of seizure recurrence within the same febrile illness. **Methods:** 70 children admitted for febrile seizure between 6 months to 5 years were included in the study; they were divided into two groups, those with a single episode of seizure and the remaining were children with recurrent seizures. An age and sex matched group of 35 children with fever but no convulsion were the controls. Serum sodium levels were evaluated in all the children. **Results:** There was no significant difference in the mean serum sodium between the study group and controls. The mean serum sodium level of children with recurrent seizures is significantly lower than the mean serum sodium level of children with a single seizure (134.31SD 3.79 versus 138.2 SD 3.66 mmol/l,  $p < 0.01$ ).

**Conclusion:** Measurement of the serum sodium in a child with febrile seizures helps in predicting seizure recurrence within the same febrile illness.

### INTRODUCTION

Febrile convulsion is the most common seizure disorder in the pediatric age group. A febrile seizure is a seizure accompanied by fever (temperature  $\geq 100.4^{\circ}\text{F}$  or  $38^{\circ}\text{C}$  by any method), without central nervous system infection, that occurs in infants and children 6 through 60 months of age.<sup>1</sup> Risk of recurrence in febrile convulsion is 30–40 % and half of these go on to get a second recurrence.<sup>2</sup> Convulsions in children generate a huge amount of fear in the parents or caregivers regarding the child's illness. One of the most frequently asked question is the probability of another convulsion during the febrile episode.

During routine electrolyte studies in patients with febrile convulsions, some researchers found the serum sodium level to be lower in children with recurrent convulsion within the same febrile illness.<sup>3-5</sup> With this background we performed a prospective case control study to assess the role of serum sodium level as an indicator of seizure recurrence within the same febrile episode.

### METHODS

The study was done at the Department of Pediatric Medicine, associated Kamla Nehru Hospital, Gandhi Medical College, Bhopal from November, 2009 to October, 2010. The study population was children aged 6 months to 5 years presenting to the Pediatric Emergency or Out Patient Department with fever (axillary temperature  $>100.4^{\circ}\text{F}$ ) and convulsions, either generalized or focal. Parents or guardians of the children were counseled and informed written consent taken.

Controls consisted of children with fever but without a convulsion, matched for sex and age (to the nearest six months). They had no signs of gastroenteritis or inadequate fluid intake and neither were they receiving any medications which could be expected to influence the serum sodium level.

Children with evidence of central nervous system infection/malformations, *Plasmodium falciparum* infection, history of birth asphyxia, previous unprovoked seizure, persistent

neurological deficit, developmental delay and children with gastroenteritis or pneumonia were excluded.

Axillary temperatures were recorded by mercury thermometers as near to the time of convulsion as possible. Two millilitres of clotted blood in a plain vial was taken maintaining strict asepsis. The sample was analyzed within 30 minutes by an electrolyte autoanalyser (Carelyte, Carewell Biotech Ltd.) which used ion selective electrode method. Children were followed up in the In-Patient Department during the next 24 hours for any seizure recurrence. Those with febrile seizures were divided into two groups, those having a single seizure and those with recurrent seizures.

Student's t-test was used to determine differences in mean serum sodium levels between the control and study group, and also between those with a single seizure and recurrent seizures. The relation between the probability of a recurrent seizure and serum sodium level was assessed using logistic regression. The level of significance was taken as  $p < 0.05$ .

## RESULTS

There were 70 children with febrile seizures in the study, consisting of 47 boys and 23 girls. The mean age was 28 (SD 13.6) months. Fifty percent had a previous history of febrile seizures and 25.7% had a family history of febrile seizures. Ninety percent had a generalized seizure while 64.3% had a simple febrile seizure. The control group consisted of 35 children with a mean age

of 28 (SD 15.4) months. There was no significant difference in the mean serum sodium levels between children with febrile seizure (137.1 SD 4.1 mmol/L) and controls (138.2 SD 4.3 mmol/L). Within the febrile seizure group, the mean serum sodium level in the children with recurrent seizures was significantly lower than the mean in those with a single seizure (134.3 SD 3.8 mmol/L versus 138.2 SD 3.7 mmol/L,  $p < 0.01$ ). Univariate analysis showed no difference in age, gender, temperature, past history or family history of febrile seizure between those with a single seizure and those with recurrent seizures.

Figure 1 shows relationship between serum sodium levels at presentation and the probability of a recurrent febrile seizure. The probability of a recurrent seizure approached 0.9 in those with serum sodium levels lower than 130 mmol/L and became less than 0.1 in those with serum sodium levels more than 140 mmol/L. The increase in the probability of recurrence of febrile seizure with the decrease in serum sodium levels is significant, and for every one mmol/L decrease in serum sodium levels, the odds of a recurrent seizure increased by a factor of 1.35 (odds ratio 1.35)

## DISCUSSION

In our prospective study, 19 (27%) out of 70 children with febrile seizures have serum sodium levels  $< 135$  mmol/L. This is comparable to the incidence of 18-35% found in other studies.<sup>6,7</sup> We found no significant difference between the mean serum sodium of children with febrile seizures and controls. This is contrary to the results of

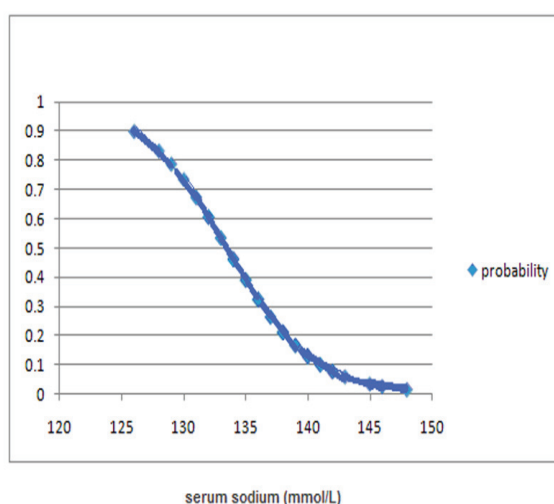


Figure 1. Serum sodium levels and probability of recurrent febrile seizures

other studies.<sup>8,9</sup> This difference in observation may be attributed to the fact that their control group consisted of children with afebrile seizures and not febrile children without convulsions, as was ours.

In our study, 21 (30%) of children developed a recurrent seizure. This is comparable to the 28 % incidence reported by Hugen *et al.*<sup>5</sup> We observed significantly lower mean serum sodium in children with recurrent seizures as compared to children with a single febrile seizure. This result has been supported by the works of Hugen *et al.*<sup>5</sup> and Kirivanta *et al.*<sup>3</sup> However, no such difference was found by two other studies.<sup>8,9</sup> These differences could be due to sample size (the number of patients included in both studies was larger than ours) or specific genetic predisposition.

Although the AAP CPG 2011 guidelines<sup>1</sup> on neurodiagnostic evaluation of a child with simple febrile seizures recommend that measurement of electrolytes should not be performed for the sole purpose of identifying the cause of a simple febrile seizure, our study demonstrates that serum sodium level can assist in predicting the risk of recurrence within the same febrile episode.

## REFERENCES

1. Subcommittee on Febrile seizures, Febrile Seizures: Guideline for the Neurodiagnostic Evaluation of the Child With a Simple Febrile Seizure. *Pediatrics* 2011; 127:389-94.
2. Vestergaard M, Basso O, Henriksen TB, Ostergaard JR, Olsen J. Risk factors for febrile convulsions. *Epidemiology* 2002; 13(3):282-7.
3. Kirivanta T, Airaksinen EM. Low sodium levels in serum are associated with subsequent febrile seizures. *Acta Paediatr* 1995; 84:1372-4.
4. Millichap JG. Studies in febrile seizures. II. Febrile seizures and the balance of water and electrolytes. *Neurology* 1960; 10:312-21.
5. Hugen CA, Oudesluys-Murphy AM, Hop WC. Serum sodium levels and probability of febrile seizure. *Eur J Pediatr* 1995; 154(5):403-5.
6. Chiarelli F, De Palma C, Verrotti A, Lombardi G, Domizio S. Electrolytic changes during febrile convulsions. *Pediatr Med Chir* 1985; 7(2):249-52.
7. Rutter N, Smales ORC. Role of routine investigations in children presenting with their first febrile convulsion. *Arch Dis Child* 1978; 52:188-91
8. Thoman JE, Duffner PK, Shucard JL. Do serum sodium levels predict febrile seizure recurrence within 24 hours? *Pediatr Neurol* 2004; 31:342-4.
9. Heydarian F, Ashrafzadeh F, Cam S. Simple febrile seizure: the role of serum sodium levels in prediction of seizure recurrence during the first 24 hours. *Iran J Child Neurology* 2009; 3(2):31-4.