

Serum Zinc Level in Children with Febrile Convulsion and its Comparison with that of Control Group

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Abstract

Objective: Febrile convulsion is the most common disorder in childhood with good prognosis. There are different hypotheses about neurotransmitters and trace element (such as zinc) changes in cerebrospinal fluid and serum, which can have a role in pathogenesis of febrile convulsion. The aim of the present prospective analytical case-control study was to determine whether there was any changes in serum zinc level in children with febrile convulsion during seizure.

Methods: Ninety-two children aged 6 months to 5 years were divided into three groups: group A, 34 children with febrile convulsion, group B, 40 children having fever without convulsion, and group C, and 18 children with non-febrile convulsion. Serum zinc levels for the three groups were estimated by atomic absorption spectrophotometry (AAS). Data were analyzed to compare zinc level among the three groups using appropriate statistical tools employing SPSS 13.

Findings: Serum zinc levels of groups A, B, and C had a mean value of 76.82 ± 24.36 mg/l, 90.12 ± 14.63 mg/l and 94.53 ± 17.39 mg/l, respectively. Serum zinc level of group A was lower than those of the other two groups ($P < 0.006$). It was also lower in group B than in group C ($P < 0.006$).

Conclusion: These findings revealed that serum zinc level decreases during infection; this decrease was more significant in patients with febrile convulsion.

Key Words: Fever; Convulsion; Febrile convulsion; Serum zinc level

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Introduction

Febrile convulsion is one of the most common causes of hospitalization of children in pediatric ward that occurs in children between 5 months and 6 years of age. The pathogenesis of this condition is still unknown. However, several theories, such as genetic basis, reduction of serum as well as cerebrospinal fluid (CSF) zinc and magnesium level and low Gamma- aminobutyric acid (GABA) have been proposed^[1,2]. Low CSF GABA values have been reported in association with several seizure disorders, including febrile convulsion^[3].

Zinc is known to play a control role in the immune system, and zinc- deficient persons experience increased susceptibility to a variety of pathogens. Zinc also functions as an antioxidant and can stabilize membranes. Zinc modulates the affinity of neurotransmitters such as glutamate to their receptors and facilitates the inhibitory effect of calcium on N-methyl-D-aspartate receptors and thus prevents the excitatory neuronal discharge^[4].

We carried out a prospective case-control study to reveal the relationship between low serum concentration of zinc and febrile convulsion.

Subjects and Methods

This prospective analytical case-control study was conducted in Rasoul-e-Akram teaching hospital from January 2003 to January 2005. The study included 92 children between 6

months to 5 years of age of both sexes (34 with febrile seizure, 18 with generalized seizure and 40 age and sex matched febrile patients). Febrile children were taken as control.

All patients in febrile seizure group (first bout of single generalized febrile seizure persisting for <15 minutes) and fever group were suffering from viral infection. In non-febrile seizure group the final diagnosis was idiopathic seizure.

Children who had mental retardation, atypical convulsion, focal seizure, chronic diseases, malnutrition, central nervous system infection, pneumonia, urinary tract infection, and other bacterial infections, diarrhea, hemolysis or local infection were excluded from study.

One milliliter of peripheral blood was collected in an acid-propylene tube within 12 hours after admission to hospital. All samples were centrifuged and serum was preserved in -80°C.

Serum zinc was estimated by Atomic Absorption Spectrophotometry in Cellular, Molecular Research Center affiliated to the Faculty of Basic Sciences.

The project was approved by the scientific advisory and ethical committees of Iran University of Medical Sciences. Written informed consent forms were signed by the parents before including the children in the study.

For statistical analysis, SPSS 13 program using t-test, was employed. Chi-square test was performed to compare proportion between 2 or more discrete variables. $P < 0.05$ was considered statistically significant.

Table 1: Demographic data and serum zinc level in febrile seizure children in comparison with fever and seizure groups

Groups	Male/Female	Mean (SD) age (year)	Mean (SD) serum zinc level (mg/l)
Fever	21/19	3.5 ± 1.2	90.1 ± 14.6
Febrile Seizure	24/20	3.1 ± 1.5	76.8 ± 24.4
Seizure	9/9	2.7 ± 1.4	94.5 ± 17.4

P-value: 0.006

Findings

From 92 children, 40 (43.5%) patients were females, and 52 (56.5%) patients were males. Patients' age was 3.23 ± 1.37 years (females: 3.23 ± 1.41 years, males: 3.22 ± 1.35 years). Mean zinc level in patients was 86.06 ± 20.42 mg/l. There was no significant relation between the mean serum zinc level in females and males (84.12 ± 16.94 mg/l vs. 87.56 ± 22.78 mg/l, $P > 0.05$). Table 1 shows the demographic data and mean serum zinc levels in the 3 groups.

Discussion

The mechanisms underlying febrile convulsion, which have multiple etiologic factors, are not yet clear. Some changes in the levels of proinflammatory cytokines, and zinc in serum and cerebrospinal fluid have been suggested to be responsible for the pathogenesis of febrile convulsion^[5]. We conducted this cross sectional study in Iranian children aged 6 months to 5 years. In comparison with another study^[6] our patients were older (3.23 vs. 19.30 months) and we observed no significant gender difference in relation to serum zinc level^[7]. Mollah et al indicate that male children are more prone to febrile seizure than female children^[6].

In our study a significantly low serum zinc level was found in patients with febrile convulsion as compared to the controls. Similar findings were noted by others. Papierkowski et al found that the mean serum concentration of magnesium and zinc were significantly lower in the children with febrile convulsion^[7]. In another study, researchers have shown that children with febrile convulsion had significantly higher plasma IL-1 beta and prostaglandin levels and lower serum zinc levels during the acute phase. They concluded that these changes may be responsible for the pathogenesis of febrile convulsion^[8].

To understand further the role of trace elements in pathogenesis of febrile convulsion, serum zinc, copper, magnesium and CSF zinc, Mg and protein levels were measured by spectrometry in patients with febrile convulsion, bacterial meningitis and viral CNS infection and in the control group. Authors showed serum and CSF zinc levels were decreased in children with febrile convulsion^[1]. Gunduz et al conducted a study to determine the serum and CSF zinc levels in children with febrile convulsions. They observed that serum and CSF zinc levels decreased during infectious diseases, and that this decrease was more significant in patients with febrile convulsion^[9].

As a limitation in our study, we couldn't assess the CSF zinc level. Zinc is a fundamental component of body enzymes that modulates CNS activities. CSF hypozincemia activates N-methyl-D-aspartate receptors or disinhibits GABAergic action, thus resulting in febrile convulsion^[2]. However, Gerty et al's findings do not support the hypothesis that febrile convulsions are related to reduced CSF zinc concentration^[10].

Conclusion

This study has shown a significant relation between low levels of serum zinc and febrile convulsion. Larger studies should be carried out to determine the relation between low level of CSF zinc and febrile convulsion in Iran.

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