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A study of serum zinc levels in children with febrile convulsions in comparison with normal and febrile children

Madhubalan T., Chidambaranathan S.*, Ramamoorthy R.

Department of Pediatrics, Rajah Muthiah Medical College and Hospital, Annamalai University, Tamil Nadu, India

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*Correspondence:

Dr. Chidambaranathan S., E-mail: arvindr84@gmail.com

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ABSTRACT

Background: A seizure is a paroxysmal time-limited change in motor activity and or behavior that results from abnormal electrical activity in the brain. Seizures are common in the pediatric age group and occur in approximately 10% of children. Most seizures in children are provoked by somatic disorders originating outside the brain such as high fever, infection, syncope, head trauma, hypoxia, or toxins. To determine whether children with febrile convulsion have decreased serum zinc level when compared to normal children and children with fever without convulsions.

Methods: The study included children admitted with bronchiolitis in between during the period of September 2018 to January 2019 at Department of Pediatrics, Raja Muthiah Medical College and Hospital. It is a case-control study. A sample size of 50 was selected for each group Totally 3 Groups, 1. Children with febrile convulsions, 2. Children with fever without convulsions, 3. Normal Children.

Results: The mean serum zinc level in children with febrile convulsions was 42.9 mcg/dl. The serum zinc level in children with fever and normal children was 70 mcg/dl and 71 mcg/dl respectively. On comparing the serum zinc level among the three groups statistical significance was obtained between children with febrile convulsions and the other two groups namely normal children and children with fever alone. Thus, decreased serum zinc level is a significant predisposing factor for febrile convulsions. By using Posthoc Multiple comparisons test we came to know that the Fever convulsion group is significantly different from fever and normal group. There is no significant difference between fever and normal group.

Conclusions: This study shows that serum zinc levels are decreased in children with febrile convulsions, thus indicating that zinc deprivation plays a significant role in the pathogenesis of febrile convulsions.

Keywords: Febrile Seizures, Posthoc multiple comparison, Zinc Level

INTRODUCTION

A seizure is a paroxysmal time-limited change in motor activity and or behavior that results from abnormal electrical activity in the brain. Seizures are common in the pediatric age group and occur in approximately 10% of children. Most seizures in children are provoked by somatic disorders originating outside the brain such as high fever, infection, syncope, head trauma, hypoxia, or

toxins. Less than one-third of seizures in children are caused by epilepsy, a condition defined as two or more unprovoked seizures occurring at an interval greater than 24 hrs apart.² Infants and children are more prone to have seizures than adults. This reflects the greater neuronal excitability at certain ages as the excitatory glutamate system and inhibitory GABA system do not always balance each other.³ This results in a tendency to exhibit symptomatic seizures related to high fever, infections,

minor asphyxia, medication, bacteria toxins and biochemical disturbances like hyponatremia, hypernatremia, hypocalcemia, etc.⁴ Febrile seizures occur in young children at a time in their development when the seizure threshold is low. They typically occur relatively early in an infectious illness usually during the raising phase of the temperature curve. The rectal temperature may exceed 39.2°C and approximately one-fourth of seizure occurs at a temperature of greater than 40.2°C.5 Febrile seizures occur in common childhood infections such as upper respiratory tract infection, lower respiratory tract infection, otitis media, acute gastroenteritis, and children respond to these infections with comparably higher temperatures.⁶ The onset of febrile seizures generally follows a bell-shaped pattern. 94% occur within the first 3 years of age and 6% after 3 years of age. Approximately one half appears during the second year of life with a peak incidence between 18-24 months. Febrile seizures occurring before 6 months of age should raise the suspicion of serious infections like bacterial meningitis.⁷ Febrile seizures after 5 years of age should be managed cautiously because benign causes are less common in older children.8

METHODS

The study included children admitted with bronchiolitis in between during the period of September 2018 to January 2019 at Department of Pediatrics, Raja Muthiah Medical College and Hospital. It is a case-control study. A sample size of 50 was selected for each group Totally 3 Groups, 1. Children with febrile convulsions, 2. Children with fever without convulsions, 3. Normal Children.

Inclusion criteria

- Children aged six months to five years with the first episode of simple febrile convulsions.
- Children aged six months to five years with fever without convulsions.
- Normal healthy children between six months to five years.

Exclusion criteria

 Cerebral palsy, Seizure disorder, Chronic diseases, Weight <70% of expected, Complex febrile seizure, Children on zinc preparations, Recurrent febrile seizure, Children on anticonvulsants.

This study included 150 children aged between 6 months and 5 years among which 50 had presented with the first episode of simple febrile seizures, 50 had fever without seizures and 50 were healthy. Informed consent of the parents of the three groups of children was obtained in a printed consent form in Tamil as the predominant population was illiterate. Any questions or doubts were cleared by the examining physician in Tamil and the signature of the parent or left-hand thumb impression was obtained. The study protocol was approved by the ethics

committee of hospital. Prior to the inclusion of the children in the study, a detailed history of the presenting complaints was recorded which included duration of fever, time of onset of seizures, type of seizures, duration of seizures, past history of seizures and family history of seizures. In addition, history suggestive of any triggering factors for the febrile episode like cough and cold, nasal discharge, ear discharge, burning micturition or crying during micturition were also recorded. Vital signs namely heart rate; respiratory rate and blood pressure were measured and recorded. Three milliliters of whole blood were collected by venipuncture under strict aseptic precautions in sterile metal-free acid propylene washed plastic test tube. The sample was allowed to stand without any disturbance for five hours to enable the settling down of erythrocytes. Then the serum was separated by centrifuging at 2500 revolutions per minute under aseptic conditions.

Statistical analysis

serum zinc levels in three groups of children namely children with febrile convulsions, children with fever alone and normal children. The data collected was entered by a data entry operator and analyzed by a statistician using SPSS software.

RESULTS

In the febrile convulsions group 60% of children were below 2 years of age, 24% between 2 to 3 yrs, 10% between 3 to 4 yrs and 6% were between 4 to 5 yrs of age. In the fever group, 42% were below 2 yrs of age, 22% between 2 to 3.yrs, 18% between 3 to 4 yrs and 18% were between 4 to 5 yrs of age. In the normal group, 30% were below 2 yrs of age, 26% between 2 to 3 yrs of age, 22% between 3 to 4 yrs of age and 22% were between 4 to 5 yrs of age, p=0.060 not significant (Table 1).

Only children with weight for expected more than 70% were included in this study as children with severe malnutrition may have coexistent micronutrient deficiencies. In the febrile convulsions group, 48% had normal nutritional status, 52% had grade I PEM. In the fever group, 50% had normal nutritional status and 50% had grade I PEM. In the normal group, 44% had normal nutritional status and 56% had grade I PEM. p=0.829 not significant (Table 2).

Mean serum zinc level was 43.5 mcg/dl among normal children and 42.2 mcg/dl among children with grade I PEM. There is no significant variation with the nutritional status of the children. p=0.511 not significant (Table 3).

The mean serum zinc level in children with febrile convulsions was 42.9 mcg/dl. The serum zinc level in children with fever and normal children was 70 mcg/dl and 71 mcg/dl respectively. On comparing the serum zinc level among the three groups statistical significance was

obtained between children with febrile convulsions and the other two groups namely normal children and children with fever alone. Thus, decreased serum zinc level is a significant predisposing factor for febrile convulsions. By using Posthoc Multiple comparisons test we came to know that the Fever convulsion group is significantly different from fever and normal group. There is no significant difference between fever and normal group. p=0.0000 <0.0001 significant (Table 4).

Table 1: Age distribution.

A go gwoun		Group				
Age group		F+C	F	N	Total	
< 2 yrs	Number	30	21	15	66	
	% within Group	60.0%	42.0%	30.0%	44.0%	
2 to < 3 yrs	Number	12	11	13	36	
	% within Group	24.0%	22.0%	26.0%	24.0%	
3 to < 4 yrs	Number	5	9	11	25	
	% within Group	10.0%	18.0%	22.0%	16.7%	
4 to <= 5 yrs	Number	3	9	11	23	
	% within GROUP	6.0%	18.0%	22.0%	15.3%	
Total	Number	50	50	50	150	
	% within group	100.0%	100.0%	100.0%	100.0%	

Table 2: Nutritional status.

Nutritional status		Group				
		F+C	F	N	Total	
Grade 1 PEM	Number	26	25	28	79	
	% within Group	52.0%	50.0%	56.0%	52.7%	
Normal	Number	24	25	22	71	
	% within Group	48.0%	50.0%	44.0%	47.3%	
Total	Number	50	50	50	150	
	% within Group	100.0%	100.0%	100.0%	100.0%	

Table 3: Serum zinc level and nutritional status.

Nutritional status		N	Mean	Std. Deviation	Std. Error mean
Serum zinc level	Grade 1 PEM	26	43.5577	6.11883	1.20000
(microgram/dl)	Normal	24	42.2667	7.64180	1.55988

Table 4: Serum zinc level in the three groups.

					95% Confidence	95% Confidence interval for mean		
	N	Mean	Std. Deviation	Std. Error	Lower bound	Upper bound		
F+C	50	42.9380	6.85110	0.96889	40.9909	44.8851		
F	50	70.0380	5.07334	0.71748	68.5962	71.4798		
N	50	71.3640	5.62185	0.79505	69.7663	72.9617		
Total	150	61.4467	14.38832	1.17480	59.1252	63.7681		

DISCUSSION

This study was conducted to determine whether children with febrile convulsion had low serum zinc levels compared to children with fever alone and normal children. The mean age of febrile convulsions was 20 months in this study. Lynette et al reported a mean age of 18 months and all other studies reported mean age of

onset between 20 and 25 months. Positive family history was present in 10% of children with febrile convulsion in this study. This is significantly less when compared to other studies. Frantzen, Lennox-Buchthal et al, in 1981 reported 20% of children with a positive family history in his study. Farwell in 1994 reported positive family history in 29% of cases. However, the finding that children with a positive family history had an earlier age

of onset of febrile convulsions shown in these studies was present in this study also. The mean age of onset was 17.8 months in children with a positive family history which is less compared to 20 months as a whole. ¹⁰ Similar findings were reported by Gatti S, et al. The mean serum zinc levels were 42.9 mcg/dl, 70 mcg/dl and 71.3 mcg/dl in children with febrile convulsions, children with fever alone and normal healthy children.

Children with febrile convulsions have statistically significant low serum zinc levels when compared to children with fever and normal children. 11 Children with fever did not show a significant decrease in serum zinc level compared to normal children which is similar to the findings of has shown that serum zinc levels are decreased in children with fever though the magnitude of decrease was not as much as in febrile convulsions. 12 The serum zinc levels did not show any significant correlation with age of onset sex, axillary temperature or the fever-seizure interval in this study. 13

All the previous studies have shown similar findings in this aspect.¹⁴ In this study the mean serum zinc level in normal children was found to be 71.3 mcg/dl which is the lower limit of the normal reference level of 70 to 110 mcg/dl. The mean serum zinc level in the and were 85.7 mcg/dl and 107.8 mcg/dl respectively.

The mean serum zinc level in children with fever in this study is 70 mcg/dl which is again less than the corresponding values reported by Hauser WA et al. As the serum zinc level in any population is influenced by factors such as dietary pattern, vitamin A and Vitamin D deficiency, zinc levels in the soil and water, further studies are need in this aspect to identify the probable cause for this finding.¹⁵

CONCLUSION

Zinc has already been recommended by the WHO as a part of the management of acute watery diarrhoea. The role of zinc in febrile convulsions should be investigated by further studies and if the results are reproducible zinc supplementation should be extended to other common pediatric conditions like febrile convulsions, pneumonia, etc. However, considering the fact that zinc has multiple beneficial roles in the body system, zinc supplementation may still serve as a cost-effective measure for the prevention of febrile convulsions in the susceptible age group especially in the presence of positive family history.

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Institutional Ethics Committee

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