Journal of Cardiovascular Disease Research
ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

SERUM FERRITIN, SERUM SODIUM LEVELS IN CHILDREN OF AGE 6 - 60 MONTHS WITH FEBRILE SEIZURE: A CROSS- SECTIONAL STUDY IN A TERTIARY CARE HOSPITAL

Authors

Sandeep M[1]., Sridhar P V[2]., Thammanna P S[3]., Ishrath Fathima T M.,[4]

[1]MBBS, MD, Assistant Professor, Department of Pediatrics, Mandya Institute of Medical Sciences, Mandya, Karnataka.

[2]MBBS, MD, Associate Professor* MBBS, Department of Pediatrics, Mandya Institute of Medical Sciences, Mandya, Karnataka.

[3]DCH, MD, Professor, MBBS, MD, Junior Resident Department of Pediatrics, Mandya Institute of Medical Sciences, Mandya, Karnataka.

[4]MBBS, MD, Junior Resident, Department of Pediatrics, Mandya Institute of Medical Sciences, Mandya, Karnataka

* **Correspondence Author**:
Dr Sridhar P V,
Associate Professor,
Department of Paediatrics,
Mandya Institute of Medical Sciences, Mandya, Karnataka

ABSTRACT

Background: Febrile seizures are seizures that occur in children of age group 6 months to 5 years associated with a temperature of 38^0 C (100.4^0F) or higher. Iron deficiency and sodium imbalance are postulated as a risk factor for febrile seizures. This study was conducted with objective to determine serum ferritin and serum sodium levels in children with febrile seizures.

Material and Methods: Prospective cross- sectional study was conducted in wards of Department of Pediatrics, MIMS, Mandya. A total of 100 children were enrolled into study. Hemoglobin, serum ferritin and sodium levels were estimated and analyzed using appropriate statistical tools.

Results: 68 % of children with febrile seizure were male. Male to Female ratio was 2.13: 1. Prevalence of anemia was 44% in febrile seizure group. Mean serum ferritin level in febrile seizure group was 46.71 and in febrile non seizure group was 114.83 (p= 0.022). Mean serum sodium in febrile seizure single episode group was 136.91 and in those with recurrent episode was 135.14 (SD= 2.35) (p= 0.016).

Conclusion: Iron deficiency (anemia, serum ferritin) is more frequently seen in children with febrile seizure. Children with recurrent episode of convulsion are observed to have lower serum sodium level. Early detection and replenishment of iron and correction of sodium disturbance may be thus helpful in preventing/ aborting further episode of febrile seizure.

Key words: Febrile seizure, ferritin, sodium, iron deficiency

Introduction

Febrile seizures are seizures that occur in children of age group 6 months to 5 years associated with a temperature of 38^0 C (100.4^0F) or higher, are not the result of Central Nervous System (CNS) infection or any metabolic imbalance, and occur in the absence of any history of prior afebrile seizures. May be simple or complex febrile seizure.[1] Febrile seizure is the most common type of seizure disorders in children, affecting 2% - 5% of children.

Febrile seizures are often benign in majority of times and rarely leads to brain damage. Febrile seizures can be simple or complex in nature. Most common type been simple febrile seizures. The risk of recurrence of febrile seizure after 1st episode is 50% and 28% in children < 1 year and > 1 year of age respectively.[2, 3]

Iron deficiency is the commonest micro-nutrient deficiency worldwide. It is a preventable and treatable condition. Iron is needed for metabolism of neurotransmitters and for myelination.[4] Iron deficiency alters the electron transport and neurotransmitter synthesis like norepinephrine, dopamine, glutamate, gamma - aminobutyric acid (GABA) in the brain thereby altering the normal functioning of the neural tissue. Hence iron deficiency may alter the seizure threshold of a child.[5, 6]

Iron deficiency anaemia (IDA) in the age group of 6 months to 5 years is defined as haemoglobin less than 11 g/dl, serum ferritin less than 20 ng/ml, mean corpuscular volume (MCV) less than 70fl, mean corpuscular haemoglobin (MCH) less than 25pg/cell and RDW >15%.[7]

Many studies have shown that variations in serum electrolyte levels will increase the susceptibility to seizures and recurrent of febrile seizure during childhood. Relative hyponatremia i.e 130-135mEq/mL is a significant factor in the depolarization of nerve cells, electrical discharge and can be cause of convulsions.[8] Due to deficiency of sodium ion, there is more calcium ion influx, and generation of repetitive action potential which will cause repetitive seizure initiation.[9] Thus serum sodium deficiency leads to a higher risk of recurrence of febrile seizure or convulsion in the first 24 hours of simple febrile convulsion.

Sodium levels is observed to be lower in children with complicated convulsions in comparison with those having simple convulsions. The sodium concentrations are lowest in children with repeated seizures compared with children having simple or other complicated types of febrile seizures such as focal seizures.

Iron deficiency and serum sodium imbalance are postulated as a risk factor (major precipitating factor) for febrile seizures in children. They are easily preventable and correctable condition.

This study was conducted with objective to determine serum ferritin and serum sodium levels in children of age 6 months to 5 years presenting with febrile seizures.

Materials And Methods

Study Design: Prospective cross-sectional study

Study Period: 3 months (March- June 2022)

Sample Size: Calculated using the formula

$= 4pq/d^2$

Where

p = prevalence (based on previous study frequency of iron deficiency anemia in children, it is taken as 0.61)

q= 1- p = 0.39, d= 0.1

Hence sample size = $\frac{4* 0.61* 0.39}{(0.1)^2}$ = **95**

Hence the final minimum sample size for the study was 95

Sampling Method: Purposive sampling

Study Population: Children of age group 6 months to 5 years presenting with febrile seizure to Pediatric wards, Department of Pediatrics, Mandya Institute of Medical Sciences, Mandya, were included in the study

Inclusion Criteria: Children of age group 6 months to 5 years whose parents providing consent for inclusion of their child in study

Case- Group I

- Presenting with seizure associated with axillary temperature of 100^0 F or more
- Febrile children with recurrent seizure

Control- Group II

- Children admitted to hospital with fever without any seizure

Exclusion criteria:

° Children with signs of dehydration
° Children with inadequate fluid intake
° Children with developmental delay/ neurological disorders
° Children with prior history of non-febrile seizure
° Children with chronic hemolytic anemia

Method of Data Collection (study tools):

The present study was carried out in Wards of Department of Paediatrics, Mandya Institute of Medical Sciences, Mandya. Children of age group 6 months to 5 years with febrile seizure satisfying inclusion and exclusion criteria were included after obtaining informed written consent from parents. Study was approved by Institutional ethics committee. They were assessed, detailed history and clinical examination done, socio- demographic data was collected and entered in a predesigned proforma. Relevant investigations like the hematological profile (complete blood counts), serum ferritin, serum electrolyte and serum calcium were done in the study subjects included. Additional investigations like lumbar puncture, neuro imaging were done based on child's condition as per institutional protocol.

Serum ferritin levels: < 12 ng/ml was considered as iron deficiency, > 12 ng/ml as normal. Hemoglobin < 11 g/ dl was used as cut off for considering anemia. Serum sodium < 130 mEq/L was considered as hyponatremia, 130- 135 as relative hyponatremia and sodium value 135- 145 mEq/L as normal.

Statistical Analysis:

Data thus obtained was compiled and entered in MS Excel spreadsheet and analyzed using Open Epi statistical software, version 2.3. Results were expressed in the form of

descriptive statistics like frequency and percentage, analyzed using inferential statistics like Chi square test.

Mean and standard deviation was calculated for continuous variable and compared using unpaired t test. A p value of < 0.05 was considered statistically significant.

Results

Total of 100 children satisfying inclusion and exclusion criteria were included into the study after obtaining informed written consent from parents. 50 children belong to group I (febrile seizure) and 50 children belong to group II (febrile non seizure).

Among the children included in study, 68% were male in group I and 54% were male in group II. Male to Female ratio in group I was 2.13: 1 and in group II was 1.17: 1. (Table1)

Table 1: Distribution of study subjects according to gender (n= 100)

Gender	Group I (%) N= 50	Group II (%) N= 50
Male	34 (68)	27 (54)
Female	16 (32)	23 (46)

Majority of children included in the study belonged to 25- 42 months age roup borth in group I and group II. (Table 2)

Table 2: Distribution of study subjects according to age group (n= 100)

Age group (months)	Group I (%) N= 50	Group II (%) N= 50
6- 24	13 (26)	12 (24)
25- 42	28 (56)	26 (52)
43- 60	9 (18)	12 (24)

In group I (febrile seizure) 44% subjects had anemia, 32% of children in group II (febrile non seizure) had anemia. The difference in distribution observed was not significant statistically (p= 0.216).

Table 3: Distribution of study subjects according to hemoglobin level (n= 100)

Hemoglobin (g/dl)	Group I (%) N= 50	Group II (%) N= 50
</ = 11	22 (44)	16 (32)
> 11	28 (56)	34 (68)

Table 4: Mean hemoglobin, ferritin and sodium among study groups (n= 100)

Parameter	Group I (mean ± SD) N= 50	Group II (mean ± SD) N= 50	Unpaired t test P value
Hemoglobin (g/dl)	10.82 ± 1.55	11.36 ± 1.89	0.121
Serum ferritin (ng/ml)	46.71 ± 123.46	114.83 ± 167.19	0.022
Serum sodium (mEq/L)	136.36 ± 2.14	137.23 ± 2.40	0.0586

Mean hemoglobin in febrile seizure group was 10.82 and in febrile non seizure group was 11.36, the difference in mean value of two groups was not significant statistically (p= 0.121). Mean serum ferritin level in febrile seizure group was 46.71 and that in febrile non seizure group was 114.83, the difference in mean ferritin level of two groups was significant statistically (p= 0.022). Mean serum sodium level in febrile seizure group was 136.36 and in febrile non seizure group was 137.23, the difference observed was not significant statistically (p= 0.0586) (Table 4).

In febrile seizure group 13 children had serum ferritin level < 10 ng/ml as compared to 7 children in febrile non seizure group. Higher number of children in febrile seizure group had iron deficiency (serum ferritin < 10 ng/dl) as compared to febrile non seizure group, however the difference in the frequency was not significant statistically (p= 0.21).

Of the 50 children with febrile seizure 12 had recurrent episode. Mean serum sodium level in children with febrile seizure single episode was 136.91 (SD 2.09) and in those with recurrent episode was 135.14 (SD= 2.35). The difference in mean values of the 2 sub groups was statistically significant (p= 0.016).

Discussion

The present study was a hospital based prospective cross sectional study. Total of 100 children were included in the study. Maximum number of children with febrile seizure were of age group 25- 42 months (56%), followed by 6- 24 months (26%). 68% of children with febrile seizure were male and as compared to 54% in febrile non seizure group . Male to Female ratio in febrile seizure group was 2.13: 1. It can be inferred from the above observation that male children have higher preponderance of febrile seizure. This observation is identical to that observed by Kumawat R et al.[10]

In our study it was observed that frequency of children with Hb < 11 g/dl (I.e anemia) was more in febrile seizure group (44%) as compared to febrile non seizure group (32%), however the difference was not significant statistically (p= 0.216). Mean hemoglobin in febrile seizure group was 10.82 and in febrile non seizure group was 11.36, mean values was lower in febrile seizure group however the difference was not significant statistically. It has been reported by Ghasemi et al. that anemia can be associated with precipitation of febrile seizure.[11]

Mean serum ferritin level in children with febrile seizure was 46.71 ± 123.46 and in febrile non seizure group was 114.83 ± 167.19. The difference was significant statistically (p= 0.022). It can be inferred that children with low serum ferritin are at higher risk of febrile seizure. Low serum ferritin level in children with febrile seizure has been reported in past studies done by Krishnamurthy C et al., Leela Kumari P et al. And Singh P et al. [4, 6, 12]

Mean serum sodium in febrile seizure group was 136.36 and in febrile non seizure group was 137.23, the difference was not significant statistically (p= 0.0586). Mean serum sodium in febrile seizure single episode group was 136.91 (SD 2.09) and in those with recurrent episode was 135.14 (SD= 2.35). The difference in 2 sub groups was statistically significant (p= 0.016). Similar finding of lower sodium levels in

children with recurrent episode of febrile seiure has been reported by Kulandaivel M et al. and Salehiomran M et al.[8, 9]

Conclusion

It is observed that iron deficiency (anemia, serum ferritin) is more frequently seen in children with febrile seizure. Hence it suggests that there exists a correlation between iron status and febrile seizure. Children with recurrent episode of convulsion are observed to have lower serum sodium level as compared to children with febrile seizure single episode. Early detection and replenishment of iron and correction of sodium disturbance may be thus helpful in preventing/ aborting further episode of febrile seizure

Funding: No funding sources
Conflict of interest: None
Ethical approval: The study was approved by the Institutional Ethics Committee

References

1. Mohamad A. Mikati, Dmitry Tchapyjnikov. Febrile seizures. In: Kliegman RM, Stanton BF, SP Geme III JW, Schor NF, Behrman RE. Nelson Textbook of Pediatrics. 21st ed., Vol. 2. Philadelphia: Elsevier; 2019. 3092- 94.
2. Gupta S, Agarwal N, Maheshwari M. Iron Deficiency as a risk factor for febrile seizures – a case control study. PJSR. 2015;8(2):37-40.
3. Nasehi MN, Abbaskhanian A, Omran MRS. Association between iron deficiency anemia and febrile seizure: a systematic review and meta-analysis. J Pediatr Rev. 2013;1(2):13-8.
4. Kumari PL, Nair MK, Nair SM, Kailas L, Geetha S. Iron deficiency as a risk factor for simple febrile seizures - a case control study. Indian Pediatrics 2011;49:17-9.
5. M. Senthil Kumar, B. R. Sasikumar. "Low Iron Status: A Possible Risk Factor for Febrile Seizures". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 90, November 09; Page: 15546-48.
6. C. Krishnamurthy, J. Rukmani, Syed Ali Fathima. Comparative study of serum ferritin level in simple and complex febrile seizures in Government Tirunelveli Medical College. IAIM, 2019; 6(3): 13-17.
7. Ramesh M, Kannan N, Senthil K. A study to determine the association between serum ferritin levels and febrile seizures in children. Sri Lanka J Child Health. 2015; 44(4):193-6.
8. Salehiomran MR, Ebrahimzadeh H, Hajiahmadi M. The serum sodium levels and recurrence of simple febrile seizure during the first 24 hours in children. Caspian J Pediatr March 2018; 4(1): 278-81.
9. Kulandaivel M. Serum Sodium Levels and Probability of Recurrent Febrile Convulsions. Int J Sci Stud 2017;5(2):5-8.
10. Kumawat R, Garg P, Karnawat BS, Verma IP, Arora A, Sonkaria M. Study of iron deficiency as a risk factor for first episode of simple febrile seizure. Int J Contemp Pediatr. 2017;4(5):1881-5.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

11. Ghasemi F, Valizadeh F, Taee N. Iron-deficiency Anemia in Children with Febrile Seizure: A CaseControl Study. Iran J Child Neurol. 2014;8(2):38-44.
12. Singh P, Mehta V. Is iron deficiency anaemia a risk factor for febrile seizure: A case control study. Int J Contemp Pediatr. 2016;3(4):1307-11.