



Original Research Article

A study on serum calcium and magnesium levels in seizures disorders in pediatric age

Vinod Kumar Mandala¹, Murali Krishna Thummakomma¹, Siddhartha Gangadhari¹, Sireesha Patibandla^{1,*}, T Jaya Chandra²

¹Dept. of Paediatrics, Nilofer Hospital for Women & Children, Hyderabad, Telangana, India

²Dept. of Microbiology, GSL Medical College, Rajahmundry, Andhra Pradesh, India



ARTICLE INFO

Article history:

Received 20-07-2022

Accepted 01-09-2022

Available online 17-08-2022

Keywords:

Serum

Electrolytes

Age

ABSTRACT

Introduction: Seizures are the most common neurologic disorder of childhood. A study was undertaken to find the correlation between serum Calcium and Magnesium levels and seizure disorders in pediatric age.

Materials and Methods: It was a prospective case control time bound study, conducted in the department of paediatrics, Gandhi Medical College, Secunderabad. Study protocol was approved by the institutional ethics committee. Informed written consent was taken from the parents of the participants. Children of both gender, aged 1 month – 14 years with seizures were included, included in the test and non seizures in control category. After thorough clinical examination venous blood samples were collected for the estimation of serum electrolyte levels, 24 hours after onset of seizures on admission. T test was used to find the statistical significance and $p > 0.05$ was considered statistically significance.

Results: The mean age was 8.6 and 7.8 years respectively in test and control groups. Seizures were diagnosed to be due to gliosis, mesial temporal sclerosis, infarcts, hippocampal sclerosis, leighs disease. Statistically there was significant difference between the serum electrolyte levels.

Conclusion: There was decrease in serum Ca and Mg levels with seizures. However, there was no correlation between serum electrolytes and severity of seizures.

This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

Seizures are the most common neurologic disorder of childhood, occur in 4 to 10%, approximately and accounts for 1% of all emergency room visits.^{1,2} The incidence is highest among the children below 3 years and decreases with increasing age.^{3,4}

Epileptic seizures can be induced in any normal human brain with a variety of different electrical or chemical stimuli. The ease and rapidity with which these seizures can occur, and the stereotyped nature of the seizures produced suggest that the normal brain, particularly the cerebrum

contains within its fine anatomic and physiologic structure, a mechanism which is inherently unstable and which can be influenced in many different ways to produce a seizure. Thus many kinds of metabolic abnormalities and atomic lesions of brain are claimed to produce seizures, and conversely, there is no pathognomonic lesion of the epileptic brain.

The influence of infectious diseases on the serum minerals is clearly reported in the literature.⁵ Similarly children with seizures present frequently to emergency department also require a thorough laboratory work up, because elevated calcium (Ca) and magnesium (Mg) is found to have increasing roles in pathophysiology of epilepsy. Hypomagnesiemia and hypocalcemia cause hyper

* Corresponding author.

E-mail address: ishadr117@gmail.com (S. Patibandla).

excitability of neurons which is associated with seizures in adults and children. Influence of dietary Mg deficiency in seizures is reported.⁶ However some other studies reported that there is no change in levels of serum Ca and Mg in seizure disorders.⁷

With these it is very clear that there is controversy in serum Mg and Ca levels in seizures. Hence a study was undertaken to find the correlation between serum Ca and Mg levels and seizure disorders in pediatric age group.

2. Materials and Methods

It was a prospective case control time bound study, conducted in the department of paediatrics, Gandhi Medical College, Secunderabad. Study was conducted over a period of 1 year, March 2011 to 2012. Study protocol was approved by the institutional ethics committee. Informed written consent was taken from the parents of the participants.

Children of both gender, aged 1 month – 14 years with seizures were included in the study. Those aged > 14 years, who are on AED, with neurologic defects such as hemiplegia, mental retardation, developmental delay, with cutaneous syndromes such as tuberous sclerosis, neurofibromatosis, VHL, sturge weber syndrome) and those who refused submit the consent were excluded.

During the study period, convenient sampling was considered. Total 80 samples considered. The participants were divided into test and control groups. All the study participants were included in the test group and non seizures children were grouped in control category.

Thorough clinical examination and detailed history was taken from all the study members. Investigations such as neuro imaging, EEG were conducted to find the etiology of seizures. Then venous blood samples were collected for the estimation of serum electrolyte levels, 24 hours after onset of seizures on admission. Blood samples were sent to laboratory for estimation of serum electrolytes by using ion selective electrode potentiometry.⁵

2.1. Statistical analysis

Data were analyzed using SPSS 20. Non parametric data were reported as mean + standard deviation. T test was used to find the statistical significance and $p > 0.05$ was considered statistically significance.

3. Results

Among the 80 (100%) study members, 50 (62.5%) were test and 30 (37.5%) were included in control groups. Age wise, in the test group, 22% (11) were < 1 – 5 years age, 28% (14) in 6 – 10 years age and 50% (25) in 11 – 14 years age. Where as in control group, it was 33.3% (10) each in 1 – 5 years, 6 – 10 years and 11 – 14 years age, respectively (Table 1). The mean age was 8.6 and 7.8 years respectively in test and control groups.

In this report, 36% (18) were diagnosed to be idiopathic epilepsy, meningoencephalitis, neurocysticercosis in 14% (7) each, tuberculoma in 12% (6), hypoparathyroidism in 6% (3) and seizures in 18% (9) cases. Seizures were diagnosed to be due to gliosis, mesial temporal sclerosis, infarcts, hippocampal sclerosis, leighs disease (Table 2).

In the control group, Ca were ranged between 5.1 - 6 mg/dl and Mg levels were between 1.5 – 2.0 meq/l. Whereas in test group, Ca were ranged between 4.1 – 4.9 mg/dl and Mg levels were between 1.6 – 2.0 meq/l. Statistically there was significant difference between the serum electrolyte levels among the test and control groups, respectively (Table 3). The electrolyte levels were statistically significant among the children with and without epilepticus (Table 4).

Table 1: Age wise distribution of the study participants in the groups; n (%)

S.No.	Age in years	Test	Control
1	<1 – 5	11 (22)	10 (33.3)
2	6 – 10	14 (28)	10 (33.3)
3	11 – 14	25 (50)	10 (33.3)
	Total	50 (100)	30 (100)

Table 2: Etiology of seizures among the study members.

S.No.	Etiology	Number	Percentage
1	Idiopathic epilepsy	18	36
2	Meningoencephalitis	7	14
3	Neurocysticercosis	7	14
4	Tuberculoma	6	12
5	Hypoparathyroidism	3	6
6	Others	9	18
	Total	50	100

Table 3: The mean+ SD values of serum Ca and Mg levels in the groups.

Group	Ca in mg/dl	Mg in meq/l
Test	4.66 ± 0.94	1.81 ± 0.25
Control	5.23 ± 0.52	1.94 ± 0.16
P Value	< 0.01	< 0.01
Statistical analysis	There was significant difference	

Table 4: Serum electrolyte levels in with or without epilepticus status among the study team.

Status of Epilepticus (n)	Ca in mg/dl	Mg in meq/l	P value
Present (34)	4.7+1.061	1.8+0.24	>0.01
Absent (16)	4.58+0.67	1.85+0.27	>0.01

4. Discussion

Epilepsy is one of the old maladies, serious neurological disorders reported in the Charakasamhita, 400 BC; it was called with a Sanskrit word means loss of consciousness.^{8,9} However, the perception of epilepsy, a brain disorder begun in 18 century. Approximately 5 – 10% population have at least one seizure attack in the life, the incidence was more in early childhood.¹⁰ More than 50% of seizures have their onset in childhood.⁹

The incidence was 13% below 10 years age and 20% between 30 – 60 years age group.¹¹ In this study, the 50% of the children were below 10 years, the mean age was 8.6 years. The mean age was reported to be 9.43 years by in one of the north India reports by Pandey et al.¹² The investigators also reported that 10.05 years was the mean age in urban population 8.82 years for rural. However, the data were not analyzed in this category in this study.

Gender wise, in this study, the male female ratio was 1.5. The male female ratio was reported to be Tambe SHM et al.¹⁰ Similar results were also reported by Holden et al and Powell et al.^{13,14} Holden et al.¹³ studied 227 neonates of which 157 (56.77%) neonates were male and 120 (43.32%) neonates were female. Powell et al. studied total of 24 cases of which 17 (70.83%) were male neonates and 7 (29.16%) were females neonates.¹⁴ But the cause for the male child predominance was not reported.

In this study, mean + SD values of serum Ca and Mg levels were 4.66 ± 0.94 mg/dl, $5.23 + 0.52$ mg/dl and 1.81 ± 0.25 meq/l, $1.94 + 10.16$ meq/l respectively in the test and control groups; statistically there was significant difference (Table 3). Ca levels were declared as 4.5 ± 0.08 mg/dl, 4.66 ± 0.04 mg/dl by Odapi et al.,¹⁵ 2.38 ± 0.12 mg/dl, 2.48 ± 0.12 mg/dl by R Sinert et al.,¹⁶ respectively in the test and control groups. When Mg levels were considered, Horaciom et al.¹⁷ reported 1.81 ± 0.2 meq/l, 2.08 ± 0.06 meq/l, 1.7 ± 0.22 meq/l, 2.1 ± 0.19 meq/l by S K gupta et al.,¹⁸ respectively in the test and control groups. Seizures were reported when the serum Ca levels fall below 2.4 mg/dl and when the Mg levels were considered below 1.2 meq/l is the threat.¹⁹ In addition, sodium levels are also another influencing factor.^{20,21} but in this study, sodium levels were not estimated, which is another limitation of this research.

In this study, Idiopathic was identified as predominant (36%) cause, followed by meningoencephalitis, neurocysticercosis, tuberculoma and hypoparathyroidism (Table 2). Similar findings were reported by R Sinert et al.¹⁶ Vimelesh et al. mentioned that tuberculoma and tubercular meningitis were the common causes for this epilepsy in the pediatric age.²² Supraorbital brain abscess was mentioned as common cause for epilepsy by Charles G et al. and meningoencephalitis by et al.²³

The mean Ca levels were $4.7+1.061$ mg/dl and Mg level was $1.8+0.24$ meq/l among the study subjects with the status of epilepticus; statistically there was no significant

difference (Table 5). Similarly there was no significant difference between Ca and Mg levels among the study subjects without the status of epileptics (Table 5). There was fall in the serum Mg levels with the status of epilepticus. But this observation is not consistent with S K Gupta et al.¹⁸ According to Uzma Jamil et al. report, serum Ca level was nearly half and Mg was nearly $2/5^{th}$ of previously diagnosed epileptics who were currently presented in status.²³

5. Conclusion

These we conclude that there was decrease in serum Ca and Mg levels among the children with seizures. However, there was no correlation between the levels of serum electrolytes and severity of seizures.

6. Conflict of Interest

The authors declare that they have no conflict of interest.

7. Source of Funding

None.

References

- Guidelines for the management of childhood epilepsy. *Ind Paediatr.* 2009;46:681–98.
- Blumstein MD, Friedman MJ. Childhood seizures. *Emerg Med Clin North Am.* 2007;25(4):1061–86. doi:10.1016/j.emc.2007.07.010.
- Mcabee GN, Wark JE. A practical approach to uncomplicated seizures in children. *Am Fam Physician.* 2000;62(5):1109–16.
- Roth H, Drislane F. Seizures. *Neurol Clin.* 1998;16(2):257–84. doi:10.1016/S0733-8619(05)70064-5.
- Chandra TJ. Correlation between serum calcium levels and smear grading among the pulmonary tuberculosis patients. *J Microbiol Infect Dis.* 2018;8(1):19–22.
- Vinning EP. Paediatric Seizures. *Emerg Med Clin Of Nor Am.* 1994;12(4):973–88.
- Karbasi SA, Mosadegh MM, Fallah R. Utility of laboratory studies in seizures of children older than one month of age. *Age Singapore Med J.* 2009;50(8):814–6.
- Nair PP, Kalita J, Misra UK. Status epilepticus: why, what, and how. *J Postgrad Med.* 2011;57(3):242–52. doi:10.4103/0022-3859.81807.
- Sridharan R. Epidemiology of epilepsy. *Curr Sci.* 2002;82(6):664–70.
- Tambe SHM, Inamdar IA, Bari NA, and ANC. Study of seizures among pediatric age group (0-12 years) in tertiary health care center of a district of Maharashtra, India. *Int J Contemp Pediatr.* 2017;4(2):512–7.
- Trescher H, William L, Ronald P. The epilepsies in walter GB radley neurology in clinical practice. 3rd Edn. Butterworth Heinman Publishers; 2012. p. 1745–79.
- Pandey S, Singhi P, Bhavneet. Prevalence and treatment of gap in childhood epilepsy in a north Indian city: A community based study. *J Trop Pediatr.* 2013;60(2):118–23.
- Faiz N, Malik M, Azam M, Afzal U. Etiology and types of neonatal seizures. *Ann Pak Inst Med Sci.* 2009;5(2):77–80.
- Holden KR, Mellitus ED, Freemann JM. Neonatal seizures: correlation of prenatal and perinatal events with outcome. *Pediatr.* 1982;70(2):165–76.
- Oladipo OO, Lesi FE, Ezeaka VC. Plasma magnesium and calcium levels in children with epilepsy in lagos. *Niger Postgrad Med J.* 2007;14(1):26–9.

16. Sinert R, Zehtabchi S, Desai S, Peacock P, Altura BT, Altura BM. Serum ionized magnesium and calcium levels in adult patients with seizures. *Scand J Clin Lab Invest.* 2007;67(3):317–26.
17. Canelas HM, De LM, Assis FB, De Jorge. Disorders of magnesium metabolism in epilepsy. *J Neurol Neurosurg Psychiatry.* 1965;28(4):378–81. doi:10.1136/jnnp.28.4.378.
18. Gupta SK, Manhas AS, Gupta VK, Bhatt R. Serum Magnesium levels in idiopathic epilepsy. *J Assoc Physicians India.* 1994;42(6):456–67.
19. Udenze IC, Arikawe AP, Azinge EC, Okusanya BO, Ebuehi OA. Calcium and Magnesium Metabolism in Pre-Eclampsia. *West Afr J Med.* 2014;33(3):178–82.
20. Nardone R, Brigo F, Trinka E. Acute Symptomatic Seizures Caused by Electrolyte Disturbances. *J Clin Neurol.* 2016;12(1):21–33.
21. De Leeuw DC, Kooter AJ. Transient seizure-induced sodium increase camouflaging a symptomatic hyponatremia. *BMJ Case Rep.* 2020;13(1):e229328. doi:10.1136/bcr-2019-229328.
22. Sethi V. Neuro tuberculosis, essentials of tuberculosis in children 4th Edn. vol. 335; 2011.
23. Jamil U, Badshah M, Ali ZN, Irshad M, Jamal J. Serum Calcium and magnesium abnormalities in patients with status epilepticus: a single center tertiary care experience. *Pak J Neu Sci.* 2015;10(3):22–6.

Author biography

Vinod Kumar Mandala, Assistant Professor

Murali Krishna Thummakomma, Assistant Professor

Siddhartha Gangadhari, Assistant Professor

Sireesha Patibandla, Assistant Professor

T Jaya Chandra, Professor

Cite this article: Mandala VK, Thummakomma MK, Gangadhari S, Patibandla S, Chandra TJ. A study on serum calcium and magnesium levels in seizures disorders in pediatric age. *Panacea J Med Sci* 2022;12(2):296-299.