

Electrolyte Derangement in Infantile Seizures

Gireesh Kumar K.M, Snehaj Srinivas, George Abraham

Abstract— A study was conducted to evaluate the electrolyte imbalances in infantile seizures. Materials and Methods: Thirty-six infants admitted at the Malabar Institute of Medical sciences Calicut formed the test group. The values are compared with that of 20 apparently healthy infants admitted for other illness. Serum ionized calcium and total calcium, sodium, potassium, Magnesium, inorganic phosphorus and alkaline phosphates were estimated in all the cases. Serum ionized calcium and magnesium were found to be altered in all the subjects even with a normal serum calcium level. Alkaline phosphatase is also found to be elevated in all test subjects. From the study it is recommend that electrolyte estimation should be carried out in all infantile seizures which will help in the early diagnosis and better treatment of infants thereby preventing further brain damage.

Index Terms— Alkaline Phosphatase, Calcium, Electrolytes, Infantile Seizures, Ionized calcium, Magnesium.

1 INTRODUCTION

Neonatal seizures are paroxysmal alterations in neurological function which can be behavioral, motor or autonomic.[1] Seizures initiates when a large number of neurons undergo excessive, synchronized depolarization resulting from excessive excitatory amino acid release such as glutamate or deficient inhibitory neurotransmitter such as gamma amino butyric acid [GABA].[2] An estimated frequency of 80-120 per 100,000 neonates per year has been suggested[3]. Infantile seizures are the most common overt manifestation of neurological dysfunction in the newborn.[4] Clinical features differ significantly from that of seizures in older patients. This is probably due to the anatomical and physiological immaturity of the infantile nervous system, such as the incomplete myelination pattern of infants, which tends to prevent highly organized, synchronized, generalized seizure activity.[5] Calcium being the most plentiful and important mineral in the body, help nerves normal function, muscles contraction, clotting of blood and proper function of the heart. Maintenance of normal blood levels of ionized calcium (Ca²⁺) plays an important role in the management of critically ill patient. The free calcium fraction is the biologically active form its concentration in plasma is tightly regulated by the calcium regulating hormones PTH and 1, 25 dihydroxycholecalciferol [6].

In the present study emphasis given to the estimation of serum electrolytes like Na⁺, K⁺, Ca²⁺, Total calcium, magnesium, , alkaline phosphatase and inorganic phosphorus in the serum of infants having signs of seizures. The variation from the normal level of these parameters does have significance in the diagnosis of seizures. So it is evident that all the infants should be screened for these parameters to avoid the risk of infantile seizures. The vast majority of infantile seizures occur within the first six months and 70% of all cases eventually rec-

- Gireesh Kumar K.M is currently working at Mahe Institute of Dental Sciences and Hospital, Mahe. Email: kmgirishk@gmail.com
- Snehaj Srinivas is currently working at School of Health Sciences, University of Calicut.
- George Abraham is currently working at Malabar institute of Medical sciences, Calicut.

ognized have been diagnosed by the second year.[7]

2 MATERIALS AND METHODS

The present study is carried out in 36 infants admitted with electrolyte imbalance in the pediatric ward of Malabar Institute of Medical sciences were taken with parental consent. Twenty cases of healthy infants with normal range of electrolytes values and no underlying disorders were taken as normal control. Infants having seizures and no other disorders other than electrolyte imbalance were taken as test subjects. The following parameters were estimated in all the subjects. One milliliter of blood was collected from all the subjects, serum separated and the serum used for the estimation of ionized calcium, Sodium and Potassium by Ion Selective Electrode Method, Total calcium is estimated using Ortho-Cresolphthaliene Complexone (OCPC) method, Magnesium by Methyl Thymol blue (MTB) method, Inorganic phosphate by Molybdate UV method and Alkaline phosphatase-Para Nitro Phenol (PNP)-AMP method. All the above investigations were carried out in a fully automated biochemistry analyzer Beckman AU 480.

Table 1: T-test statistics of the study population.

Electrolytes	Control (n=20)	Test (n=36)	t test
	Mean ± SD	Mean ± SD	P value
Sodium In mEq/L	140.95 ± 2.52	139.94 ± 4.36	0.349
Potassium In mEq/L	4.55 ± 0.31	4.66 ± 0.54	0.369
Ionized Calcium in mg/dL	6.48 ± 0.27	4.11 ± 1.06	<0.001†
Total Calcium in mg/dL	9.87 ± 0.68	7.6 ± 1.35	<0.001†
Magnesium in mg/dL	2.09 ± 0.21	1.54 ± 0.37	<0.001†
Phosphorus in mg/dL	5.71 ± 0.9	6.86 ± 1.19	<0.001†
Alkaline Phosphatase in IU/L	359.35 ± 50.76	402.25 ± 64.5	0.013†

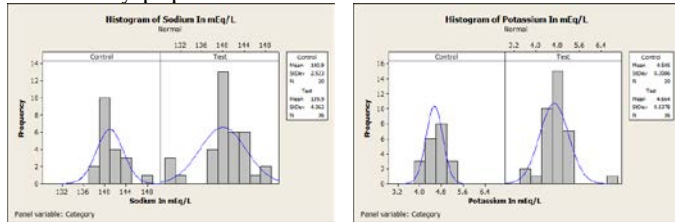
SD: Standard Deviation. †The difference in mean of the test and control has High statistical significant for total, ionized calcium, phosphorus, magnesium and Alkaline phosphatase.

3 RESULTS

The study was conducted at the tertiary care hospital, Malabar institute of Medical sciences Calicut. Thirty-six cases admitted to the pediatric ward with infantile seizure diagnosed with electrolyte imbalance and twenty apparently healthy infants were taken as control. The results of the present study were shown in table 1 and figure 1- 4 with comparison of mean val-

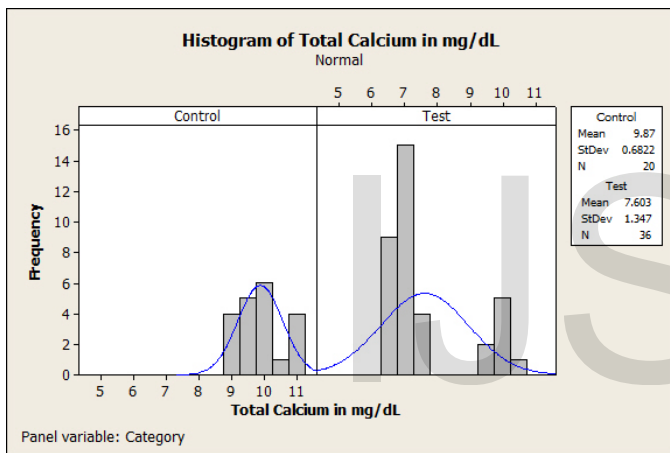
ues of the test values with that of normal control. The difference in mean between the test and control of total Calcium, Ionized Calcium, Phosphorus, Magnesium and Alkaline Phosphatase were showing High statistical significance.

Figure 1. Histogram of Sodium and potassium distribution of the study population.



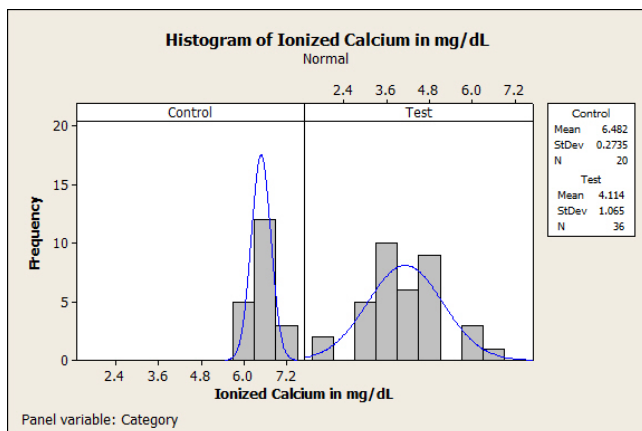
There was no statistically significant difference between the means of sodium and potassium between the test and control subjects.

Figure 2. Histogram of Total Calcium distribution of the study population.



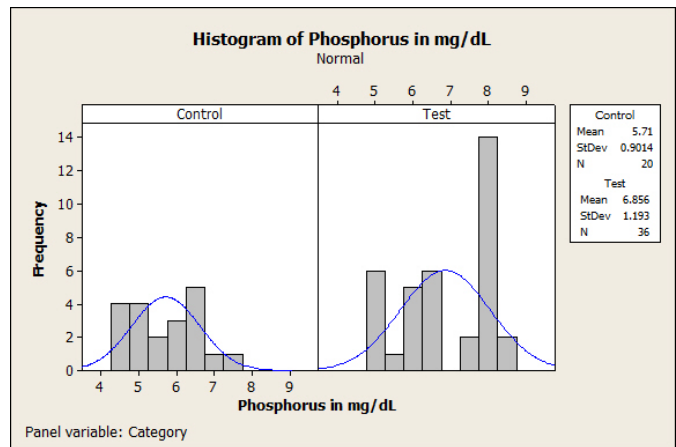
There was statistically significant difference between the means of Total Calcium between the test and control subjects.

Figure 3. Histogram of Ionized Calcium distribution of the study population.



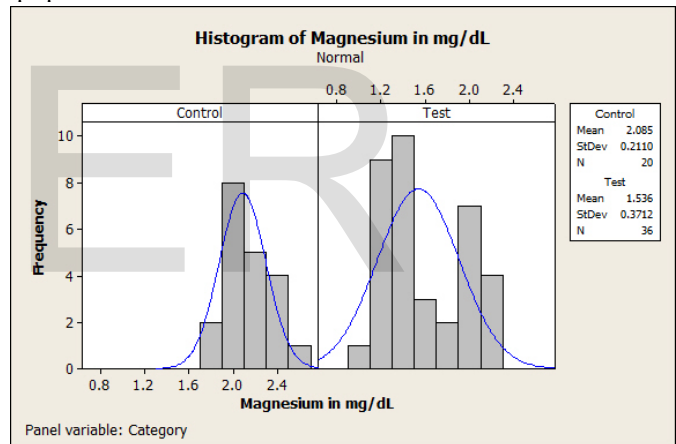
There was statistically significant difference between the means of Ionized Calcium between the test and control subjects.

Figure 4. Histogram of Phosphorus distribution of the study population



There was statistically significant difference between the means of Phosphorus between the test and control subjects.

Figure 5. Histogram of Magnesium distribution of the study population

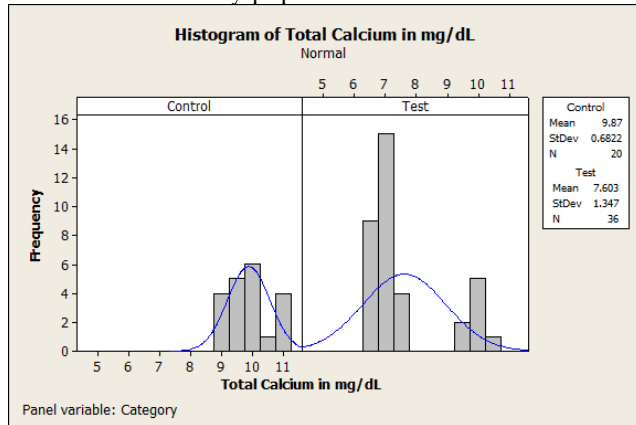


There was statistically significant difference between the means of Magnesium between the test and control subjects.

4 DISCUSSION

The present study reveals that Calcium both total and ionized, phosphorus and magnesium are deranged in the infants with seizures ($p < 0.001$) compared to normal infants. Similar finding were reported by Cockburn, F., et al.(1973)[8]. Altered Calcium but not Sodium or potassium was found in neonatal seizures in the current study which is also reported by the India study of Sood et al.(2003)[9]. Hypocalcemia and hyponatremia are reported by TC Thomas et al.(2012)[10] which was also found in the present study. Hypocalcemic seizures with an elevated alkaline phosphatase as in the present study are also reported by M Bitaraf et al.(2014)[11]. It is recommended that the routine measurement and adjustments of the Calcium phosphorus and magnesium in neonates are good tools for early identification and prevention of seizures in neonates.

Figure 6. Histogram of Alkaline Phosphatase enzyme distribution of the study population



There was statistically significant difference between the means of Alkaline phosphatase enzyme levels between the test and control subjects.

REFERENCES

- [1] Avery, Gordon B. Avery's neonatology: pathophysiology & management of the newborn. Edited by Mhairi G. MacDonald, Mary MK Seshia, and Martha D. Mullett. Lippincott Williams & Wilkins, 2005.
- [2] Holmes, G. L., & Ben-Ari, Y. . The neurobiology and consequences of epilepsy in the developing brain. *Pediatric research*, 2001; 49(3): 320-325.
- [3] Sanghvi, Jagruti P., Surekha B. Rajadhyaksha, and Meher Ursekar. "Spectrum of congenital CNS malformations in pediatric epilepsy." *Indian pediatrics* 41, no. 8 (2004): 831-838.
- [4] Rose AL, Lombroso CT. Neonatal seizure states: a study of clinical, pathological, and electroencephalographic features in 137 full-term babies with a long-term follow-up. *Pediatrics* 1999, 104:404-425
- [5] Scher MS, Aso K, Beggarly ME, Hamid MY, Steppe DA, Painter MJ. Electrographic seizures in preterm and full term neonates: clinical correlates, associated brain lesions and risk for neurologic sequelae. *Pediatrics* 1993; 91(1): 128-34
- [6] Jain, Ashish, Ramesh Agarwal, M. Jeeva Sankar, Ashok Deorari, and Vinod K. Paul. "Hypocalcemia in the newborn." *The Indian Journal of Pediatrics* 77, no. 10 (2010): 1123-1128.
- [7] Volpe JJ, Neonatal seizures. In: *Neurology of the Newborn*, 4th edition, (ed JJ Volpe), pp 129-159. WB Saunders, Philadelphia, 2000
- [8] Cockburn, F., J. K. Brown, N. R. Belton, and J. O. Forfar. "Neonatal convulsions associated with primary disturbance of calcium, phosphorus, and magnesium metabolism." *Archives of disease in childhood* 48, no. 2 (1973): 99-108.
- [9] Sood, Arvind, Neelam Grover, and Roshan Sharma. "Biochemical abnormalities in neonatal seizures." *The Indian Journal of Pediatrics* 70, no. 3 (2003): 221-224.
- [10] Thomas, Teena C., Joshua M. Smith, Perrin C. White, and Soumya Adhikari. "Transient neonatal hypocalcemia: presentation and outcomes." *Pediatrics* 129, no. 6 (2012): e1461-e1467.
- [11] Bitaraf, Masoume, Mohsen Pourazizi, Behrouz Bavarian, Aria Sotoudeh, Ali Rashidy Pour, Ali Rabbani, and Fereidoon Mostafavi. "Hypocalcemic seizure and related factors after neonatal period; A single-center, retrospective study." *Journal of Paramedical Sciences* 5, no. 3 (2014).