Original Research Article

Study of serum magnesium levels and its correlation with febrile convulsions in children aged 6 months to 5 years of age

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Abstract

Background: Various studies have shown the correlation between Magnesium, Zinc and Copper levels in Serum and Cerebrospinal fluid (CSF) and occurrence of Febrile Convulsions. Hypomagnesaemia is characterized by hyper excitability of the central nervous system leading to convulsions. Hence the study is undertaken to find out the Serum Magnesium levels and its correlation with febrile convulsions.

Aim: To Study the Serum levels of Magnesium in children: 6 months - 5 years of age with febrile convulsions and to establish the correlation between serum Magnesium levels and febrile convulsions.

Materials and methods: This study was done in the Department of Pediatrics, Gandhi Medical College, Secunderabad from July 2015 to July 2016. It was an Observational Prospective study. A total of 120 children 6 months to 5 years of age admitted with history of fever and convulsions diagnosed as febrile convulsions were included in the study. Serum Magnesium levels were measured using catalyst method by Synchron CXR systems. Informed Consent was taken from Parents of all the children. Detailed Clinical History was taken along with thorough Clinical examination. Complete Blood Counts, Serum Magnesium levels, Serum Electrolytes, Blood Glucose and Serum Calcium levels were done. CT scan brain was done wherever required

Results: Out of 120 total cases: 104 (86.67%) were Typical Febrile Convulsions. 16 (13.33%) were Atypical Febrile convulsions. Hypomagnesemia was seen in 19 (16%) children. Out of these, 9 (47.36%) cases were Males and 10(52.64%) cases were Females. Out of 104 Typical Febrile convulsions: 17 cases were shown hypomagnesemia, 87 were shown Normal magnesium levels. Out

of 16 Atypical Febrile convulsion cases: Only 2 cases were having hypomagnesemia and 14 were having Normal Magnesium.

Conclusion: No association was found with Gender, Age, and Temperature of the patient and subtype of febrile convulsions. Statistically significant association was found with hypomagnesemia and 'Typical Febrile convulsions'. No such association was found with Atypical Febrile convulsions. Therapeutic value of administration of Magnesium in children with febrile convulsions associated with hypomagnesemia to be established. This requires further interventional studies. Larger clinical studies are required to establish the association of hypomagnesemia and febrile convulsions. Further studies are suggested to determine the effect of Magnesium administration for the prevention of febrile convulsions.

Key words

Febrile seizure, Hypomagnesemia, Synchron CXR system.

Introduction

Febrile seizures are convulsions that occur from 6 months to 60 months of age associated with temperature of ≥38 ˚C, that are not due to CNS infection or any metabolic imbalance and that occur in the absence of a history of prior afebrile seizures.

Simple Febrile Seizures: Primary generalized convulsions, usually tonic–clonic in nature associated with fever, lasting for maximum of 15 minutes, and do not recur within a 24 hours

Complex Febrile Seizures: Prolonged seizures lasting >15 minutes / Focal and/or Recur within 24 hours.

The normal plasma magnesium levels are 1.5 to 2.3 mg/dl. Magnesium is essential for membrane stabilization and nerve conduction. Hypomagnesemia is defined as serum magnesium levels below 1.5 mg/dl. Febrile convulsion is one of the most common seizure disorders in childhood. The exact etiology and pathogenesis is still not fully established. Factors like Genetic predisposition and Alteration of neurotransmitters and some trace elements are incriminated.

Role of Magnesium Levels in Febrile Convulsions

- Glutamate is a major excitatory neurotransmitter in the brain acting as an agonist at NMDA receptors.
- Extracellular Mg2+ normally blocks NMDA receptors.
- Thus hypomagnesemia may release the inhibition of NMDA receptor.
- This leads to glutamate-mediated depolarization of the postsynaptic membrane and enhancement of epileptiform electrical activity

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Materials and methods

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Clinical examination. Complete Blood Counts, Serum Magnesium levels, Serum Electrolytes, Blood Glucose and Serum Calcium levels were done. CT scan brain was done wherever required.

Inclusion criteria:

- Children from 6 months to 5years of age with normal Neurological development with a diagnosis of Febrile Convulsions.
- Children with febrile convulsion admitted for the first time to our hospital

Exclusion criteria:

- Seizures due to CNS infections and metabolic causes
- Children with History of Neonatal seizures
- Children on magnesium supplements and/or received magnesium recently
- Children admitted with febrile convulsions but who were already evaluated during previous admission in our institution were excluded from the study

Results

Total No. Cases studied: 120 over a period of one year from July 2015 to June 2016. Out of 120 cases, 67 (55.84%) were males and females 53 (44.16%) as per **Figure – 1**. Amongst 120 cases 31 were infants, 33 toddlers and 56 were in preschool age .serum magnesium levels were normal in 101 (84%) and in only 19 (16%) cases showed hypomanesemia as per **Figure - 2**.

Figure – 1: Gender distribution of cases.

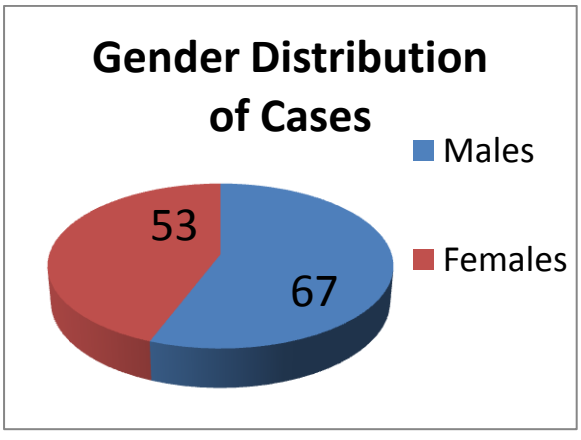
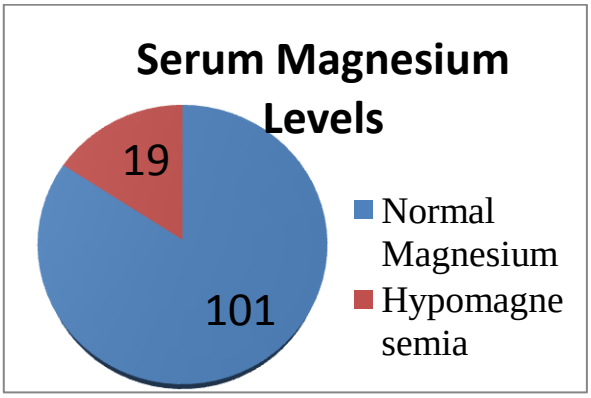


Figure – 2: Serum magnesium levels.



Hypomagnesemia was seen in 8 infants (6.6%) as compare to toddlers and preschool aged where only 4 (3.3%) and 7 (5.8%) respectively had hypomagnesemia as per **Table - 1**.

Temperature was <100 ˚F in 10 cases, between 100 ˚F – 102 ˚F in 103 cases and in 7 cases it was >103 ˚F which was statistically not significant pvalue0 0.4919 as per **Figure - 3**.

Out of 19 hypomagnesemia cases, males were 9 (47.36%) and females were 10 (52.64%) with insignificant p value 0.2090 as per **Figure - 4**.

Other biochemical abnormalities that were noted in these febrile convulsions children were hypocalcemia - 19 (15.83%), hypoglycemia - 7 (3.3%) and hyponatremia – 4 (3.3%) as per **Figure - 5**.

Out of 104 cases of typical febrile seizure, 17 cases (16%) had hypomagnesemia which was stastistically significant with p value 0.014 as per **Figure - 6**.

Out of 16 cases of focal seizure, 2 had hypomagnesemia, out of 16 cases of clonic seizure 3 had hypomagnesemia. Out of 38 tonic seizure and 51 GTCS seizure 5 and 9 cases had hypomagnesemia respectively. P=0.2036 as per **Figure - 7**.

The most frequently identified cause of febrile seizure was URTI (34%) then acute GE (20%),

LRTI (17%), viral pyrexia (10%) , malaria (8%) and UTI (8%), others (3%) as per **Figure - 8**.

S. Magnesium between 1.4-1.5 mg/dL was present in 8 (42.1%) cases, S. Magnesium between 1.3-1.4 mg/dL was present in 10 (52.63%) cases and S. Magnesium < 1.3 mg/dL was present in 1 (5.26%) cases as per **Figure – 9**.

Table – 1: Age wise distribution of febrile convulsion cases vs mg levels.

MAGNESIUM LEVELS	INFANTS (31)	TODDLERS (33)	PRE SCHOOL (56)
DECREASED	8	4	7
NORMAL	23	29	49

Figure – 3: Temperature distribution.

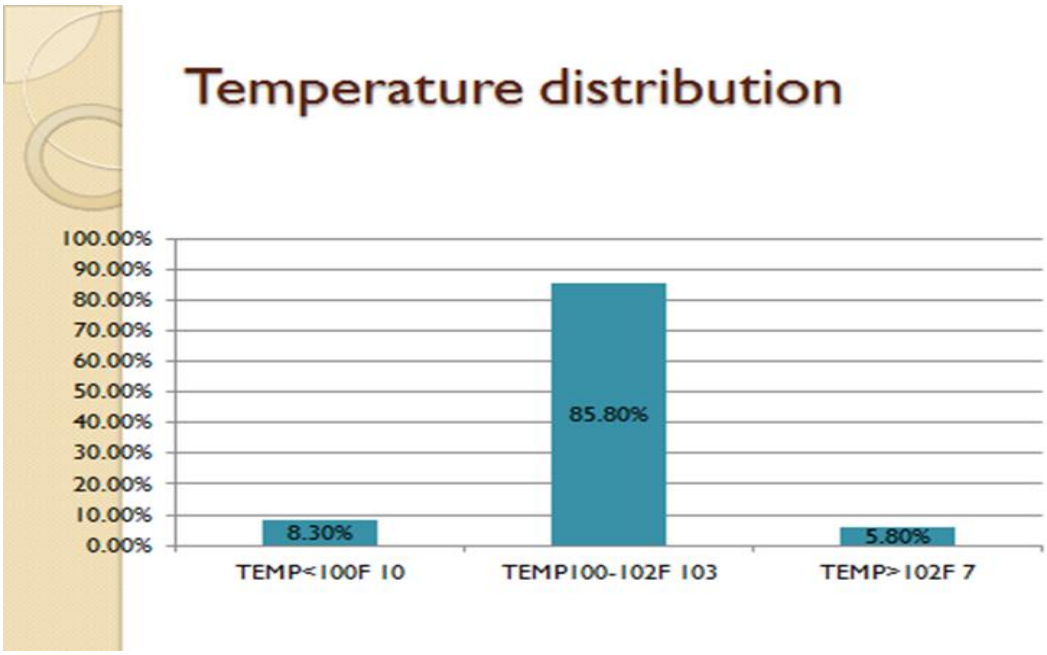


Figure – 4: Distribution of hypomagnesemia according to sex.

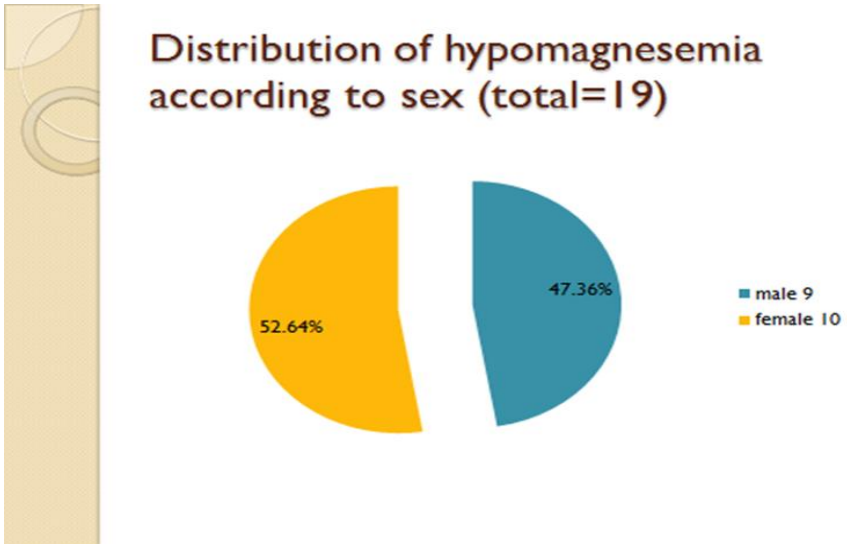


Figure – 5: Association between hypomagnesemia and other biochemical abnormalities.

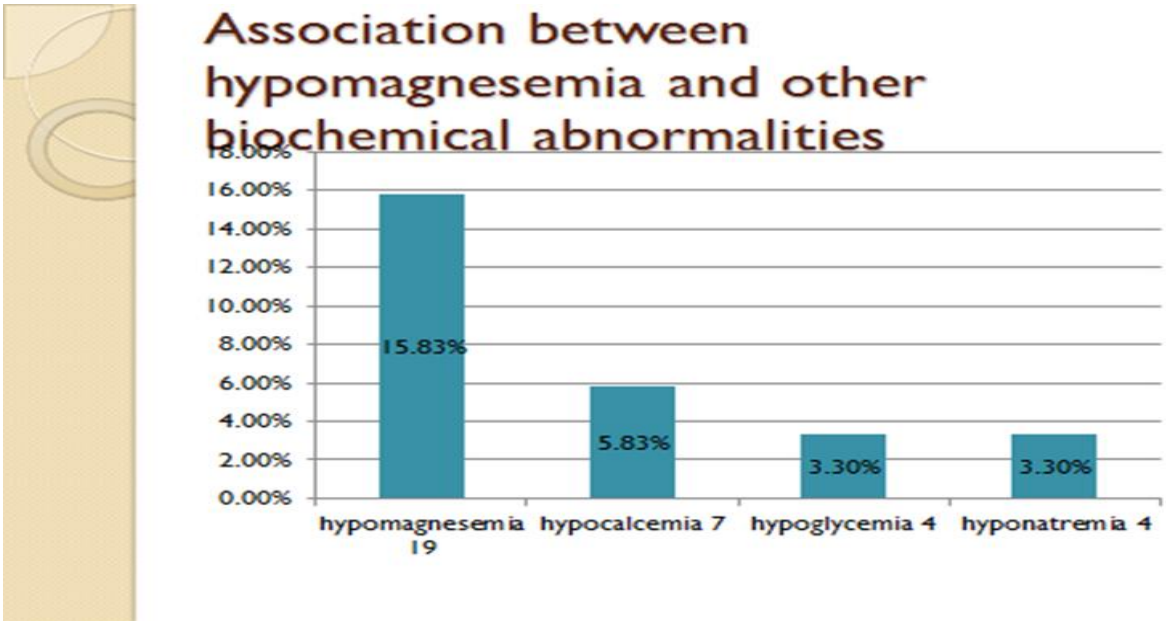
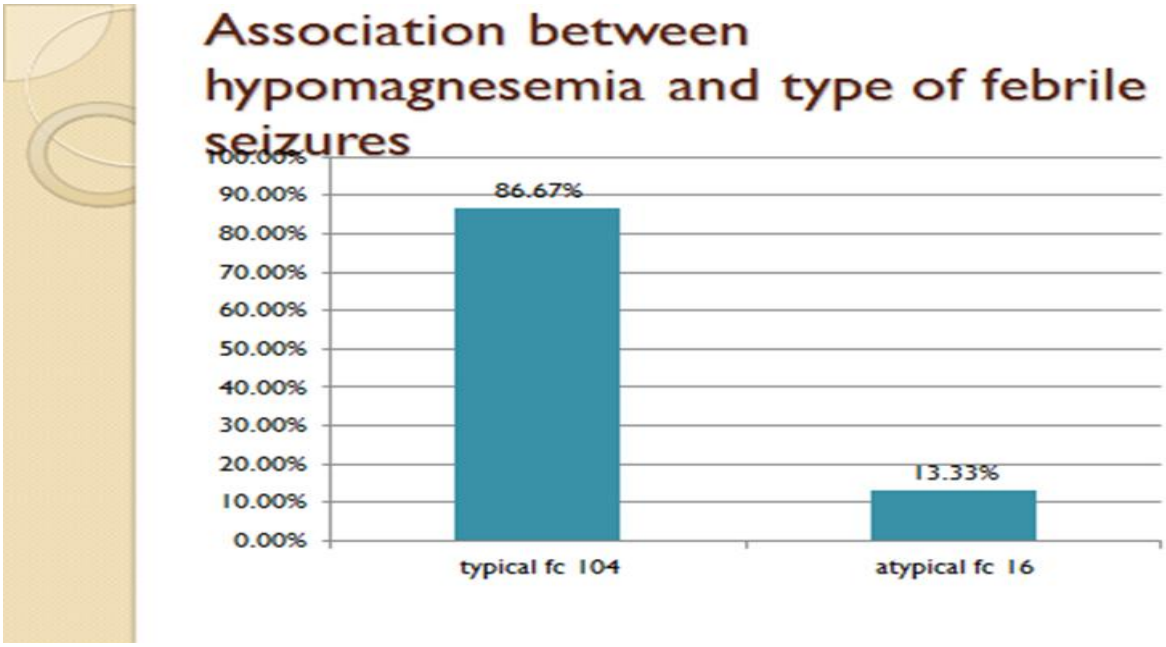


Figure – 6: Association between hypomagnesemia and type of febrile seizures.



Discussion

Magnesium (Mg) is the fourth most common cation in the body and third most common intracellular cation. It is mainly found in muscle, other soft tissues, bone and erythrocyte [1].

It is also involved in neuronal function and it inhibits the facilitatory effects of calcium on synaptic transmission and also exerts a voltage dependent blockage of N-methyl-D-aspartate (NMDA) receptor channel [2].

The actions of magnesium on nervous system is that it reduces the release of acetylcholine at the neuromuscular junction by antagonising calcium ions at the presynaptic junction, reduced excitability of nerves, and acts as anticonvulsant, reverses cerebral vasospasm [7].

Figure – 7: Association between hypomagnesemia subtype of seizures.

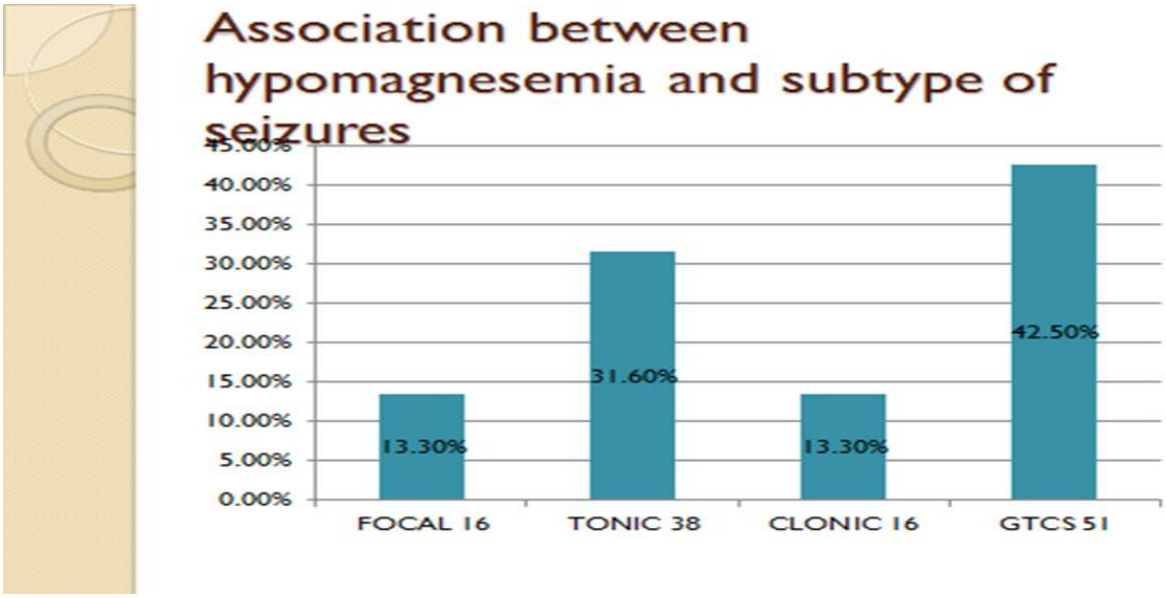


Figure – 8: Association between etiology of fever and hypomagnesemia.

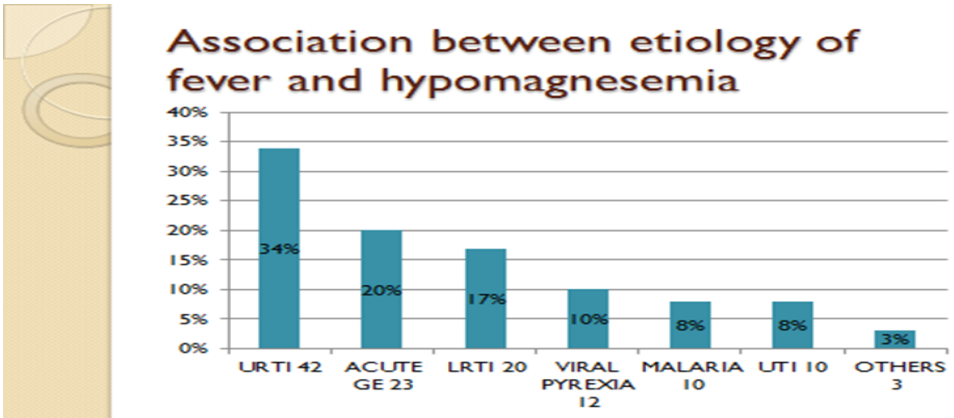
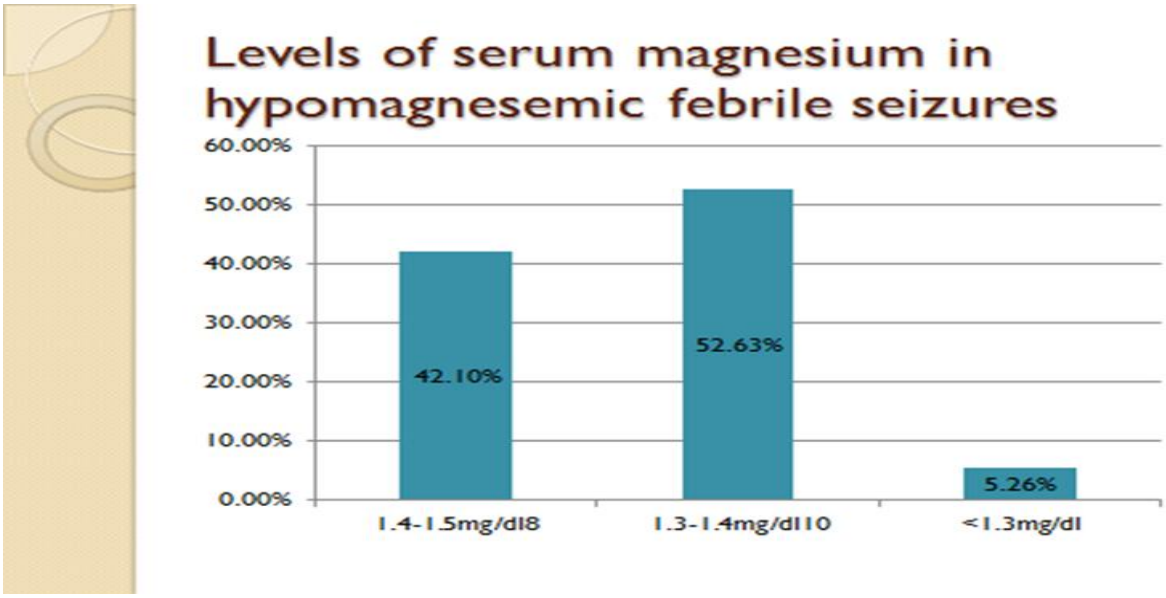


Figure – 9: Levels of serum magnesium in hypomagnesemic febrile seizures.



It has been suggested that low serum Mg has occasionally been associated with significant effects on the central nervous system especially in causing seizures.

It is suggested that an alterations in Mg concentrations in plasma and intracellular matrix gives rise to a functional impairment of the cell membranes, which might trigger seizures. Recent evidences indicate that the deficiency of Mg can play a significant role in febrile convulsions [7, 8].

Therefore, it is assumed that the deficiency of these elements can have contributing effect in the incidence of febrile convulsion.
Majority (99%) of magnesium is intracellular, the normal serum magnesium concentration is 0.7–1.15 mmol/l (1.7-2.8 mg/dl) [8]. Amonst 19 cases of hypomagnesium, 8 (42.1%) cases had serum magnesium levels between 1.4-1.5 mg/dl, 10cases 952.63) had s.mg levels between 1.3-1.4 and one case (5.6%) had s.mg levels below 1.3 mg/dl.

Magnesium plays an important role in establishing the electrical potential across cell membranes as a result of its involvement in the Na+/K+ ATPase system, which is responsible for maintaining sodium and potassium gradients across cell membranes and normal potassium concentration [9].

Magnesium also effects calcium metabolism; the production of cyclic adenosine monophosphate (cAMP) is magnesium dependent, which in turn controls the release of parathyroid hormone. Not surprisingly deficiency of magnesium is often associated with hypocalcaemia [5, 6] in contrast our study had only 7cases (5.83%) of hypocalcemia and it was absent in Balu ram and sherlin study [11] in our study. Most common other metabolic abnormalities associated with hypomagnesemia were hypocalcemia followed by hypoglycaemia and hyponatremia.

Our study had more female children with hypomagnesemia 10 (52.64%) than males 9 (47.36%) in contrast to other studies which showed male predominance, Baluram and Sherlin [11] and Mishra, Om Prakash, et al. [13]. Other study like Ali Abbaskhan Iyan, et al. [10] also showed significant negative correlation between hypomagnesemia and severity of fever like in our study.

In our study there is positive correlation between hypomagnesemia and typical febrile seizure with p value of 0.0124 unlike in other studies like Ahmed Talebian, et al. [12].

Our study showed most common subtypes seizure activity (hypomagnesemia cases) being generalized tonic clonic seizures seen in 9 cases out of 51 GTCS cases followed by tonic, clonic and focal type. Most common etiological of fever was upper respiratory tract infection 42 cases (34%), a cute GE23 cases (20%), LRTI 20 (17%), viral pyrexia 12 (10%), malaria and UTI each 10 cases (8%) others 3%.

In our study ,The mean value for magnesium in normomagnesemia cases was 2.25 ± 0.23 with P value calculated as 0.01224 which was significant and in hypomagnesemic cases it was 1.38 ± 1.2 with p value 0.083793 which was not significant. Many other studies like Koshrashoni, et al. [14] also had no significant correlation between serum magnesium levels and febrile convulsion. Unlike in B.C. Chaparwal, et al. study [5] which showed significant decrease in serum magnesium levels in febrile convulsions although total no of cases study was less.

Conclusions

No association was found with Gender, Age, and Temperature of the patient and subtype of febrile convulsions Statistically significant association was found with hypomagnesemia and ‘Typical Febrile Convulsions’ No such association was found with Atypical Febrile Convulsions Therapeutic value of administration of Magnesium in children with Febrile convulsions associated with hypomagnesemia to be established. This requires further interventional

studies. Larger clinical studies are required to establish the association of hypomagnesemia and febrile convulsions. Further studies are suggested to determine the effect of Magnesium administration for the prevention of febrile convulsions.

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