



HYPOMAGNEAEMIA AMONG CHILDREN AT PEDIATRIC INTENSIVE CARE UNIT, NISHTAR HOSPITAL, MULTAN.

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Article received on:

14/12/2018

Accepted for publication:

20/06/2019

ABSTRACT... Objectives: This study was conducted to determine the frequency of hypomagnesaemia among children admitted in pediatric intensive care unit (PICU). **Study Design:** Cross-sectional study. **Setting:** Department of Pediatric medicine, Unit-I, Nishtar Hospital, Multan. **Periods:** From 1st August 2017 to 31st May 2018. **Material & Methods:** A total of 379 children of age group 1-12 years and either gender were admitted at PICU irrespective of presenting complaint with duration of illness less than 2 weeks were included. Post stratification chi-square test was applied to see the effect of different variables like age of the patients, BMI, duration of illness and serum Magnesium levels, hypomagnesaemia, residential status, socioeconomic status, mother's education and gender, on hypomagnesaemia. P value < 0.05 was considered as significant. **Results:** Of these 379 study cases, 221 (58.3%) were boys while 158 (41.7%) were girls. Mean age of our study cases was 4.81 ± 2.27 years. Mean duration of illness was 5.57 ± 2.34 days. Mean weight of study cases was 17.30 ± 5.92 kilograms. Mean serum Magnesium level was 1.45 ± 0.67 mg/dl. Hypomagnesemia was found to be present in 190 (50.1%). Male gender, urban residential status, illiteracy, hospitalization before PICU admission, disease duration of 1 to 2 weeks and weight < 20 kg turned out to be significantly associated ($p < 0.05$) with hypomagnesaemia. **Conclusion:** High frequency of hypomagnesaemia was noted among children admitted at PICU. Children with hypomagnesaemia had prolonged hospital stay and adverse outcomes. Hypomagnesaemia was significantly associated with male gender, residential status, mother's educational level, hospitalization before PICU admission, disease duration and weight.

Key words: Frequency, Hypomagnesaemia, Pediatric Intensive Care Unit.

Article Citation: Joiya SJ, Khan MA, Shabbir I. Hypomagnesaemia among children at pediatric intensive care unit, Nishtar Hospital, Multan. Professional Med J 2020; 27(3):461-466. DOI: 10.29309/TPMJ/2020.27.3.2478

INTRODUCTION

Magnesium is the 2nd most abundant intracellular cation and it is vital for more than 300 enzymatic reactions which are involved in various metabolic processes in our body¹⁻⁴, but still, it is often a parameter which is overlooked by the clinicians. Hypomagnesaemia is now recognized as a significant risk factor for parthenogenesis and thus for hypertension, decreased bone stability, increased susceptibility to epileptic seizures in children and also associated with high incidence of renal stones.^{3,4} More specifically, low magnesium levels were associated with poor endothelial reactivity, higher oxidative stress, increased intima-media thickness, vascular calcification, progression of CKD and mortality.⁵⁻⁷

Hypomagnesaemia is a common entity occurring up to 12% of hospitalized patients and up to 60% of patients in intensive care settings though often missed. Symptomatic magnesium depletion may be due to gastrointestinal or renal losses. It may present with hypokalemia, hypocalcemia and tetany. Hypocalcemia and hypokalemia in hypomagnesaemia are often refractory to treatment with vitamin D or parathyroid hormone (PTH) or potassium supplementation unless the underlying magnesium deficit is corrected.⁸

Magnesium deficiency is frequently observed in critically ill patients and it is associated with high mortality in patients of ICU and different studies have reported 20 – 70 % frequency

of hypomagnesaemia in patients admitted in ICU.⁹⁻¹¹ Haque et al reported 44 % frequency of hypomagnesaemia in children admitted to PICU.⁹

This study was conducted to determine the frequency of hypomagnesaemia among children admitted in pediatric intensive care unit (PICU) as there is only one retrospective study done in Pakistan from Karachi with a sample size of 179.⁹ This study was planned with large sample size which was thought to give more authentic and reliable information to produce useful baseline database of our local population.

MATERIAL & METHODS

This cross-sectional study was carried out at Pediatric Intensive Care Unit (PICU) of Department of Pediatric medicine, Unit-I, Nishtar Hospital, Multan from 1st August 2017 to 31st May 2018. This study was approved by the ethical review committee of our institution and requirement of informed consent was waived. Sample size was estimated using WHO sample size calculator. The frequency of hypomagnesaemia in children in PICU as 44%⁹ and margin of error as 5% were used. This gave minimum sample size of 379 children.

Patients were included in study by using non-probability consecutive sampling technique. All children of age group 1-12 years, of either gender admitted at PICU of irrespective of presenting complaint with duration of illness less than 2 weeks were included. However, Patients who took replacement for hypomagnesaemia in last 24 hours, or presenting with acute kidney injury (AKI) and chronic renal failure or with known congenital renal magnesium wasting (e.g., Bartter's syndrome and Gitelman's syndrome) were excluded from the study.

A specialized proforma was developed to record the findings of this study. All the patients who met inclusion criteria of this study were registered from Department of Pediatrics, Pediatric intensive care unit (PICU) of Nishtar Hospital, Multan. Informed consent was taken from the parents of these patients describing them objectives of this study, ensuring them confidentiality of the information

provided and fact that there is no risk involved to the patient while taking part in this study. All the relevant baseline investigations were done. Venous blood sample (5 ml) was drawn by a trained phlebotomist and sent to laboratory of Nishtar Hospital Multan for serum analysis of magnesium levels (by senior pathologist having 5 years post fellowship experience) within first 24 hours of admission in PICU to diagnose hypomagnesaemia. (Serum magnesium level <1.5 mg/dL (0.62 mmol/L) which was outcome variable of this study.

All the data was entered and analyzed using SPSS Version 18. Mean and standard deviation were calculated for quantitative variables like age of the patients, BMI, duration of illness and serum Magnesium levels. Frequencies and percentage were calculated for the qualitative variables like hypomagnesaemia, residential status, socioeconomic status, mother's education and gender. Effect modifiers like age, BMI, socio-economic status, residential status, mother's education, duration of illness, hospitalization before PICU admission and gender were controlled by making stratified tables. Post stratification chi-square test was applied to see their effect on outcome. P value < 0.05 was considered as significant.

RESULTS

Out of 379 study cases, 221(58.3%) were boys while 158 (41.7%) were girls. Mean age of our study cases was 4.81 ± 2.27 years (ranging 2 to 11 years). Our study results have indicated that majority of our study cases i.e. 283 (74.4%) belonged to the age group of 1 – 5 years. There were 205 (54.1%) cases from rural areas, 252 (66.5%) belonged to poor families (income of the family as less than Rs.20000 per month) and majority of the mothers i.e. 253 (66.8%) were illiterate (could not read and write). Mean duration of illness was 5.57 ± 2.34 days and majority of patients i.e. 300 (79.2%) had disease duration up to 1 week and 111 (29.3%) had history of hospitalization before PICU admission. Mean weight of our study cases was 17.30 ± 5.92 kilograms and majority of our study cases i.e. 299 (78.9%) had weight equal/less than 20 kilograms.

(Table-I).

Mean serum Magnesium level was 1.45 ± 0.67 mg/dl and hypomagnesemia was present in 190 (50.1%) of our study cases. (Figure-1). Hypomagnesemia was stratified with regards to gender, age, residential status, socioeconomic status, mother’s educational level, hospitalization before PICU admission, disease duration and weight. (Table-II). Male gender, urban residential status, illiteracy, hospitalization before PICU admission, disease duration of 1 to 2 weeks and weight < 20 kg turned out to be significantly associated ($p < 0.05$) with hypomagnesaemia (Table-II).

Variables	Frequency (%)
Age	
1-5 years	283 (74.7%)
6-12 years	96 (25.3%)
Gender	
Male	221 (58.3%)
Female	158 (41.7%)
Residence	
Rural	205 (54.1%)
Urban	174 (45.9%)
Socioeconomic Status	
Poor	252 (66.5%)
Middle	127 (33.5%)
Level of Education	
Illiterate	253 (66.8%)
Up to SSC	110 (29.0%)
Intermediate & above	16 (4.2%)
Hospitalization	
Yes	111 (29.3%)
No	268 (70.7%)
Disease duration	
Up to 1 week	300 (79.2%)
1 – 2 weeks	79 (20.8%)
Weight	
Equal or Less than 20 Kg	299 (78.9%)
More than 20 Kg	80 (21.1%)

Table-I. Characteristic of study variables (n=379).

DISCUSSION

Magnesium is an intracellular cation with roles in multiple physiologic processes, such as parathyroid metabolism, cardiovascular tone, nerve conduction, and proper function of

adenosine triphosphate complexes. However, serum hypomagnesemia (defined as <1.5 mg/dL [0.62 mmol/L]) is often asymptomatic and “not often clinically significant.” Studies in PICUs have reported a 20% to 60% incidence of hypomagnesemia on arrival but are divided on its role in predicting mortality and length of ICU stay.^{10,11} Outside of the ICU, hypomagnesemia has been reported in children with malignancy and in up to 15% of those being treated for malnutrition, but its role as a routine laboratory assessment has not been studied.^{12,13}

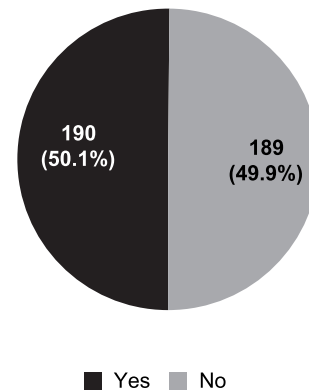


Figure-1. Hypomagnesaemia amongst study cases (n=379).

Magnesium deficiency commonly occurs in critical illness and correlates with a higher mortality and worse clinical outcome in the intensive care unit (ICU). Magnesium has been directly implicated in hypokalemia, hypocalcemia, tetany, and dysrhythmia.¹⁴ Moreover, magnesium may play a role in acute coronary syndromes, acute cerebral ischemia, and asthma. Magnesium regulates hundreds of enzyme systems. By regulating enzymes controlling intracellular calcium, magnesium affects smooth muscle vasoconstriction, important to the underlying pathophysiology of several critical illnesses. The principle causes of magnesium deficiency are gastrointestinal and renal losses; however, the diagnosis is difficult to make because of the limitations of serum magnesium levels, the most common assessment of magnesium status.¹³⁻¹⁵

Variable	Hypomagnesaemia		Total (n=379)	P-Value
	Yes (n=190)	No (n=189)		
Gender				
Male	127 (66.8%)	94 (49.7%)	221 (58.3%)	0.001
Female	63 (33.2%)	95 (50.3%)	158 (41.7%)	
Age Groups				
1-5 years	142 (74.7%)	141 (74.6%)	283(74.7%)	0.99
6-12 years	48 (25.3%)	48 (25.4%)	96 (25.3%)	
Residential Status				
Rural	48 (25.3%)	157 (83.0%)	205 (54.1%)	0.001
Urban	142 (74.7%)	32 (17.0%)	174 (45.9%)	
Socioeconomic Status				
Poor	126 (66.3%)	126 (66.7%)	252 (66.5%)	0.99
Middle	64 (35.7%)	63 (33.3%)	127 (33.5%)	
level of Education				
Illiterate	142 (74.7%)	111 (58.7%)	253 (66.8%)	0.001
Upto SSC	32 (16.8%)	78 (41.3%)	110 (29.0%)	
Intermediate and above	16 (8.4%)	0 (0%)	16 (42.2%)	
Hospitalization before PICU admission				
Yes	95 (50%)	16 (8.5%)	111 (29.3%)	0.001
No	95 (50%)	173 (91.5%)	268 (70.7%)	
Disease Duration				
< 1 week	127 (66.8%)	173 (91.5%)	300(79.2%)	0.001
1-2 weeks	63 (33.2%)	16 (8.5%)	79 (20.8%)	
Weight				
< 20 kg	158 (83.1%)	141 (74.6%)	299 (78.9%)	0.045
> 20 kg	32 (16.9%)	48 (25.4%)	80 (21.1%)	

Table-II. Stratification of study variables with respect to effect modifiers of hypomagnesaemia.

Our study included a total of 379 study cases admitted to PICU meeting inclusion criteria of our study. Of these 379 study cases, 221 (58.3%) were boys while 158 (41.7%) were girls. Haque et al⁹ from Karachi also reported 66.5% male gender predominance in children admitted to pediatric intensive care unit (PICU). Our study results are in compliance with that of Haque et al.⁹ Another study from Karachi also reported 66% male gender predominance which is in compliance with that of our study results.¹⁶ Ahmed et al¹⁷ reported 58% boys admitted to PICU showing predominance over female patients which is similar to that of our study results. Rady HI¹⁸ from Egypt also reported 56% male gender predominance which is close to our findings. Volakaliet al¹⁹ also reported 64% boys being admitted to PICU. Male predominance in this aspect could be due to overall male gender predominance in our society.

Mean age of our study cases was 4.81 ± 2.27 years (minimum age as 2 years while maximum

age as 11 years). Mean age of male patients was 4.88 ± 1.99 years while that of girls was 4.72 ± 2.62 years ($p = 0.482$). Our study results have indicated that majority of our study cases i.e. 283 (74.4%) belonged to age the age group of 1 – 5 years. Haque et al⁹ also reported 56.3 ± 5.5 months mean age of the children admitted to PICU, these findings are in compliance with that of our study results. Another study conducted by Haque et al¹⁶ from Karachi reported 63% children admitted to PICU were less than 5 years of age which is similar to that of our study results. A study from Ahmed et al¹⁷ reported 41 months mean age of the children admitted to PICU which is similar to that of our study results. Rady et al¹⁸ from Egypt also reported children less than 5 years of age predominating (87%) admitted to PICU. Volakali et al¹⁹ reported 54.26 ± 49.93 months mean age of the children admitted to PICU which is close to our findings. Abebe et al²⁰ reported same findings.

Mean duration of illness was 5.57 ± 2.34 days and

majority of patients i.e. 300 (79.2%) had disease duration up to 1 week and 111 (29.3%) had history of hospitalization before PICU admission. Mean duration of stay at PICU was 3.89 days (range 1 - 15 days) in a study reported by Ahmed et al¹⁷ which is close to our findings. Volakaliet al¹⁹ reported 8.85 ± 23.28 days mean duration of PICU stay.

Mean weight of our study cases was 17.30 ± 5.92 kilograms and majority of our study cases i.e. 299 (78.9%) had weight equal/less than 20 kilograms. A study conducted by Haqueet al⁹ also reported mean weight of the children admitted to PICU was 14.7 ± 13 Kilograms which is in compliance with that of our study results.

Mean serum Magnesium level was 1.45 ± 0.67 mg/dl and hypomagnesemia was present in 190 (50.1%) of our study cases. Haque et al⁹ from Karachi also reported high prevalence of hypomagnesemia which is 44%. These findings are close to our study results. A study conducted in USA reported hypomagnesemia in critically ill children was 11 % which reached to 72 % after spinal surgeries.²⁰

Further research would be valuable in assessing the utility of magnesium level as a marker of disease severity, especially in hospitalized patients.

CONCLUSION

High frequency of hypomagnesemia was noted among children admitted in pediatric intensive care unit in our study. Children with hypomagnesemia had prolonged hospital stay. Hypomagnesemia was significantly associated with male gender, residential status, mother's educational level, history of hospitalization before PICU admission, disease duration and weight. All the children admitted to pediatric intensive care unit must be checked for serum magnesium levels on routine basis to avoid adverse events associated with it.



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AUTHORSHIP AND CONTRIBUTION DECLARATION

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2	M. Azam Khan	Supervision, Methodology, Discussion.	
3	Irfan Shabbir	Data collection, Drafting.	