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Original Research Article

Incidence and Risk Factors of Hypomagnesemia in Critically Ill Children

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Abstract:

Aim: To assess incidence and risk factors of hypomagnesemia in critically ill patients.

Methodology: 76 Paediatric intensive care unit (PICU) admissions, age ranged 1 month- 18 months of both genders were selected and parameters include weight, co-morbidities, metabolic profile (serum sodium, potassium, calcium, magnesium, blood urea nitrogen, creatinine, and blood pH), admission category (cardiac disease, sepsis, renal failure, CNS linked diseases, trauma, and others), and others. A spectrophotometer was used as an endpoint to assess the total serum magnesium assay.

Results: Out of 76 patients, males were 48 (63.1%) and females were 28 (36.9%). Out of 76 PICU admissions, hypomagnesemia was found in 34 patients. Diseases causing PICU admission were CNS diseases in 9, trauma in 7, sepsis in 23, cardiac disease in 12, renal failure in 10, and others in 15 cases. Hypomagnesemia was found in CNS diseases in 1, trauma in 1, sepsis in 14, cardiac disease in 6, renal failure in 4, and others in 8 cases. Risk factors of hypomagnesemia was hyponatremia in 2, hypokalemia in 18, hypocalcemia in 10 and metabolic acidosis in 4 cases. Age <1 year was seen in 13, and >1 year in 21 patients, length of hospitalization was 1-5 days in 15 and >5 days in 19 patients Outcome was alive in 22 and death in 12. The difference was significant (P< 0.05).

Conclusion: Age greater than one year, hospital stays longer than five days, hypokalemia, and hypocalcemia were common risk factors for hypomagnesemia.

Keywords: Magnesium, Children, Hypokalemia, Hypocalcemia.

Introduction

The body needs magnesium (Mg), an important cation, as a co-factor for over 300 enzymatic processes. [1] Numerous biological processes and cellular functions, such as neurotransmission, enzyme reactions, muscular relaxation, and bone stability, depend on it. [2] Serum contains three different fractions of magnesium: the ionized or active form (65%), protein bound (27%), and a little quantity (8%), which is also complexed to bicarbonate, phosphate, and citrate. Children who are very sick may have hypomagnesemia, or low blood magnesium levels, for a variety of causes. [3]

Hypomagnesemia in critically ill children can be caused by various reasons, such as insufficient magnesium intake or absorption, increased renal losses (due to diuretics or renal failure), gastrointestinal losses (diarrhea), and redistribution of magnesium within cells.4 Hypomagnesemia can also be caused by underlying medical illnesses such as sepsis, acute kidney injury, gastrointestinal disorders, and endocrine disorders (e.g., diabetic ketoacidosis). [5] Particularly in youngsters, hypomagnesemia may manifest with nonspecific symptoms, making a diagnosis difficult based solely on clinical indicators. [6] In critically unwell children, irritability, tremors, seizures, altered mental status, cardiac arrhythmias, and respiratory muscle weakness are common signs of hypomagnesemia. [7]

Serum magnesium levels are measured in laboratory tests to confirm the diagnosis of hypomagnesemia. In children, normal serum magnesium levels normally fall between 1.7 and 2.2 mg/dL (0.7 and 0.9 mmol/L). [8] It's crucial to understand that because the majority of magnesium is intracellular, serum magnesium levels may not always precisely reflect total body storage of the mineral.9,10 Considering this, the present study was conducted to assess incidence and risk factors of hypomagnesemia in critically ill patients.

Methodology

The present prospective study was conducted among 76 Paediatric intensive care unit (PICU) admissions, age ranged 1 month- 18 months of both genders. Parental written consent for participating in the

study was obtained before starting the study. Ethical approval was also obtained from the Institutional review board. Demographic data such as name, age, gender etc. was recorded. Recorded were parameters including weight, co-morbidities, metabolic profile (serum sodium, potassium, calcium, magnesium, blood urea nitrogen, creatinine, and blood pH), admission category (cardiac disease, sepsis, renal failure, CNS linked diseases, trauma, and others), and others. A spectrophotometer was used as an endpoint to assess the total serum magnesium assay.

Data thus obtained were subjected to statistical analysis using Mann Whitney U test. P value < 0.05 was considered significant.

Results

Table 1: Distribution of patients

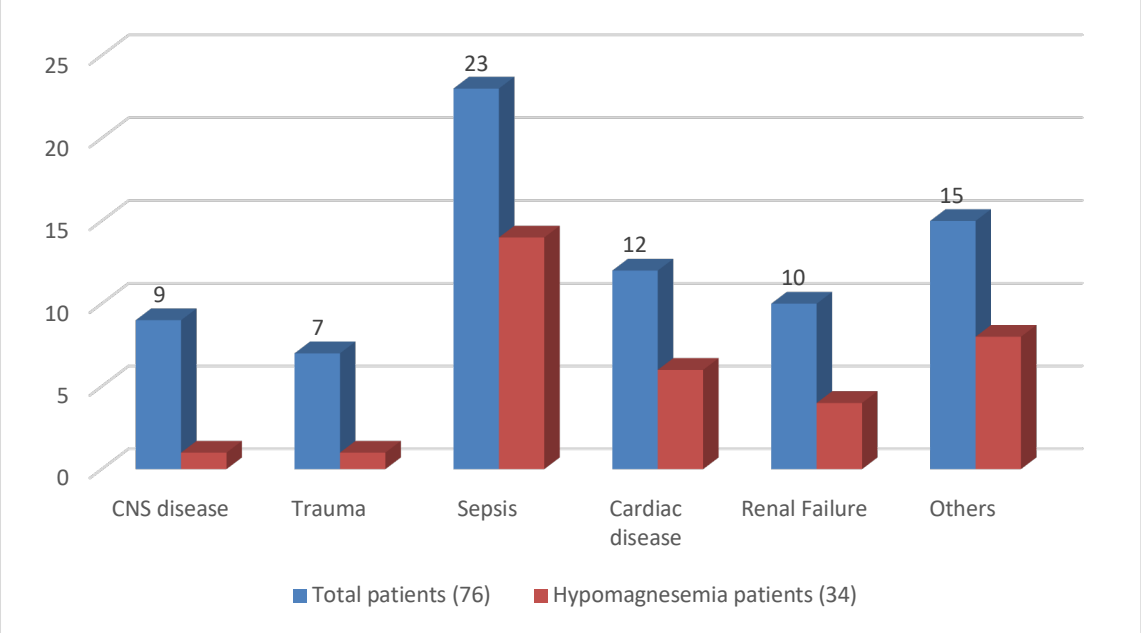
Total- 76		
Gender	**Male**	**Female**
Number	48 (63.1%)	28 (36.9%)

Out of 76 patients, males were 48 (63.1%) and females were 28 (36.9%) (Table 1)

Table 2: Assessment of incidence of hypomagnesemia

Disease	**Total patients (76)**	**Hypomagnesemia patients (34)**
CNS disease	9	1
Trauma	7	1
Sepsis	23	14
Cardiac disease	12	6
Renal Failure	10	4
Others	15	8

Out of 76 PICU admissions, hypomagnesemia was found in 34 patients. Diseases causing PICU admission were CNS diseases in 9, trauma in 7, sepsis in 23, cardiac disease in 12, renal failure in 10, and others in 15 cases. Hypomagnesemia was found in CNS diseases in 1, trauma in 1, sepsis in 14, cardiac disease in 6, renal failure in 4, and others in 8 cases (Table 2, graph I).



Graph 1:

Table 3: Risk factors of hypomagnesemia

Parameters	**Variables**	**Number**	**P value**
Metabolic profile	Hyponatremia	2	0.04
	Hypokalemia	18	
	Hypocalcemia	10	
	Metabolic acidosis	4	
Age	<1 year	13	0.05
	>1 year	21	

Length of hospitalization	5 days	15	0.18
	>5 days	19	
Outcome	Alive	22	0.04
	Death	12	

Risk factors of hypomagnesemia were hyponatremia in 2, hypokalemia in 18, hypocalcemia in 10 and metabolic acidosis in 4 cases. Age <1 year was seen in 13, and >1 year in 21 patients, length of hospitalization was 1-5 days in 15 and >5 days in 19 patients Outcome was alive in 22 and death in 12. The difference was significant (P< 0.05) (Table 3)

Discussion

Hypomagnesemia, a condition characterized by low levels of magnesium in the blood, is a common finding among critically ill patients. [11] Magnesium is an essential mineral involved in numerous biochemical processes, including energy production, muscle and nerve function, and regulation of blood pressure. In the critical care setting, hypomagnesemia can have significant implications for patient outcomes. [12,13,14] The present study was conducted to assess incidence and risk factors of hypomagnesemia in critically ill patients.

In our study, out of 76 patients, males were 48 (63.1%) and females were 28 (36.9%). In order to assess the association between ionized hypomagnesemia and organ dysfunction, duration of stay, and mortality, Soliman et al [15] documented the prevalence of the condition in critically ill patients. Once admitted, the ionized magnesium level (normal range: 0.42-0.59 mmol/L) was tested daily until the patient was released from the intensive care unit. Ionized hypomagnesemia affected 18% of patients at admission, normal ionized magnesium levels affected 68%, and ionized hypermagnesemia affected 14%. Between these three patient groups, there was no discernible variation in the duration of stay or the death rate. Hypoproteinemia, hypokalemia, and total and ionized hypocalcemia were more common in hypomagnesemic patients. A total of 23 patients experienced ionized hypomagnesemia during their stay in the intensive care unit (ICU). These patients had higher admission scores on the Acute Physiology and Chronic Health Evaluation II (14.9 +/- 5.4 vs. 11.0 +/- 6.2) and Sequential Organ Failure Assessment (SOFA; 7.1 +/- 5.4 vs. 3.9 +/- 2.8) (p <.01 for both), a higher maximum SOFA score during the ICU stay (10.0 +/- 5.6 vs. 4.4 +/- 3.2, p <.01), a higher prevalence of septic shock and severe sepsis (57 vs. 11%, p <.01), a longer ICU stay (15.4 +/- 15.5 vs. 2.8 +/- 4.7 days, p <.01), and a higher mortality rate (35% vs. 12%, p <.01). Sepsis, diuretic therapy, and an extended ICU stay were the main risk factors for hypomagnesemia during the stay.

It was found that out of 76 PICU admission, hypomagnesemia was found in 34 patients. Diseases causing PICU admission was CNS diseases in 9, trauma in 7, sepsis in 23, cardiac disease in 12, renal failure in 10, and others in 15 cases. Hypomagnesemia was found in CNS diseases in 1, trauma in 1, sepsis in 14, cardiac disease in 6, renal failure in 4, and others in 8 cases. The frequency and related risk factors of hypomagnesemia in the pediatric intensive care unit at the time of admission were ascertained by Saleem et al. [16] Based on their magnesium levels, patients were classified into two groups: normo-magnesemic and hypomagnesemic. The p-value, crude and adjusted odds ratios (AoR) were computed. Conclusions. When 79 patients (44%) were admitted to the PICU, hypomagnesemia was discovered. Age and gender differences did not exist between the two groups. Age over one year (p- 0.05, AOR 3.71), sepsis (p- 0.03, AOR 3.11), hypokalemia (p- 0.06, AOR 1.8), hypocalcemia (p- 0.05, AOR 1.6), use of diuretics (p- 0.05, AOR 1.37), use of aminoglycosides (p- 0.003, AOR 3.12), and hospital stay longer than five days (p- 0.03, AOR 1.71) were the significant risk factors found. The death rate was greater (32/100) in those with normal magnesium levels. The mortality rate was higher for those with normal magnesium levels (32/100 or 32%) than for those with hypomagnesemia (22/79 or 27.8%).

Risk factors of hypomagnesemia were hyponatremia in 2, hypokalemia in 18, hypocalcemia in 10 and metabolic acidosis in 4 cases. Age <1 year was seen in 13, and >1 year in 21 patients, length of hospitalization was 1-5 days in 15 and >5 days in 19 patients Outcome was alive in 22 and death in 12. Singhi et al [17] enrolled a total of 100 children (68 boys, 32 girls) aged 6 months to 12 years (mean +/- SD 4.9 + 3.5 years) admitted consecutively to a PICU were studied. At admission and on every alternate day venous blood was obtained for the estimation of serum and RBC-magnesium, serum calcium, sodium, and potassium, and arterial blood for ionized calcium and pH. This was done after ethical approval and informed consent. Hypomagnesemia and hypermagnesemia occurred in 60 percent and 4 percent of patients, respectively. The incidence of hypomagnesaemia was 30.1, and hypermagnesemia was two episodes per 100 patient days. The incidence of low RBC-Mg was 17.3 episodes per 100 patient days. Hypomagnesaemia was more common in patients with raised intracranial pressure (63 episodes per 100 patients days). Mortality was nine-fold higher in hypomagnesemic (30 per cent, 19 of 63) compared

with normomagnaesemic (3.3 per cent, one of 30) patients. If Mg and Ca both were low, the mortality rate was 33 per cent (15 of 45 patients) in contrast to nil if both were normal ($p < 0.05$). They concluded that hypomagnesaemia and low RBC-Mg are a common occurrence in PICU patients and are associated with higher mortality.

Dandinavar SF et al [18] assessed the frequency of hypomagnesemia at the time of PICU admission and its relationship to the length of stay in the PICU, time spent using a mechanical ventilator, and the outcome—discharge or death—at the end of the hospital stay. Among the 343 youngsters, 28 percent had hypomagnesemia, 7 percent had hypermagnesemia, and 64.7% had normomagnesemia. The prevalence of hypomagnesemia was higher in neurological conditions. There was no correlation discovered between magnesium and the duration of mechanical ventilation. The group with hypomagnesemia had a substantially longer PICU stay ($p=0.031$). Hypokalemia was present in 35.4% of patients with hypomagnesemia and hypocalcemia in 37.5% of individuals. Those with hypomagnesemia had a greater death rate (30.2%) than those with normomagnesemia (22.1%).

Conclusion

Age greater than one year, hospital stays longer than five days, hypokalemia, and hypocalcemia were common risk factors for hypomagnesia.

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