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Significance of Serum Magnesium Levels In Critically Ill-Patients

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Abstract: *Magnesium is fourth most common cation in the body and second most common intracellular cation after potassium, yet its deficiency in critically ill-patients is frequently overlooked. Some authors have called Mg "the forgotten electrolyte" [5,6], because, although Mg alterations are common, hypomagnesemia is an important but underdiagnosed electrolyte abnormality. There is a paucity of data in Indian literature, addressing this common, but underdiagnosed electrolyte deficiency. Present study was to assess the magnitude of magnesium deficiency and its influence on the outcome of critically ill-patients with emphasis on the implications of hypomagnesemia and on treatment options. A prospective observational study was conducted on 65 patients admitted to the Intensive Care Unit of our hospital. The subjects enrolled into the study were monitored for serum magnesium levels within 24 hours of admission, 2ml of venous blood sample was taken and processed for magnesium analysis. Serum magnesium levels were estimated. Results analysed and discussed. Hypomagnesemia is common in sepsis patients, both in the ICU and in the wards. In order to provide optimal care, ICU clinicians should be familiar with the principles and practice of fluid and electrolyte pathophysiology. Hypomagnesemia should be identified and corrected, because it is associated with increased adverse events and higher mortality in critically ill patients.*

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I. Introduction

Magnesium is fourth most common cation in the body and second most common intracellular cation after potassium, yet its deficiency in critically ill-patients is frequently overlooked.[1,2,] Various studies have reported the incidence of hypomagnesemia up to 65% in critically ill-patients.[3] Although many paradigms have been explored to minimize the mortality in critical care units, magnesium loss has been scarcely addressed; in this respect leading to inconclusive results. Serum magnesium monitoring may have prognostic and perhaps therapeutic implications because critically ill-patients are predisposed to both symptomatic or asymptomatic magnesium deficiency that can lead to some important clinical consequences (such as hypokalemia, cardiac arrhythmias, hypocalcemia, neurotoxicity and psychiatric problems), ultimately increasing the morbidity and mortality.[4] Some authors have called Mg "the forgotten electrolyte" [5,6], because, although Mg alterations are common, hypomagnesemia is an important but underdiagnosed electrolyte abnormality

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II. Methodology

A prospective observational study was conducted on 65 patients admitted to the Intensive Care Unit of our hospital. The subjects included were 38 males and 27 females in the age group of 16 – 70 years.There were no specific exclusion criteria for the patient except for treatment with magnesium products. The subjects enrolled into the study were monitored for serum magnesium levels within 24 hours of admission, 2ml of venous blood sample was taken and processed for magnesium analysis. Serum magnesium levels were estimated. Reference range for magnesium concentrations were set by drawing blood from healthy volunteers of staff f(1.7 to 2.4 mg/dl). Serum magnesium level of < 1.7 mg/dl was regarded as hypomagnesemia and > 2.4 mg/dl as hypermagnesemia.

Other laboratory investigations included were arterial blood gas analysis, sodium, potassium, calcium, biliru- bin, urea, creatinine and glucose. Details collected from the patients were need for ventilator, duration of ventilator support, length of stay, general patient demographics and mortality in the ICU. Patients were followed until their discharge from the ICU. The APACHE IV score was determined on the first day. APACHE scoring system takes into consideration various parameters like physiological variables, vital signs, urine output, neurological score, along with age related parameters and comorbid conditions, which may have a significant impact on the outcome of these critically ill patients [7]. APACHE IV is the newest standardized scoring metrics

to assess the severity of illness and prognosis among critically ill adults in the ICU. APACHE IV, an improved and updated model for predicting mortality among critically ill patients includes new variables like mechanical ventilation, rescaled Glascow coma scale, PaO2/FiO2 ratio, ICU admission diagnosis and source etc [8,9]. APACHE IV is probably a more reliable prediction of high risk of death in patients with stroke than APACHE II, which has been widely used in ICU studies [10]. APACHE IV score was calculated using an online calculator.

III. Results

Totally, 65 patients admitted to the MICU were considered for the study. At admission, 43% patients had hypomagnesemia, 7% patients had hypermagnesemia and 50%patients had normomagnesemia. The serum magnesium values were ranging from 1mg/dl to 3mg/dl. When the variables were compared between patients with low and normal magnesium levels, a statistically significant difference was observed in need for ventilator support and duration of mechanical ventilation. Length of stay in the ICU did not vary significantly between the two groups. The mean APACHE IV score on admission was 43.43 ± 17.67 for the hypomagnesemic group and 42.29 ± 19.02 for the normomagnesemic patients. Mean APACHE IV score of patients in the two groups also did not signifi- cantly differ. Hypomagnesemic patients had more incidences of electrolyte abnormalities such as hypokalemia (20% vs 6.25%), hyponatremia (40% vs 12.5%) and hypocalcemia (33% vs 3%). Hypomagnesemic patients had a higher rate of mortality (39% vs 25%) when compared to the normomagnesemic patients. There was a significant positive correlation between serum magnesium and serum potassium levels. 47% of hypomagnesemic patients had diabetes mellitus, whereas 33% in normomagnesemic group had diabetes.

IV. Discussion

Assessment of magnesium status in either of these compartments in critical illness is impractical. The physician must therefore rely on determination of serum magnesium to determine if a patient is magnesium deficient.[11] Occurrence of magnesium deficiency in critical illness correlates with higher morbidity and mortality. Magnesium deficiency has been found to co-exist in up to 40% of patients with other electrolyte abnormalities. Magnesium has a marked effect on the regulation of transmembrane sodium and potassium movement. There are multiple reasons for magnesium deficiency in critical care settings e.g., decreased absorption caused by impaired gastrointestinal activity, malnutrition, renal wasting of various drugs (e.g., digoxin, gentamicin, loop diuretics etc.), diabetes mellitus, hypokalemia and hypocalcemia.[12] In our study, we found 76.47% patients of hypomagnesemia were on magnesium lowering drugs while as 46% of normomagnesemic patients were on magnesium lowering drugs. The difference was statistically significant (P = 0.030). Diuretics acting at loop of Henle such as furosemide have been shown by micropuncture studies to result in marked magnesium deficiency. Aminoglycosides have been shown to cause reversible renal lesion that results in hypermagnesuria and hypomagnesemia.[13] In a retrospective analysis of 179 children of a pediatric ICU, it was found that hypomagnesemia was more often seen in patients receiving diuretics and aminoglycosides.[11] Proton pump inhibitor associated hypomagnesemia is a rare, but potentially life-threatening side-effect that has emerged only in the era of mass use of these agents.[13]

The relationship between hypomagnesemia and mortality rate varies from study to study. A higher mortality rate was detected in hypomagnesemia patients when compared with normomagnesemic patients by Chernow *et al*.[14] (41% vs. 13%), Rubeiz *et al*.[15] (46% vs. 25%) and Safavi and Honarmand[16] (55% vs. 35%). Guérin *et al*.[17] had found no difference in ICU mortality between hypomagnesemic and normomagnesemic groups (18% vs. 17%); but noted a higher mortality rate among hypermagnesemic patients. Soliman *et al*.[18] observed that patients who develop ionized hypomagnesemia during their ICU stay have higher mortality rates (2-3 times higher). Limaye *et al*.[19] observed that mortality rate in hypomagnesemic group was 57% when compared with 31% in the normomagnesemic group. Present study showed the mortality rate of hypomagnesemic patients 76.47% as compared to normomagnesemic patients (36%), almost similar results as previously reported. The higher mortality in our study can be ascribed to higher incidences of other electrolyte deficiencies and multiorgan dysfunction in the hypomagnesemic group when compared with normomagnesemic group.

V. Conclusion

Hypomagnesemia is common in sepsis patients, both in the ICU and in the wards. In order to provide optimal care, ICU clinicians should be familiar with the principles and practice of fluid and electrolyte pathophysiology. Hypomagnesemia should be identified and corrected, because it is associated with increased adverse events and higher mortality in critically ill patients.

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