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# HYPOMAGNESEMIA IN INTERNAL CARE UNIT

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## ABSTRACT

**Background/Objective:** Hypomagnesemia is one of the most common electrolyte disturbances in the critically ill patients. The aim of our study was to define the prevalence of admission hypomagnesemia in critically ill patients and to evaluate its relationship with organ dysfunction, length of stay, and mortality.

**Methods:** It is a retrospective review of 150 patients, admitted to the intensive care unit (ICU) at the Siirt State Hospital over 2 years period. 119 patients included in this study. Observations were made on admission total serum magnesium level, need for ventilator, duration of mechanical ventilation, ICU lengths of stay, and general patient demographics.

**Results**: Electrolyte abnormalities were observed in 42.4% of patients. The serum magnesium level (normal value, 1.7-2.4 mg/dL) was measured at admission. 12,6% of patients had hypomagnesemia (mortality rate 53.3%), 68,9% had normal magnesium levels (mortality rate 26.8%) . There was significant difference in mortality rate (53.3% vs 26.8%), the length of ICU stay (11.23$\pm$5.34 vs 4.8$\pm$2.15) and ventilatory support [60% (9/15) vs 29.2% (24/82)] between these two groups of patients ($p < 0.05$ for all).

The incidence of sepsis was twice as common in hypomagnesemic patients as compared to normomagnesemic patients ($p<0.05$). The mean APACHE score between two groups was not statistically significant

**Conclusion**: Development of hypomagnesemia during an ICU stay is associated with morbidity and mortality. Monitoring of serum magnesium levels may be prognostic for these patients.

**Keywords:** Magnesium; Intensive Care Unit ; Evaluation Score; Mortality

## INTRODUCTION

Magnesium is one of the most common plasma cation. It regulates ion channels and plays very important role in neuromuscular transmission and enzimatic activity. Hypomagnesemia is an emerging electrolyte disturbance in hospitalized patients; especially in the critically ill ones and it has been shown to predict mortality in the intensive care unit (ICU). Its prevalence has a wide range (11% to 61%) (1). It is an unnoticed problem, although it should be searched because of its importance for the prognosis of patients (2,3). The severity of hypomagnesemia can be assessed using subjective clinical evaluation and biochemical markers of organ dysfunction. Objective scoring system such as the Acute Physiology and Chronic Health Evaluation (APACHE) II score, is also used to assess severity of critically ill patients. The scoring systems may determine high-risk groups of the patients and therapeutic interventions can be used to reduce morbidity and mortality of these groups. The APACHE II score incorporates 12 physiologic variables, age, and an assessment of chronic diseases in patients (4,5).

The aim of our study was to define the prevalence of hypomagnesemia in critically ill patients at admission and to evaluate the relationship of magnesium level with organ failure,

length of stay, electrolyte disorders, ventilator need, duration of mechanical ventilation, and mortality rate. We also aimed to evaluate the APACHE II score in determining the patient's morbidity and mortality in the critically ill hypomagnesemic patients admitted to ICU.

## MATERIAL and METHOD

It is a retrospective review of 150 patients admitted to the ICU of the Siirt State Hospital between March 2008 and March 2010. were excluded . At the time of admission, the patient's age, sex, diagnosis, clinical features and electrolyte and biochemical parameters were recorded . 31 patients ; under the age of 18 , with burn injury, renal failure, $Mg^{++}$ administration were excluded . 119 patients evaluated for our study.

Renal dysfunction was defined as a serum creatinine of >1.2 mg/dL. APACHE II score was determined on the first day of admiision. Other routine laboratory investigations were recorded. Normal values of the test are shown in Table -1.

Total serum magnesium (Mg) concentrations were recorded at the time of admission to the ICU. Patients were classified into two groups according to their initial $Mg^{++}$ level as hypomagnesemia (<1.7 mg/dL) and normomagnesemia (1.7-2.4 mg/dL).

### Statistical analysis

Statistical analysis was performed using SPSS software version 13.0 for PC (SPSS Inc., Chicago, USA). Continuous variables are expressed as mean±standard deviation. Differences between the groups according to continuous variables were assessed by Student's *t*-test. For categorical variables, differences between groups and associations between the variables were

calculated with Pearson's Chi Square Test and Fisher's Exact Test. The results were evaluated in the 95% confidence interval and $p<0.05$ values were accepted as significant.

## RESULTS

The number of patients who died was 49 and mortality rate was 41.2%. The mean age of the patients was 61.87±21.77. The number of male and female patients was close to each other. Clinical features of the patients were shown in Table -2.

Electrolyte abnormalities were observed in 42.4% of patients. The serum magnesium level (normal value, 1.7-2.4 mg/dL) was measured at admission. 12,6% of patients had hypomagnesemia (mortality rate 53.3%), 68.9% had normal magnesium levels (mortality rate 26.8%)

The mean duration of stay in ICU of patients with low serum magnesium was 11.23±5.34 days while that of patients with normal serum magnesium was 4.8±2.15 days. There was significant difference for either duration of stay in ICU or mortality between groups.

Patients in hypomagnesemic group had significantly more need to ventilatory support than normomagnesemic patients (Table 2). The patients with hypomagnesemia 60% (9/15) needed mechanical ventilatory support, while 29.2% (24/82) of the normomagnesemic group needed ventilatory support. The difference was statistically significant ($p<0.05$). The mean APACHE II score on admission in the hypomagnesemic group was 13.45±1.32 while that of normomagnesemic group was 14.10±3.43. The difference was not statistically significant.($p>0.05$ )

The patient with sepsis was twice as common in hypomagnesemic patients as compared to normomagnesemic patients ($p<0.05$).

The mortality rate in hypomagnesemic group was 53.3% (8/15); whereas in normomagnesemic group was 26.8% (22/82). Significantly higher mortality rate was observed in hypomagnesemic patients as compared to normomagnesemic patients ($p< 0.05$).

**Table-1**:Normal Concentration of the electrolytes

| Serum Electrolytes | Normal concentration | |
|---|---|---|
| Sodium | <134 meq/L<br>>145 meq/L | Hyponatremia<br>Hypernatremia |
| Potassium | <3.5 meq/L<br>>5.1 meq/L | Hypokalemia<br>Hyperkalemia |
| Calcium | < 8 mg /dL<br>>10.2 mg/dL | Hypocalcemia<br>Hypercalcemia |
| Magnesium | <1.7 mg/dL<br>>2.4 mg/dL | Hypomagnesemia<br>Hypermagnesemia |

**Table-2 :** Clinical Features of The Patients

| Clinical Features | Number of patients(n=119) | Exitus (n=49) | Alive(n=70) |
|---|---|---|---|
| Hemorrhagic Stroke | 27 | 8 | 19 |
| Obstructive Lung disease | 26 | 18 | 8 |
| Iscemic Stroke | 23 | 11 | 12 |
| Sepsis | 18 | 12 | 6 |
| Intoxication | 12 | 0 | 12 |
| Contusion cerebri | 8 | 3 | 5 |
| Gastrointestinal Bleeding | 3 | 1 | 2 |
| Diabetic Coma | 2 | 0 | 2 |

**Table-3:**Results of Study

| | Hypomagnesemia | Normomagnesemia |
|---|---|---|
| Number of Patients | 15 (12.6%) | 82( 68.9%) |
| Age | 58.34 ±2.12 | 60.14±1.38 |
| APACHE* II Score | 13.45±1.32 | 14.10±3.43 |
| ICU** Stay | 11.23±5.34 | 4.8±2.15 |
| Mortality (%) | 53.3 | 26.8 |
| Need Ventilator n (%) | 9(60%) | 24(29.2%) |
| Duration of Mechanical Ventilation (Day) | 8.1±4.01 | 4.4±3.20 |
| Sepsis (n) | 8/15 | 4/82 |

***APACHE: Acute Physiology and Chronic Health Evaluation, **ICU: Intensive Care Unit**

## DISCUSSION

ICUs are the units with the highest mortality frequencies within hospital departments. Mortality rates in ICUs changes between 16% and 67% depending on the patient groups followed-up and their characteristics. Critically ill patients have a high prevalence of electrolyte disorders because of the presence of multiple causative factors. Early diagnosis and treatment is necessary. Clinicians should be informed about electrolyte homeostasis and the underlying pathophysiology of electrolyte disorders to provide optimal therapy for patients (6).

Magnesium is the second most abundant intracellular cation after potassium. Magnesium deficiency is common in ICU patients and it correlates with higher mortality rate and worse clinical outcome (7). Many factors contribute to hypomagnesemia and magnesium

deficiency in critically ill patients; like impaired gastrointestinal absorption, nasogastric suction, poor content of magnesium in feeding formulae or total parenteral nutrition solutions, administration of drugs such as diuretics, aminoglycosides, amphotericin-B which cause renal wasting of magnesium (8,9).The prevalence of hypomagnesemia was in the range of 14% to 70% (7).

Some studies had been published about the relationship between hypomagnesemia and mortality. Rubeiz et al. (10) reported nearly double mortality rates (46% vs 25%) in

hypomagnesemic patients compared with those with normomagnesemia. Guerin et al. (1) found no significant difference between hypomagnesemic and normomagnesemic patients in ICU mortality (18% vs 17%). Chernow et al. (11) similarly reported no difference between hypomagnesemic and normomagnesemic patients in mortality (13% vs 11%). Safavi et al. (12) had found no significant difference between hypomagnesemic and normomagnesemic groups in ICU mortality; but noted a higher mortality rate among hypermagnesemic patients. Our results showed significant difference between patients with hypomagnesemia or normomagnesemia at admission in ICU mortality.

Magnesium may play an important role in sepsis, as magnesium ions are essential for several important immunologic functions and serve as a natural calcium antagonist, an important step in propagating cellular injury (13). In animal models, magnesium deficiency increased production of inflammatory cytokines with increases in lethality associated with endotoxin challenge (14). The prevalence of hypomagnesemia was particularly common in patients with sepsis and septic shock. Sepsis was one of the independent risk factors for developing hypomagnesemia during the ICU stay.

Salem et al. (15) showed that progressive magnesium deficiency and hypomagnesemia were strongly associated with increased mortality in experimental sepsis, and magnesium replacement therapy provided significant protection from an endotoxin challenge. In the present study, the incidence of sepsis was twice as common in hypomagnesemic patients as compared to normomagnesemic patients ($p<0.05$).

Hypomagnesemia is known to cause muscle weakness and respiratory failure. It is one of the factors causing difficulty in isolation the patient from the ventilator (16). In the current study it has been seen that patients with hypomagnesemia needed ventilatory support more frequently and for a longer duration. Soliman et al. (17) found that those patients who develop ionized hypomagnesemia during their ICU stay had higher APACHE II score on admission. We could not find significant difference between the groups about the APACHE II scores.

## CONCLUSION

Magnesium disorder is one of the most important situation in critically ill patients during course of stay in the ICU. The development of hypomagnesemia during the ICU stay is associated with higher morbidity and mortality rates. It may be the result of underlying disease, using diuretics, or sepsis. Early diagnosis and treatment is necessary. Clinicians should be informed about magnesiım homeostasis and the underlying pathophysiology of disorders to provide optimal therapy for patients.

Monitoring of serum magnesium may be prognostic in ICU. It must be monitored carefully. Additional studies are required to address the current approach to magnesium imbalance in critically ill patients, as well as the association of hypomagnesemia with morbidity and mortality, and the effect of the correction of this electrolyte disorder.

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