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RESEARCH ARTICLE
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Incidence and Risk Factors of Hypomagnesemia in Patients of Surgical Intensive Care Unit of Taibh University Madinah Hospitals

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ABSTRACT

Background: Magnesium is the 4th most common cation in the human body and the second most common cation inside of cells. In the ICU, patients often have low magnesium levels, a condition known as hypomagnesemia. Magnesium deficiency is common in critically ill patients due to gastrointestinal and/or renal disorders, which can lead to severe neuromuscular and cardiovascular clinical symptoms due to subsequent hypokalemia and hypocalcemia.

Aim: to identify patients at risk for hypomagnesemia in the surgical intensive care unit at Taibh University Madinah Hospitals.

Patients and Methods: Research was done on 130 people at the University of Taibh University Madinah Hospitals. Over the course of 6 months, we monitored everyone at the Intensive Care Unit of Taibh University Madinah Hospitals. Humans > 18 years.

Results: There were significant correlation between Magnesium (mmol/l) and Age and Sex and Medical condition, between Magnesium (mmol/l) and Age and Sex and Residence and between Magnesium (mmol/l) and Age and Sex and Residence.

Conclusion: Magnesium disorders are widespread in those who are seriously unwell. We found that severely ill individuals typically have lower serum concentrations of calcium, magnesium, and phosphate. magnesium is significantly correlated to Age, Sex and Medical condition.

Keywords: *Hypomagnesemia, Surgical Intensive Care Unit*

INTRODUCTION

Magnesium is a crucial electrolyte that helps to keep many cellular and metabolic processes running smoothly. Hypomagnesemia has been demonstrated in studies to be present in critical care unit patients. High mortality, cardiac arrhythmias, septic shock, prolonged ICU stay, increased need for intubations, and delayed weaning from ventilation are all associated with low magnesium levels (Chowdhury & Ponieman, 2022).

Magnesium (Mg) is the fourth most common cation in the human body and the second most common cation inside of cells. About 60% of a healthy adult's magnesium is found in their bones, 20% in their muscles, 20% in their soft tissues, 0.5 in their erythrocytes, and 0.3% in their serum, for a total of about 25 g or 1000 mmol Mg. About 80% of the Mg in plasma is associated to proteins, whereas the other 20% is ionised or complexed to filterable ions (Al Alawi et al., 2018).

These potentially terrifying consequences may be avoided if magnesium supplements are prescribed under close medical monitoring. Estimating Value Hypomagnesemia in critically ill patients is very important for establishing a window of opportunity for therapies. Complications from hypomagnesemia include ventricular arrhythmia, coronary artery spasm, and sudden cardiac death. It's also linked to more deaths and longer hospital stays (Liamis et al., 2021).

Clinical manifestations of Mg shortage in critically ill patients include hypokalemia, hypocalcemia, and severe neuromuscular and cardiovascular symptoms, and are usually caused by gastrointestinal and/or renal diseases. Considering where it can be found in the body, determining your magnesium status is not a simple task. However, the Mg tolerance test and serum Mg levels are the most common (Hansen & Bruserud, 2018).

The purpose of this research was to identify hypomagnesemia in surgical critical care unit patients at Taibh University Madinah Hospitals and the factors that increased their risk.

MATERIAL AND METHODS

This was a study done in Taibh University Madinah Hospitals. The study was conducted on 130 subjects. All were followed at the ICU, Taibh University Madinah Hospitals over a period of 6 month.

Inclusion criteria

Patients over the age of 18 hospitalised to the Surgical Intensive Care Unit at Taibh University Madinah Hospitals with a normal Ca level were studied for a period of 6 months.

Exclusion criteria

Patients who had previously been hospitalised within two weeks of their presentation, those who had hypomagnesemia at the time of admission, and those who were receiving vitamin D therapy as a supplement. Malignancy and known parathyroid illness are now being treated.

METHODS

This research relied on a sampling technique known as "convenience." All patients admitted to the ICU at Taibh University Madinah Hospitals, as well as patients in other Intensive Care Units, throughout a six-month period. Serum ionised magnesium concentration was determined with an ion-selective electrode technique, whereas total serum magnesium concentration was evaluated with a colorimetric assay. After resuscitation, total and ionised magnesium levels were checked on days 1 and 3 of nutritional support and on day 5 of intensive care unit admission. Patient albumin,Ca, Mg, phosphorus, blood urea, and creatinine levels were evaluated.

Ethical Approval

Each study participant signed a consent form after they were fully briefed on the research's purpose and methods, and the project was given the green light by the university's ethics board. All procedures used in this study have been performed in accordance with the principles outlined in the Declaration of Helsinki, put out by the World Medical Association to ensure the

ethical conduct of medical research involving human subjects.

Statistical Analysis

The data was analysed using IBM's SPSS version 24. (May 2016). Statistical significance was determined using the Kristall-Wallis test, the Wilcoxon test, a Spearman correlation, and a logistic regression. Each variable was analysed based on the specific facts it contained (parametric or not). If the P-values were < 0.05, we concluded that the results were significant (5%).

RESULTS

TABLE 1: Demographic data among studied cases.

Age	
Mean ± SD	50.5± 5.5
Sex	
Male	64
Female	66

This table shows that the mean age was 50.5± 5.5, 64 were male, 66 were female.

TABLE 2: Diseases among studied cases

Infections	39 (30.0%)
Septic shock	13 (10.0%)
Respiratory	13 (10.0%)
GIT	2 (1.5%)
CNS	33 (25%)
Poisoning	5 (4%)
Traumatic Brain Injury	10 (8.0%)

This table shows that there were 30% who had Infections, 10% Septic shock, 10% Respiratory, 1.5% GIT, 25% CNS, 4% Poisoning, 8% had Traumatic Brain Injury.

TABLE 3: Laboratory results among studied cases.

Albumin	3.5±1.1
	2.7-4.6
Total Calcium	1.8±0.4
	1.1-2.2
Ionized Calcium	1.01±0.1
	0.8-1.8
Phosphorus	1.08±0.4
	0.7-1.5
Urea	52±4.2
	45-58
Creatinine (µmol/L)	110±10.0
	90.0-120.0
Magnesium (mmol/l)	0.03 ±0.01
	0.01-0.05

This table shows Laboratory results among studied cases. The mean Albumin was 3.5±1.1, Total Calcium was 1.8±0.4, Ionized Calcium was 1.01±0.1, Phosphorus was 1.08±0.4, Urea was 52±4.2, Creatinine (µmol/L) was 110±10.0, and Magnesium (mmol/l) was 0.03 ±0.01.

TABLE 4: Correlation between Magnesium (mmol/l) and different risk factors among the studied groups.

		Magnesium (mmol/l)	
		r	P
Age		0.975	0.0001
Sex		0.23992	0.002
Medical condition		0.918860	0.0001

P value< 0.05 is significant, P value< 0.01 is highly significant, SD:Standard deviation, ZMWU = Mann- Whitney U test, X2= Chi-Square test

There were significant correlation between Magnesium (mmol/l) and Age and Sex and Medical condition

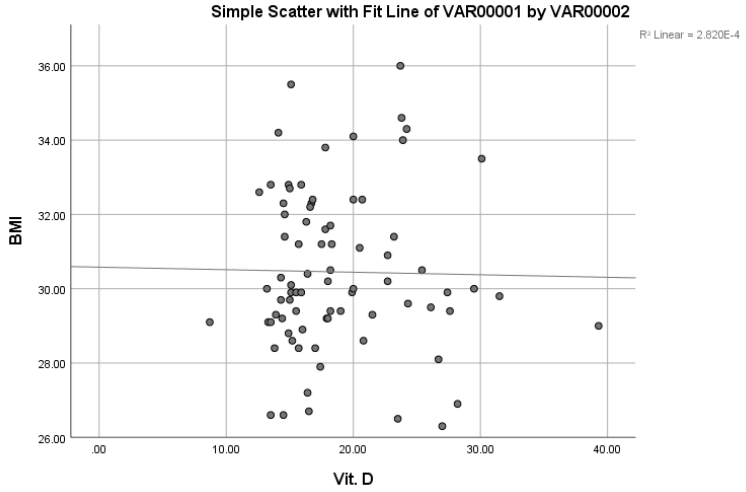

FIG. 1: Correlation between Magnesium (mmol/l) and age

TABLE 5: Univariate Correlation between Magnesium (mmol/l) and different risk factors among the studied groups.

		Fungal infection
Age	Correlation	-0.348
	Significance	<0.0001
Sex	Correlation	-0.471
	Significance	<0.0001
Residence	Correlation	-0.412
	Significance	<0.0001

P value < 0.05: Statistically significant difference | P value < 0.001: Statistically high significant difference.In Univariate correlation regression there were significant Correlation between Magnesium (mmol/l) and Age and Sex and Residence

TABLE 6: Correlation between Magnesium (mmol/l) and different risk factors among the studied groups.

Variable		Value
Age	Correlation	71.305
	Significance	<0.0001
Sex	Correlation	20.495
	Significance	<0.0001
Residence	Correlation	25.595
	Significance	<0.0001

Correlation regression: ANOVA P value > 0.05: Statistically non-significant difference | P value < 0.05: Statistically significant difference | P value < 0.001: Statistically high significant difference.In Multivariate correlation regression There were significant co Correlation between Magnesium (mmol/l) and Age and Sex and Residence.

DISCUSSION

Over 300 enzyme systems, including those involved in Na-K ATPase, Ca-K homeostasis, neuronal, and muscular functions, are regulated by magnesium, making it the second most important intracellular cation. Patients in critical care units have a hypomagnesemia prevalence of 60%, compared to 2% in the general population. (Laupland et al., 2020).

Hypomagnesemia, whether symptomatic or asymptomatic, causes serious complications such as hypocalcemia, hypokalemia, cardiac arrhythmias, neurotoxicity, and mental symptoms, eventually raising morbidity and mortality rates. Some patient populations, particularly the elderly, are more vulnerable due to lesser intake, decreased absorption, chronic stress, and increased urine loss as a result of their regular use of diuretics and digitalis (Peres et al., 2020).

Although numerous criteria have been studied to reduce mortality in ICU, hypomagnesemia therapy has received less attention, resulting in ambiguous conclusions and recommendations. A prior cohort study, for example, found that daily magnesium supplementation in the ICU was related with lower mortality rates. This effect, however, was not proven to be independent, and the precise source was unknown (Sadeghi-Bojd et al., 2021).

Similarly, a meta-analysis found that magnesium treatment decreased atrial fibrillation, however this finding was restricted to patients in the ICU following heart surgery (Kim et al., 2022).

In the present study we found that the mean age was 50.5± 5.5, 64 were male, 66 were female.

In study to assess Prevalence of hypomagnesemia in ICU patients, Bhardwaj et al. 2017 found the average age of the participants in the study was 49.5 years old (range 15-76 years).

In this study we demonstrated that there were 30% who had Infections, 10% Septic shock, 10% Respiratory, 1.5% GIT, 25% CNS, 4% poisoning, 8% had Traumatic Brain Injury.

El Hossary et al. 2021 found that Considering case distribution by admission diagnosis, sepsis and septic shock accounted for 40% of the cases investigated, Polytrauma accounted for 16%, respiratory failure accounted for 10%, postoperative monitoring accounted for 10%, ICH accounted for 6%, uncontrolled hypertension accounted for 4%, ischemic stroke accounted for 2%, pancreatitis accounted for 2%, dehydration and electrolyte imbalance accounted for 2%, diabetic ketoacidosis accounted for 2%, organophosphorous poisoning accounted for one case, and rhabdomyolysis.

Kagima, 2013 found that sepsis and severe renal damage were the most common reasons for hospital admissions. Patients with a history of trauma who required surgery made up a slim majority.

Farrukh et al. 2021 found that Respondents' most common presenting symptom at admission to the intensive care unit was a neurological one (36.5%), followed by respiratory issues (27%).

In this study we illustrated that the mean Albumin was 3.5±1.1, Total Calcium was 1.8±0.4, Ionized Calcium was 1.01±0.1, Phosphorus was 1.08±0.4, Urea was 52±4.2, Creatinine (µmol/L) was 110±10.0, Magnesium (mmol/l) was 0.03 ±0.01.

Pannem and Munamala, 2018 found that of the 150 cases admitted in the intensive care unit, 42 (28%) of the cases had normal serum magnesium levels, 97 with hypomagnesemia (64.7%) and 11 cases with hypermagnesaemia (7.3%). The lowest serum magnesium value recorded in the study was 1mg/dl while the highest value was 3.7mg/dl with a total mean of 2.126mg/dl.

Similarly to our findings, Reinhart et al. (1985) showed that 20% of critically ill patients admitted to the ICU had hypomagnesaemia, and that their mean magnesium concentrations were lower than those identified in our cohort. Despite the fact that hypomagnesaemia has been linked to arrhythmia development, further research is needed.

Farrukh et al. 2021 found that Overall, magnesium levels averaged 1.3 mg/dL. Hypermagnesemia was present in 11 (5.5% of patients), with a mean magnesium concentration of 2.7 mg/dl. Magnesium levels ranged from 1 mg/dl at the low end to 4.2 mg/dl at the high end of the range. The hypomagnesaemia subset had the highest prevalence of electrolyte abnormalities due to hypocalcemia (37.25 %).

In Kagima, 2013 work, Reports of hypomagnesemia found a prevalence of 16.7%, with hypokalemia at 9.6% and hypocalcaemia at 6.1%.

According to a study conducted in 2011, Limaye et al. found that 69% of patients in India had both hypocalcemia and hypomagnesemia. Hypocalcemia and hypomagnesemia have often been seen together in the medical literature. Not addressing magnesium deficiency makes it challenging to treat hypocalcemia.

Hypomagnesaemia and hypokalemia were found to be significantly associated in the study by Abouamer et al. 2020; this may be attributable to aetiologies that result in both magnesium and potassium loss, such as vomiting, diarrhoea, diuretic usage, or nasogastric suction. Furthermore, hypomagnesemic patients have elevated renal potassium losses.

The results of this study established a definite association between Magnesium (mmol/l) and Age, Sex, and Health Status.

Farrukh et al. 2021 found that babies have a higher prevalence of hypomagnesaemia than older people.

Dwivedi et al. 2021 identified age over one year as a risk factor for hypomagnesaemia.

Raza et al. 2020 found that There was a significant increase in the reporting of hypomagnesaemia among individuals diagnosed with neurological illnesses compared to all other diagnoses ($p<0.05$).

Magnesium possesses vasodilatory mechanisms in severe sepsis and septic shock that are endothelium-dependent and non-endothelium-dependent, as was highlighted in a 2011 study by Pranskunas et al. Saleem and Haque, 2009 also found a higher prevalence among boys.

CONCLUSION

Magnesium disorders are widespread in those who are seriously unwell. Our research shows that critically ill patients have lower than normal serum amounts of calcium, magnesium, and phosphate. Age, sex, and health status are all major predictors of magnesium levels.

CONFLICT OF INTEREST

There is no bias in the authors' work.

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Author contribution

Each of the authors made an equal contribution to the final product.

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