ORIGINAL ARTICLE

SERUM POTASSIUM AND MAGNESIUM IMBALANCE AS PREDICTORS OF ADVERSE OUTCOMES IN NEW-ONSET ATRIAL FIBRILLATION

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ABSTRACT

Background: Electrolyte imbalances, particularly in potassium and magnesium, are prevalent in patients with new-onset atrial fibrillation (AF) and may influence in-hospital outcomes.

Objective: To evaluate the association between serum potassium and magnesium imbalances and in-hospital morbidity and mortality in patients with new-onset AF.

Methods: This prospective observational study included 220 patients admitted with new-onset AF. Serum potassium and magnesium levels were measured upon admission. Clinical outcomes, including in-hospital morbidity and mortality, were recorded. Statistical analyses were performed to assess associations.

Results: Of the 220 patients, 45% had hypokalemia (<3.5 mEq/L), and 38% had hypomagnesemia (<1.8 mg/dL). Hypokalemia was associated with increased incidence of arrhythmias ($p<0.01$) and prolonged hospital stay ($p<0.05$). Hypomagnesemia correlated with higher mortality rates ($p<0.05$). Multivariate analysis confirmed that both hypokalemia and hypomagnesemia were independent predictors of adverse in-hospital outcomes.

Conclusion: Serum potassium and magnesium imbalances are significant predictors of in-hospital morbidity and mortality in patients with new-onset AF. Monitoring and correction of these electrolytes may improve patient outcomes.

Keywords: Atrial fibrillation, serum potassium, serum magnesium, electrolyte imbalance, in-hospital outcomes, mortality, morbidity.

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INTRODUCTION

Atrial fibrillation (AF) is a prevalent arrhythmia which plays a major role in morbidity and mortality in all regions of the world. It is associated with the risk of stroke, heart failure and ischemic events[1]. Since the electrolyte imbalances are a common feature of AF patients, and they have been associated with the pathogenesis and progression of this arrhythmia[2,3]. Hypokalemia and hypomagnesemia are frequent features of AF patients which may worsen the arrhythmogenic substrate and lead to adverse outcomes[4]. Both potassium and magnesium are important in ensuring the cardiac electrical balance and electrolyte deficiency increases arrhythmogenesis by modulating the myocardial action potential[5].

Previous research has demonstrated that hypokalemia may increase the rate of arrhythmias and adverse clinical outcomes in patients with AF[6]. Likewise, magnesium is recognized as an important electrolyte in the regulation of the electrical activity of the heart and magnesium deficiency has also been related to a high risk of AF-related complications[7,8]. Nevertheless, the precise contribution of serum potassium and magnesium imbalances to in-hospital morbidity and mortality is not well studied with respect to new-onset AF[9,10]. Consequently, this paper will seek to examine how these electrolyte imbalances affect in-hospital outcomes (e.g., arrhythmias, hospital length of stay, etc.) and in-hospital mortality.

MATERIALS AND METHODS

Study Design and Population: This observational prospective study was carried out at Cardiology Department of Shiekh zayed hospital and medical College Rahim yar khan with the period between 1st April 2024 to 31st December 2024. The sample size in the study was 220 consecutive patients who were 18 years and above and had been hospitalized with new-onset AF. The study excluded patients who have had a prior history of AF, chronic

electrolyte disturbances or who had been receiving intravenous electrolyte supplementation. The group was monitored throughout the time they were admitted in the hospital to measure the clinical outcome.

Data Collection: Demographic (age, sex, comorbidities) and serum potassium and magnesium and clinical (arrhythmias, hospital stay, mortality) outcomes. The levels of serum potassium were divided into normal, (3.5-5.0 mEq/L), hypokalemia, (<3.5 mEq/L), and hyperkalemia, (>5.0 mEq/L). Serum levels of magnesium were determined as normal (1.8-2.5 mg/dl), hypomagnesemia (<1.8 mg/dl), and hypermagnesemia (>2.5mg/dl). The first ones were arrhythmias, the length of stay (>7 days), and in-hospital mortality.

Statistical Analysis: Statistical computations were done in SPSS version 26.0. Demographic characteristics and electrolyte imbalances were summarized with descriptive statistics. t-tests were used to compare continuous variables and chi-square tests were used to compare categorical variables. A multivariate logistic regression analysis was performed to determine the independent relationships between serum electrolyte imbalances and unfavorable in-hospital outcomes after adjusting the possible confounder.

RESULTS

The study cohort consisted of 220 patients with a mean age of 68.4 ± 10.2 years. The majority of patients were male (60%), and the most common comorbidities were hypertension (55%), diabetes mellitus (40%), and coronary artery disease (30%). (Table 1)

Table 1: Demographics of all the included patients

Demographic Variable	Frequency (%)
Age (mean ± SD)	68.4 ± 10.2
Male	132 (60%)
Hypertension	121 (55%)
Diabetes Mellitus	88 (40%)
Coronary Artery Disease	66 (30%)

Out of the 220 patients, 45% had hypokalemia, and 38% had hypomagnesemia. Serum potassium levels were abnormal in 58% of patients, while 20% exhibited hyperkalemia. Serum magnesium levels were abnormal in 42% of patients, with 4% showing hypermagnesemia. (Table 2)

Table 2: Frequency of Serum Electrolyte Imbalances

Electrolyte Imbalance	Frequency (%)
Hypokalemia	99 (45%)
Hypomagnesemia	84 (38%)
Hyperkalemia	44 (20%)
Hypermagnesemia	9 (4%)

Hypokalemia was associated with a significantly higher incidence of arrhythmias (62% vs. 30%, $p<0.01$) and prolonged hospital stays (55% vs. 25%, $p<0.05$). Hypomagnesemia correlated with a higher mortality rate (12% vs. 3%, $p<0.05$).

Table 3: Clinical Outcomes Associated with Serum Electrolyte Imbalances

Clinical Outcome	Hypokalemia (%)	Hypomagnesemia (%)	Normal Electrolytes (%)	p-value
Arrhythmias	62	48	30	<0.01
Prolonged Hospital Stay	55	50	25	<0.05
Mortality	9	12	3	<0.05

The multivariate logistic regression analysis revealed that both hypokalemia (odds ratio [OR] 2.3, 95% CI 1.5–3.5) and hypomagnesemia (OR 2.1, 95% CI 1.3–3.2) were independent predictors of adverse in-hospital outcomes, including arrhythmias, prolonged hospital stay, and mortality.

Table 4: Logistic Regression Analysis

Variable	Odds Ratio (OR)	95% Confidence Interval (CI)
Hypokalemia	2.3	1.5–3.5
Hypomagnesemia	2.1	1.3–3.2

DISCUSSION

The present work demonstrates that serum potassium and magnesium abnormalities have a strong influence on the morbidity and mortality of patients with newly developed atrial fibrillation (AF) in-hospital. Hypokalemia was linked with more arrhythmias and extended hospitalization, and hypomagnesemia was linked with greater in-hospital mortality. Both electrolytes became independent predictors of poor outcomes, highlighting the clinical significance of keeping track of these imbalances and treating them in patient with A-fibrillation.

Potassium is a key element in the maintenance of cardiac excitability and conduction. Hypokalemia may lengthen the duration of action potential and predispose myocardial tissue to arrhythmias[1,2]. Our results are consistent with the past literature where, patients with hypokalemia experienced increased cases of arrhythmias, and an increased hospital stay[3,4]. Likewise, hyperkalemia is less common in our study; however, it has been linked to both the conduction abnormalities and sudden cardiac death in the AF patients[5]. It has been shown that the correction of potassium decreases the recurrence of arrhythmia and enhances short-term prognosis in several studies[6,7]. Thus, early diagnosis and treatment of potassium disproportion in the acute environment of new-onset AF are important.

Magnesium is a cofactor in enzymatic reactions that require ATP usage and are essential in the regulation of cardiac ion channels (particularly potassium and calcium channels)[8,9]. Hypomagnesemia has been associated with higher mortality and cardiac morbidity in AF-patients[10]. We found that in hypomagnesemic patients the mortality rate was 12 percent, which is consistent with previous studies that magnesium deficiency predisposes patients to ventricular arrhythmias and sudden cardiac death[11,12]. It has been demonstrated by clinical trials that magnesium supplementation can decrease the incidence of AF and can ameliorate the outcome of critically ill patients and postoperative patients[13,14]. Interaction between magnesium and potassium is particularly important: magnesium shortage may exacerbate potassium loss, and the co-correction is a required step and condition to restore cardiac stability[15,16].

The logistic regression analysis proved that hypokalemia (OR 2.3), as well as hypomagnesemia (OR 2.1), were independent predictors of adverse in-hospital outcomes. This indicates that electrolyte imbalances are not only the predictors of the severity of illness, but can also be the cause of arrhythmogenesis and poor clinical outcomes. This connection is corroborated in other studies: Pothineni et al.[17] found that patients with combined hypokalemia and hypomagnesemia were at a much greater risk of developing in-hospital complications than were the patients with isolated deficiencies. Additionally, other risk factors including heart failure, hypertension, and diabetes have been reported to interact with hypokalemia and hypomagnesemia, making people even more vulnerable to adverse outcomes[18,19].

Clinical Implications: We find that a regular check of electrolytes is critical and necessary in patients who have been hospitalized with new-onset AF. Hypokalemia and hypomagnesemia can be detected and corrected early to reduce the incidence of arrhythmias, long hospital stays, and, possibly, in-hospital mortality. Recent instructions suggest that serum electrolyte measurements should be performed at the time of admission and throughout the hospitalization period, particularly in the patients who are taking diuretics, antiarrhythmics, or undergoing cardiac surgery[20,21]. Implementing standard practices to rectify electrolytes have the potential to improve the performance of the clinic and resource utilization.

Limitations: The study is restricted by the single center design and the relative shortness of in-hospital follow-up. No evaluation of long-term outcomes outside of hospitalization was done. Future research should include multicenter cohort studies with longitudinal follow-up on a larger group of participants to establish cause and effect and the most appropriate remedies. Moreover, randomized trials that examine the effect of proactive supplementation with potassium and magnesium on morbidity and mortality in patients with AF would yield quality evidence to inform practice[22,23].

In short, hypokalemia and hypomagnesemia are both common among patients presenting with new-onset AF and both have a considerable impact on in-hospital outcomes. These electrolyte imbalances must be addressed and treated immediately in clinical care to reduce the burden of arrhythmia, reduce the hospital stay, and improve survival.

CONCLUSION

Serum potassium and magnesium imbalances are frequent in patients with newly-onset atrial fibrillation, and are strongly linked with poor in-patient outcomes, such as arrhythmias, length of stay, and mortality. Independent predictors of these complications were found to be hypokalemia and hypomagnesemia. Electrolyte disturbances can be corrected early and this is how patient outcomes can be improved. Routine monitoring and standardized correction measures of potassium and magnesium should be viewed as an important part of in-hospital management of AF patients. Further research is required to establish whether proactive electrolyte supplementation will be able to reduce morbidity and mortality further.

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