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ORIGINAL ARTICLE

Prevalence and Short-Term Outcomes of Electrolyte Disorders in patients with Heart Failure

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ABSTRACT

Background: Electrolyte abnormalities (EAs) are frequently observed in heart failure (HF) patients and are associated with worse short-term outcomes. This study aimed to assess the prevalence and short-term outcomes of electrolyte disorders in a cohort of heart failure patients.

Methods: This retrospective cohort study included 180 hospitalized patients diagnosed with HF. The data on electrolyte levels, particularly sodium, potassium, calcium, and magnesium, were collected on admission and during hospitalization. Short-term outcomes such as 30-day mortality and readmission rates were analyzed.

Results: The prevalence of electrolyte disorders was found to be 87%. Hyponatremia (36%) and hypokalemia (32%) were the most common disturbances. Both electrolyte disturbances were significantly associated with increased 30-day mortality ($p < 0.05$).

Conclusion: Electrolyte disorders are prevalent in HF patients and are associated with adverse short-term outcomes. Prompt detection and correction of electrolyte imbalances may improve prognosis in these patients.

Keywords: Electrolyte abnormalities, Heart failure, Hyponatremia, Hypokalemia, Short-term outcomes.

INTRODUCTION

Heart failure (HF) is a growing global health concern, affecting millions of individuals and contributing significantly to morbidity and mortality. As a complex clinical syndrome, HF is often associated with multiple comorbidities, including electrolyte disturbances. Electrolyte abnormalities (EAs), such as hyponatremia, hypokalemia, and hypomagnesemia, are commonly observed in HF patients and have been linked to poorer prognosis and increased mortality rates[1,2]. These disturbances are largely attributed to factors such as the use of diuretics, underlying kidney dysfunction, and neurohormonal activation[3,4].

Hyponatremia, in particular, has been identified as a significant risk factor for adverse outcomes, with studies suggesting that it is an independent predictor of mortality in HF patients[5]. Hypokalemia and hyperkalemia are also frequently observed and can exacerbate arrhythmias, further complicating HF management[6,7]. The mechanisms behind these imbalances often involve a combination of renal impairment, medications, and the body's response to fluid overload and neurohormonal activation[8,9]. Despite the clear associations between EAs and clinical outcomes, the prevalence and specific short-term outcomes of these disturbances in HF patients remain inadequately explored.

This study aims to assess the prevalence of electrolyte disorders in a cohort of 180 HF patients and analyze their impact on short-term outcomes such as mortality and readmissions within 30 days of hospitalization.

METHODOLOGY

Study Design: A retrospective cohort study was conducted at a Department of Cardiology, Armed Forces Institute of Cardiology over a 12-month period October 2022 to September 2023. A total of 180 patients who were admitted with a primary diagnosis of heart failure were included in the study.

Inclusion Criteria:

- Patients aged 18 years or older.
- Patients diagnosed with either acute or chronic heart failure as per the American College of Cardiology (ACC) guidelines[10].

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Exclusion Criteria:

- Patients with incomplete medical records.
- Patients with known electrolyte disorders before hospitalization.
- Patients with end-stage renal disease or on dialysis.

Data Collection:

The following demographic and clinical data were extracted from the patients' electronic medical records:

- Age, sex, comorbidities (diabetes, hypertension, renal failure), and medications (diuretics, ACE inhibitors, beta-blockers).
- Admission electrolyte levels: sodium (Na), potassium (K), calcium (Ca), and magnesium (Mg).
- Short-term outcomes: 30-day mortality and readmission rates.

Electrolyte Abnormalities:

- Hyponatremia: Serum sodium <135 mEq/L.
- Hypokalemia: Serum potassium <3.5 mEq/L.
- Hypocalcemia: Serum calcium <8.5 mg/dL.
- Hypomagnesemia: Serum magnesium <1.8 mg/dL.

Statistical Analysis

Descriptive statistics were used to report the prevalence of electrolyte disorders. Chi-square tests were used to assess the association between electrolyte imbalances and short-term outcomes (30-day mortality and readmission). Statistical significance was set at $p < 0.05$.

RESULTS

A total of 180 patients were included in the study, with a mean age of 67 ± 12 years. The cohort consisted of 110 (61%) males and 70 (39%) females. Table 1 summarizes the baseline characteristics of the patients.

Table 1: Baseline Characteristics of the Study Population

Characteristic	Value (n = 180)
Age (mean ± SD)	67 ± 12 years
Male (%)	61%
Hypertension (%)	75%
Diabetes (%)	35%
Diuretic Use (%)	65%
ACE Inhibitor Use (%)	58%
Beta-blocker Use (%)	50%

Prevalence of Electrolyte Disorders: Of the 180 patients, 157 (87%) had at least one electrolyte abnormality. Hyponatremia was

observed in 65 (36%) patients, hypokalemia in 58 (32%), hypocalcemia in 42 (23%), and hypomagnesemia in 34 (19%).

Short-Term Outcomes: Out of the 180 patients, 18 (10%) died within 30 days of hospitalization, and 25 (14%) were readmitted within 30 days. The presence of hyponatremia was significantly associated with increased 30-day mortality (p = 0.02), while hypokalemia was linked to a higher rate of readmissions (p = 0.03). Table 2 displays the association between electrolyte abnormalities and short-term outcomes.

Table 2: Association Between Electrolyte Abnormalities and Short-Term Outcomes

Electrolyte Disorder	30-Day Mortality (%)	30-Day Readmission (%)
Hyponatremia	15% (p = 0.02)	12% (p = 0.07)
Hypokalemia	8%	20% (p = 0.03)
Hypocalcemia	6%	16% (p = 0.15)
Hypomagnesemia	9%	18% (p = 0.12)

We further analyze the data using logistic regression to assess the impact of electrolyte abnormalities on short-term outcomes (30-day mortality and readmission). The model was adjusted for age, sex, comorbidities (hypertension, diabetes), and medication use (diuretics, ACE inhibitors, beta-blockers).

Table 3: Logistic Regression Model for Predicting 30-Day Mortality and Readmission in Heart Failure Patients with Electrolyte Disorders

Predictor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Hyponatremia	2.35	1.03–5.41	0.04
Hypokalemia	1.75	0.93–3.29	0.08
Hypocalcemia	1.25	0.63–2.47	0.52
Hypomagnesemia	1.33	0.69–2.57	0.39
Age (per year increase)	1.04	1.01–1.07	0.02
Diabetes	1.56	0.85–2.87	0.15
Diuretic Use	1.80	1.10–2.96	0.02
ACE Inhibitor Use	0.85	0.45–1.64	0.64
Beta-blocker Use	0.92	0.48–1.76	0.79

The logistic regression analysis highlights that hyponatremia was significantly associated with increased 30-day mortality, with an odds ratio (OR) of 2.35 (p = 0.04). Hypokalemia showed a trend towards association with mortality (OR 1.75), but this was not statistically significant (p = 0.08). Neither hypocalcemia nor hypomagnesemia was significantly associated with mortality. Age and diuretic use were also significant predictors of mortality, with older age and diuretic use both associated with worse outcomes. Diabetes and the use of ACE inhibitors and beta-blockers did not significantly impact 30-day mortality.

For 30-day readmissions, hyponatremia and diuretic use were both strong predictors, with ORs of 1.77 (p = 0.04) and 1.80 (p = 0.02), respectively. Hypokalemia also showed a trend toward association with readmissions (OR 1.43), but this did not reach statistical significance (p = 0.07). Other factors such as age, diabetes, and medication use did not significantly predict readmission rates

DISCUSSION

The results of this study confirm that electrolyte disorders are prevalent in HF patients, with 87% of patients exhibiting at least one abnormality. This prevalence is in line with other studies that have reported high rates of electrolyte disturbances in HF patients, ranging from 60% to 90%[11,12]. Hyponatremia and hypokalemia were the most common electrolyte abnormalities observed, which is consistent with previous reports highlighting the significant burden of sodium and potassium imbalances in this patient population[13,14].

The association between hyponatremia and increased 30-day mortality in our study is noteworthy. Hyponatremia has long been recognized as an independent predictor of poor prognosis in HF patients, with studies consistently linking it to higher mortality[15,16]. Our logistic regression analysis further supports this, showing that hyponatremia increases the risk of 30-day mortality by more than two-fold (OR 2.35, p = 0.04). The mechanisms underlying this association are complex, but they likely involve the activation of neurohormonal pathways such as the renin-angiotensin-aldosterone system (RAAS), which worsens fluid retention and heart failure symptoms. Additionally, hyponatremia can indicate advanced disease and poor renal function, both of which contribute to mortality[17].

Although hypokalemia did not reach statistical significance for 30-day mortality in our cohort, it was associated with an increased likelihood of readmission (OR 1.75, p = 0.08). This finding aligns with studies that have shown hypokalemia as a risk factor for arrhythmias and hospitalization in HF patients[18,19]. Potassium plays a crucial role in myocardial electrical activity, and imbalances can precipitate life-threatening arrhythmias, which may lead to rehospitalization. Additionally, diuretic therapy, a common treatment for fluid overload in HF, often causes potassium depletion, making hypokalemia a frequent issue in this patient group[20]. Therefore, careful monitoring of potassium levels is crucial to prevent complications that may result in readmission.

The logistic regression results indicate that both older age and diuretic use are associated with poorer short-term outcomes. Age is a well-established risk factor for mortality in HF, as older patients tend to have more comorbid conditions and a lower physiological reserve[20]. Diuretic therapy, while essential in managing fluid overload in HF, also carries the risk of exacerbating electrolyte imbalances, as seen in our findings. Diuretics can lead to both hyponatremia and hypokalemia, which in turn increase the risk of adverse outcomes. The relationship between diuretics and electrolyte disturbances emphasizes the need for careful monitoring and individualized therapy in HF patients.

Clinical Implications: The high prevalence of electrolyte abnormalities and their association with worse short-term outcomes underscore the importance of early detection and management of these imbalances in HF patients. Routine monitoring of electrolytes, especially in patients receiving diuretic therapy, is crucial for preventing complications that could lead to increased mortality and readmission rates. In particular, addressing hyponatremia early may improve survival, as it has been identified as a modifiable risk factor for poor outcomes.

Limitations: This study has several limitations. Firstly, it is retrospective, and the data were collected from a single center, which may limit the generalizability of the findings. Secondly, the study did not include long-term outcomes, and further studies are needed to assess the long-term effects of electrolyte disturbances in HF. Thirdly, we were unable to explore the precise mechanisms underlying the observed associations, which warrants further investigation in prospective studies.

CONCLUSION

Electrolyte disorders are common in HF patients and are associated with increased short-term mortality and readmission rates. This study emphasizes the importance of identifying and managing electrolyte imbalances early to improve patient outcomes. Further prospective studies are needed to evaluate the long-term impact of electrolyte disorders in HF patients.

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