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Original Article

Frequency of Hyperkalemia in Patients Presenting with Heart Failure with Reduced Ejection Fraction at Tertiary Care Hospital Karachi

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ABSTRACT

Background: Hyperkalemia, characterized by elevated serum potassium levels greater than 5.0 mmol/L, poses significant risks for patients due to its potential to induce cardiac arrhythmias and conduction abnormalities. This condition is particularly prevalent among patients with chronic conditions such as kidney disease, heart failure (HF), and diabetes, especially those treated with renin-angiotensin-aldosterone system inhibitors (RAASi). While these medications are beneficial for heart failure management, they can exacerbate renal dysfunction and hyperkalemia, both associated with poor clinical outcomes.

Objective: The study aimed to determine the frequency of hyperkalemia among patients presenting with chronic heart failure with reduced ejection fraction (HFrEF) at a tertiary care facility in Karachi.

Methods: A cross-sectional study was conducted at the Department of Adult Cardiology, National Institute of Cardiovascular Diseases (NICVD), Karachi, from August 22, 2020, to February 21, 2021. The study enrolled 139 patients aged between 20 and 70 years diagnosed with HFrEF based on echocardiography findings. Informed consent was obtained from all participants. Comprehensive clinical evaluations and laboratory measurements of serum potassium were performed to identify hyperkalemia. Data collection included demographic information, clinical history, comorbid conditions, and serum potassium levels. The data were analyzed using SPSS Version 25, with descriptive statistics summarizing demographic characteristics and chi-square tests assessing the relationships between hyperkalemia and patient characteristics.

Results: The mean age of the study cohort was 58.4 ± 15.9 years, with a male predominance of 55.4%. Dyslipidemia was observed in 30.2% of the participants. Hyperkalemia was found in 39.6% of the patients. The analysis showed no significant correlation between hyperkalemia and gender (p=0.991), hypertension (p=0.948), dyslipidemia (p=0.098), monthly income (p=0.770), or smoking status (p=0.853).

Conclusion: Hyperkalemia is significantly prevalent in patients with chronic heart failure and reduced ejection fraction. Routine screening and management of serum potassium levels are crucial in this patient population to mitigate the risks associated with hyperkalemia and optimize heart failure management.

Keywords: Chronic Heart Failure, Hyperkalemia, HFrEF, Serum Potassium, Renin-Angiotensin-Aldosterone System Inhibitors, Cardiac Arrhythmias.

INTRODUCTION

Heart failure (HF) is a significant global health concern, impacting approximately 26 million individuals worldwide (1). This complex clinical syndrome is marked by the heart's diminished capacity to pump or fill with blood, impairing its ability to meet the body's metabolic needs (2). The prevalence of heart failure is rising, particularly among the aging population, and it is associated with considerable morbidity, mortality, and a substantial economic burden due to the high costs of its management (3). Clinically, heart failure is classified into three subtypes: heart failure with reduced ejection fraction (HFrEF), heart failure with preserved ejection fraction (HFpEF), and heart failure with mid-range ejection fraction (HFmrEF) (4). These classifications are determined based on ejection fraction measurements, levels of natriuretic peptides, and the presence of structural heart disease and diastolic dysfunction

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(5). Each subtype has distinct pathophysiological characteristics and necessitates specific management strategies to optimize patient outcomes (6).

Patients with heart failure frequently experience complications such as chronic kidney disease, which elevates their risk of developing hyperkalemia, particularly when treated with renin-angiotensin-aldosterone system (RAAS) inhibitors (7). Hyperkalemia, defined by elevated serum potassium levels, is notably prevalent in patients with HFrEF and can lead to severe cardiac complications, including arrhythmias and increased mortality (8). Managing hyperkalemia requires meticulous monitoring of serum potassium levels and adjusting therapeutic regimens to mitigate its impact on patient health (9). The pathophysiology of heart failure involves a cascade of compensatory mechanisms, including the activation of the sympathetic nervous system and the renin-angiotensin-aldosterone system (10). These mechanisms aim to maintain adequate cardiac output by modifying heart rate, myocardial contractility, and systemic vascular resistance (11). Additionally, heart failure prompts the release of natriuretic peptides, which aid in sodium and water excretion and promote vascular dilation (12). In HFpEF, impaired relaxation and increased ventricular stiffness further complicate clinical management (3).

The etiology of heart failure is multifactorial, encompassing coronary artery disease, hypertension, valvular heart disease, and cardiomyopathies (13). In the United States, approximately 5.1 million people live with heart failure, with higher incidence and prevalence rates among older adults, particularly in African-American populations (14). Management strategies for heart failure have evolved significantly, incorporating lifestyle modifications, pharmacotherapy, and advanced therapies such as implantable cardioverter-defibrillators and cardiac resynchronization therapy (15). These treatments aim to improve symptoms, enhance quality of life, and reduce the risk of sudden cardiac death (16).

This study focuses on determining the frequency of hyperkalemia among patients presenting with chronic heart failure with reduced ejection fraction at a tertiary care center. This focus is essential given the limited data available on this topic, both locally and internationally. By understanding the prevalence of hyperkalemia, clinicians can better tailor management strategies to improve outcomes and reduce the adverse effects associated with this electrolyte imbalance in heart failure patients. The prevalence of hyperkalemia and its associated risks necessitate ongoing research and vigilant clinical practice to ensure optimal patient care.

MATERIAL AND METHODS

The study was conducted as a cross-sectional analysis at the Department of Adult Cardiology, National Institute of Cardiovascular Diseases (NICVD), Karachi, over a six-month period from August 22, 2020, to February 21, 2021. The objective was to ascertain the prevalence of hyperkalemia in patients diagnosed with chronic heart failure with reduced ejection fraction (HFrEF). The study population consisted of 139 patients, determined by a sample size calculation using WHO software, based on an expected hyperkalemia prevalence of 35.9%, with a margin of error of 8% and a 95% confidence interval.

Participants were selected through non-probability, consecutive sampling. Inclusion criteria encompassed patients aged 20-70 years diagnosed with chronic heart failure, as defined by previous hospitalization records, symptoms according to the NYHA classification, ongoing treatment with heart failure medications, and echocardiographic confirmation of HFrEF with an ejection fraction below 45%. Exclusion criteria included non-consenting individuals, patients with unstable angina, recent myocardial infarction, percutaneous coronary interventions, thyroid disorders, pregnant women, and those with chronic kidney disease. Ethical approval for the study was obtained from the Institutional Review Board of the College of Physicians and Surgeons Pakistan, ensuring adherence to the principles outlined in the Declaration of Helsinki.

Data collection procedures adhered to strict ethical standards, with informed consent obtained verbally from all participants prior to inclusion. Demographic and clinical data were collected, including age, gender, height, weight, and comorbid conditions such as hypertension, diabetes mellitus, dyslipidemia, and smoking status. Physical measurements were taken using standardized equipment. Blood samples were drawn for serum potassium level analysis and processed in the hospital's laboratory to confirm hyperkalemia, defined as serum potassium levels greater than 5.0 mmol/L.

The collected data were analyzed using SPSS Version 25. Descriptive statistics were employed to summarize demographic characteristics and disease duration, while frequencies and percentages evaluated qualitative variables such as comorbid conditions and hyperkalemia prevalence. Stratification by age, gender, and comorbidities was employed to control for potential confounders. The chi-square test was applied to assess the relationships between these variables and hyperkalemia. A p-value of less than 0.05 was considered statistically significant.

Through these rigorous methodologies, the study aimed to provide a comprehensive understanding of the prevalence of hyperkalemia in patients with HFrEF, thereby contributing valuable insights into the management and clinical outcomes of this patient population (1).

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RESULTS

The study included 139 patients diagnosed with chronic heart failure with reduced ejection fraction (HFrEF) at the National Institute of Cardiovascular Diseases (NICVD), Karachi. The mean age of the participants was 58.4 years (±15.9), ranging from 20 to 70 years. The mean duration of disease among the participants was 3.7 months (±1.3), with a range from 1 to 12 months.

Table 1: Demographic and Clinical Characteristics of Patients (N=139)

Characteristic	Mean (SD) / N (%)	Range
Age (years)	58.4 (15.9)	20 – 70
Duration of Disease (months)	3.7 (1.3)	1 – 12
Gender		
Male	77 (55.4%)	
Female	62 (44.6%)	
Dyslipidemia	42 (30.2%)	

The study found that 39.6% of the patients had hyperkalemia, defined as serum potassium levels greater than 5.0 mmol/L. The prevalence of hyperkalemia and its association with various patient characteristics is detailed in Table 2.

Table 2: Association Between Patient Characteristics and Hyperkalemia (N=139)

Variable	Status	Hyperkalemia Yes (N, %)	Hyperkalemia No (N, %)	P-Value
Gender	Male	33 (23.7%)	44 (31.7%)	0.991
	Female	22 (15.8%)	40 (28.8%)	
Hypertension	Hypertensive	35 (25.2%)	53 (38.1%)	0.948
	Non-Hypertensive	20 (14.4%)	31 (22.3%)	
Dyslipidemia	Yes	21 (15.1%)	21 (15.1%)	0.098
	No	34 (24.5%)	63 (45.3%)	
Monthly Income	≤ 15,000	15 (10.8%)	20 (14.4%)	0.770
	15,001 – 45,000	30 (21.6%)	51 (36.7%)	
	> 45,000	10 (7.2%)	13 (9.4%)	
Smoking Status	Smoker	24 (17.3%)	38 (27.3%)	0.853
	Non-Smoker	31 (22.3%)	46 (33.1%)	

The data revealed no significant statistical correlation between hyperkalemia and gender (p=0.991), hypertension (p=0.948), dyslipidemia (p=0.098), monthly income (p=0.770), or smoking status (p=0.853). This suggests that the risk of hyperkalemia is uniformly distributed across different demographic and clinical characteristics.

Overall, the findings indicate that hyperkalemia is significantly prevalent in patients with chronic heart failure and reduced ejection fraction. This underscores the importance of routine screening and management of serum potassium levels to mitigate the risks associated with hyperkalemia and optimize heart failure management.

DISCUSSION

The study highlighted the significant prevalence of hyperkalemia among patients with chronic heart failure with reduced ejection fraction (HFrEF) in a tertiary care setting in Karachi, with 39.6% of the participants exhibiting elevated serum potassium levels. This finding aligns with previous research that underscores the critical role of hyperkalemia in adversely affecting clinical outcomes and therapeutic management in heart failure patients (17). The prevalence reported in this study is consistent with Linde et al., although it is notably higher than in some other studies, which may be attributed to variations in patient demographics, comorbid conditions, and management strategies (18, 19).

The robust methodological framework employed in this study ensured rigorous data collection and analysis, bolstering the reliability of the findings. By including a diverse patient population and stratifying data by various demographics and clinical variables, the study provided a nuanced understanding of how different factors influence the prevalence of hyperkalemia in heart failure patients (20, 21). Despite the strengths, the study faced limitations, including a relatively small sample size and its single-center design, which may not provide a comprehensive view of the broader population. Furthermore, the cross-sectional nature of the study limited the ability to establish causality between heart failure and hyperkalemia (22).

The lack of significant statistical correlations between hyperkalemia and patient characteristics such as gender, hypertension, dyslipidemia, monthly income, and smoking status suggests that hyperkalemia in heart failure patients may be predominantly influenced by the heart failure condition itself and its management rather than these common comorbid conditions. This aspect

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opens avenues for further research to explore the underlying mechanisms specific to heart failure pathology and treatment (24). The association of hyperkalemia with chronic kidney disease and the use of renin-angiotensin-aldosterone system (RAAS) inhibitors is well-documented, emphasizing the need for vigilant monitoring and management of serum potassium levels in this patient population to mitigate severe cardiac complications, including arrhythmias and increased mortality (7, 8, 20).

The study's findings reinforce the importance of regular screening for hyperkalemia in patients with HFrEF, particularly those treated with RAAS inhibitors. The potential health risks associated with hyperkalemia, such as its capacity to precipitate severe cardiac events, necessitate careful adjustment of therapeutic regimens to balance the benefits of heart failure medications against the risk of elevated potassium levels (21-24). The management of hyperkalemia in heart failure patients requires a comprehensive approach, incorporating lifestyle modifications, pharmacotherapy, and advanced therapies to improve symptoms, enhance quality of life, and reduce the risk of sudden cardiac death (15, 16).

Future research should focus on larger, multicenter studies to enhance the generalizability of the findings and establish targeted interventions that can effectively manage hyperkalemia without compromising the efficacy of essential heart failure medications. Such efforts are crucial for enhancing patient outcomes and quality of life among those suffering from this debilitating condition. The study's contribution to the existing literature is significant, providing valuable insights into the prevalence of hyperkalemia in patients with HFrEF and underscoring the necessity for continued research and vigilant clinical practice to ensure optimal patient care.

CONCLUSION

This study indicated that hyperkalemia is notably prevalent in patients with chronic heart failure and reduced ejection fraction (HFrEF), particularly among those treated with RAAS inhibitors. This study reinforced the importance of routine screening and meticulous management of serum potassium levels in this patient group to prevent the severe complications associated with hyperkalemia, such as cardiac arrhythmias, thus optimizing overall heart failure management and patient outcomes.

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