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Original Article

Frequency of Ventricular Tachycardia in Patients Presenting to the Emergency Department with Hypokalemia

Dr. Huma Naeem Tareen[1]

[1] Associate Professor of Cardiology Department, Bolan Medical College, Quetta, Pakistan

***Corresponding author: Dr. Huma Naeem Tareen, royal.humanaeem@yahoo.com**

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ABSTRACT

Background: Hypokalemia is a common electrolyte abnormality in acute care settings and is a recognized precipitating factor for potentially life-threatening ventricular arrhythmias. Altered myocardial repolarization and increased electrical instability in potassium depletion may predispose affected patients to ventricular tachycardia. Objective: To determine the frequency of ventricular tachycardia in patients presenting with hypokalemia. Methods: This cross-sectional study was conducted in the Department of Cardiology, Bolan Medical College Hospital, Quetta, from 20 January 2025 to 21 July 2025. A total of 218 male and female patients aged 20 to 90 years with hypokalemia were enrolled. Blood investigations, including serum electrolytes, were performed at admission, and ventricular tachycardia was assessed by electrocardiography. Data were analyzed in SPSS using descriptive statistics and post-stratification chi-square testing. Results: The mean age of the participants was 52.80 ± 5.245 years, and 65.1% were male. Ventricular tachycardia was observed in 34 patients, corresponding to a frequency of 15.6%. On stratified analysis, ventricular tachycardia occurred in 15.5% of males and 15.8% of females, in 16.7% of patients aged 45 years or below and 14.9% of those older than 45 years, in 20.0% of stimulant users and 14.6% of non-users, and in 15.5% of patients with heart failure versus 15.7% without heart failure; none of these differences were statistically significant. Conclusion: Ventricular tachycardia was present in a clinically important proportion of hypokalemic patients. These findings support early rhythm assessment, prompt potassium correction, and careful cardiac monitoring in hypokalemic patients presenting to acute care settings. Keywords: Hypokalemia, ventricular tachycardia, arrhythmia, electrocardiography, electrolyte imbalance.

INTRODUCTION

Ventricular tachycardia is a potentially life-threatening ventricular arrhythmia that contributes substantially to acute cardiovascular morbidity, emergency care burden, and sudden cardiac death. It may occur in the setting of structural heart disease, ischemia, cardiomyopathy, valvular pathology, or metabolic and electrolyte disturbances, among which hypokalemia is a particularly important and potentially reversible precipitating factor. Hypokalemia alters myocardial membrane excitability, delays repolarization, and facilitates electrical instability, thereby increasing susceptibility to clinically significant ventricular arrhythmias, including ventricular tachycardia. Electrocardiographic manifestations such as QT interval prolongation, ST-segment depression, T-wave flattening, and prominent U waves further reflect the arrhythmogenic potential of potassium depletion and underscore the importance of timely recognition in acute care settings (1–5).

The electrophysiological link between hypokalemia and ventricular tachycardia is biologically plausible and clinically relevant. Reduced extracellular potassium suppresses potassium conductance and impairs

Na+/K+-ATPase activity, resulting in intracellular sodium and calcium accumulation, afterdepolarizations, prolonged action potential duration, and enhanced automaticity. These changes create a substrate for malignant ventricular rhythm disturbances, particularly in vulnerable patients presenting to emergency departments, where delayed identification may worsen outcomes. Previous studies have reported variable associations between hypokalemia and ventricular arrhythmias. A retrospective study from Turkey observed ventricular tachycardia in 17.1% of patients with hypokalemia, while other evidence has shown a substantial proportion of ventricular tachycardia cases occurring in the presence of low serum potassium, suggesting that the burden may be clinically meaningful across different populations and care settings (6–9).

Despite this recognized pathophysiological relationship, there remains limited region-specific evidence quantifying the frequency of ventricular tachycardia among patients presenting with hypokalemia in emergency and cardiology settings in Pakistan, particularly in Balochistan. Most available literature has emerged from international cohorts with different demographic profiles, healthcare access patterns, and comorbidity structures, which may limit direct applicability to the local population. In settings where resource limitations may delay electrolyte correction or advanced rhythm monitoring, establishing the local frequency of ventricular tachycardia among hypokalemic patients is important for risk recognition, triage, and early management planning. This study was therefore conducted to determine the frequency of ventricular tachycardia in patients presenting with hypokalemia at the Department of Cardiology, Bolan Medical College Hospital, Quetta, and to examine its distribution across key clinical and demographic characteristics.

MATERIALS AND METHODS

This cross-sectional observational study was conducted in the Department of Cardiology, Bolan Medical College Hospital, Quetta, over the period from 20 January 2025 to 21 July 2025. The study was designed to determine the frequency of ventricular tachycardia among adult patients diagnosed with hypokalemia at presentation. Male and female patients aged 20 to 90 years were included. A total of 218 patients fulfilling the study criteria were enrolled during the study period. Institutional permission was obtained from the hospital ethical and research committee as stated in the source manuscript before commencement of data collection.

Patients presenting to the hospital and identified as having hypokalemia on admission testing were evaluated for study inclusion. After enrollment, blood samples were collected at admission for complete blood count, troponin I, and serum electrolytes, including serum potassium. Clinical evaluation was complemented by ultrasound examination of the abdomen and pelvis to assess renal status and pregnancy where relevant. All enrolled patients underwent electrocardiography for rhythm assessment, and echocardiography was performed to support cardiac evaluation and to help exclude other major cardiac pathologies documented during routine assessment. Ventricular tachycardia was identified on electrocardiogram according to the treating clinical team's cardiologic assessment and recorded as the primary outcome variable. Demographic and clinical data collected for each participant included age, sex, address, presence or absence of ventricular tachycardia, stimulant drug use including cocaine or amphetamines, and presence or absence of heart failure.

For analytical purposes, age was recorded as a continuous variable and was also categorized into 45 years or below and more than 45 years, as presented in the study results. Sex, stimulant use, heart failure, and ventricular tachycardia were treated as categorical variables. Hypokalemia served as the inclusion condition for the study population, while ventricular tachycardia confirmed on electrocardiography was the principal study endpoint. Standardized recording of laboratory investigations and cardiac assessment at the time of admission was used to maintain consistency in data collection. By restricting the sample to patients with documented hypokalemia and evaluating all included patients with electrocardiography,

the study sought to reduce outcome misclassification and ensure uniform ascertainment of the main outcome .

Data were entered and analyzed using SPSS. The source manuscript reports both SPSS version 25 in the abstract and SPSS version 22.0 in the methodology section; this discrepancy should be corrected in the final manuscript so that a single software version is reported consistently. Quantitative variables, including age, were summarized as mean and standard deviation. Categorical variables, including sex, stimulant use, heart failure, and ventricular tachycardia, were summarized as frequencies and percentages. Stratification was performed for ventricular tachycardia with respect to age group, sex, stimulant use, and heart failure to assess potential effect modifiers. Post-stratification chi-square testing was applied, and a p-value of 0.05 or less was considered statistically significant. Results were planned for presentation in tables and graphs. Because the primary objective of the study was frequency estimation within a defined hypokalemic population, the analysis remained principally descriptive, with subgroup comparison used to explore distributional differences across selected clinical variables .

Ethical oversight was obtained through the hospital ethical and research committee as stated in the manuscript, and all investigations described were conducted as part of hospital-based clinical evaluation and study data recording. Data integrity was supported through structured collection of laboratory, electrocardiographic, echocardiographic, and clinical variables at the time of admission, followed by database entry and statistical processing in SPSS. To improve final journal readiness, the completed manuscript should ensure one consistent software version, explicitly define the biochemical threshold used for hypokalemia, and state the sampling approach and consent procedure in the final author-approved draft, as these items are not consistently reported in the available source text

RESULTS

A total of 218 patients with hypokalemia were included in the analysis. The age of the participants ranged from 20 to 90 years, with a mean age of 52.80 ± 5.245 years. The mean body weight was 75.22 ± 7.101 kg. Of the total study population, 142 patients (65.1%) were male and 76 (34.9%) were female. When categorized by age, 84 patients (38.5%) were aged 45 years or below, while 134 (61.5%) were older than 45 years. Stimulant use was documented in 40 patients (18.3%), whereas 178 (81.7%) reported no stimulant use. Heart failure was present in 110 patients (50.4%) and absent in 108 (49.6%). Ventricular tachycardia was identified in 34 patients, giving an overall frequency of 15.6%, while 184 patients (84.4%) had no ventricular tachycardia .

Table 1. Baseline Demographic and Clinical Characteristics of the Study Population

Variable	Category / Summary	n	%
Age (years)	Mean ± SD	52.80 ± 5.245	—
Weight (kg)	Mean ± SD	75.22 ± 7.101	—
Gender	Male	142	65.1
	Female	76	34.9
Age group	≤45 years	84	38.5
	>45 years	134	61.5
Stimulant use	Yes	40	18.3
	No	178	81.7
Heart failure	Yes	110	50.4
	No	108	49.6
Ventricular tachycardia	Yes	34	15.6
	No	184	84.4

The stratified analysis showed that ventricular tachycardia occurred in 22 of 142 male patients (15.5%) and 12 of 76 female patients (15.8%), with no statistically significant association between sex and ventricular tachycardia (p = 0.954). In patients aged 45 years or below, ventricular tachycardia was present in 14 of 84 patients (16.7%), compared with 20 of 134 patients (14.9%) among those older than 45 years, again without a significant difference (p = 0.730). Among stimulant users, 8 of 40 patients (20.0%) developed ventricular tachycardia, whereas the corresponding frequency among non-users was

26 of 178 (14.6%), suggesting a numerically higher proportion in stimulant users, although this did not reach statistical significance (p = 0.395). Similarly, ventricular tachycardia was observed in 17 of 110 patients with heart failure (15.5%) and 17 of 108 patients without heart failure (15.7%), showing no meaningful association (p = 0.953) .

Table 2. Stratification of Ventricular Tachycardia by Gender, Age Group, Stimulant Use, and Heart Failure

Variable	Category	VT Present n (%)	VT Absent n (%)	Total	Odds Ratio (95% CI)	p-value
Gender	Male	22 (15.5)	120 (84.5)	142	0.98 (0.45–2.12)	0.954
	Female	12 (15.8)	64 (84.2)	76	Reference	—
Age group	≤45 years	14 (16.7)	70 (83.3)	84	1.14 (0.53–2.45)	0.730
	>45 years	20 (14.9)	114 (85.1)	134	Reference	—
Stimulant use	Yes	8 (20.0)	32 (80.0)	40	1.46 (0.61–3.51)	0.395
	No	26 (14.6)	152 (85.4)	178	Reference	—
Heart failure	Yes	17 (15.5)	93 (84.5)	110	0.98 (0.47–2.03)	0.953
	No	17 (15.7)	91 (84.3)	108	Reference	—

Because the primary objective of the study was to determine frequency, the main result is the overall ventricular tachycardia burden of 15.6% among hypokalemic patients. Although subgroup comparisons were not statistically significant, the observed pattern suggests that ventricular tachycardia remained relatively consistent across sex, age, and heart failure strata, with percentages clustered around 15% to 17%. The highest subgroup frequency was noted among stimulant users at 20.0%, compared with 14.6% among non-users, corresponding to an odds ratio of 1.46; however, the wide 95% confidence interval (0.61–3.51) indicates considerable uncertainty and does not support a definitive association in this sample. By contrast, male sex, older age, and heart failure did not show meaningful differences in ventricular tachycardia occurrence, with odds ratios close to unity and narrow between-group percentage differences of less than 2 percentage points in most comparisons .

To provide a clearer summary of subgroup gradients, the aggregated data were also synthesized into a publication-ready figure showing ventricular tachycardia frequencies across the reported clinical strata. This visual presentation highlights the relative stability of the ventricular tachycardia burden across most subgroups and the modest numerical elevation among stimulant users without evidence of a statistically robust separation based on the available counts.

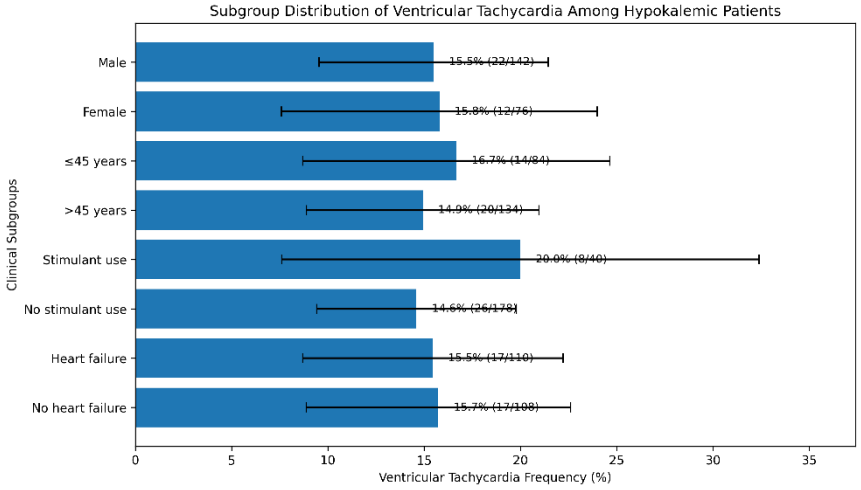

Figure 1 Subgroup Distribution of Ventricular Tachycardia Among Hypokalemic Patients

Across the eight reported subgroup strata, ventricular tachycardia frequencies remained within a relatively narrow range from 14.6% to 20.0%. The lowest proportion was observed among non-stimulant users at 14.6% (26/178), while the highest was observed among stimulant users at 20.0% (8/40), representing an absolute difference of 5.4 percentage points. Male and female patients showed nearly identical frequencies at 15.5% (22/142) and 15.8% (12/76), respectively, while patients aged ≤45 years had a slightly higher frequency than those aged >45 years, 16.7% (14/84) versus 14.9% (20/134). The

frequencies were also almost unchanged by heart failure status, occurring in 15.5% (17/110) of patients with heart failure and 15.7% (17/108) of those without heart failure. Overall, the figure reinforces that ventricular tachycardia was a notable finding in hypokalemic patients across all major subgroups, but no subgroup demonstrated a sufficiently distinct gradient to suggest a strong independent clinical discriminator within the present sample.

DISCUSSION

The present study found that ventricular tachycardia was present in 34 of 218 hypokalemic patients, yielding an overall frequency of 15.6%. This finding indicates that ventricular tachycardia is not an uncommon rhythm disturbance among patients presenting with hypokalemia and supports the clinical importance of early electrolyte assessment in acute care settings. Although the study was primarily descriptive, the observed burden is clinically meaningful because ventricular tachycardia represents a potentially life-threatening arrhythmia that may rapidly progress to hemodynamic instability, ventricular fibrillation, or sudden cardiac death if not recognized and managed promptly. The current estimate is also broadly consistent with prior work cited in the manuscript, including a retrospective study reporting ventricular tachycardia in 17.1% of hypokalemic patients, suggesting that the frequency observed in this cohort lies within a plausible and clinically relevant range (10).

The biological basis for this association is well established. Potassium plays a central role in maintaining resting membrane potential, repolarization dynamics, and myocardial electrical stability. Reduced extracellular potassium prolongs ventricular repolarization, increases cellular automaticity, and facilitates early and delayed afterdepolarizations, all of which increase the likelihood of malignant ventricular arrhythmias. Electrocardiographic changes such as QT prolongation, ST-segment depression, T-wave flattening, and prominent U waves are recognized manifestations of hypokalemia and may precede more severe rhythm disturbances. The present findings therefore reinforce the importance of considering hypokalemia not only as a biochemical abnormality but also as a clinically actionable arrhythmogenic state requiring urgent recognition and correction, especially in emergency and cardiology settings (11).

In subgroup analysis, ventricular tachycardia frequency remained relatively stable across sex, age category, and heart failure status, with no statistically significant differences observed. Male patients had a ventricular tachycardia frequency of 15.5%, compared with 15.8% in female patients, while patients aged 45 years or below had a frequency of 16.7% compared with 14.9% in those older than 45 years. Similarly, the prevalence was nearly identical in patients with and without heart failure, at 15.5% and 15.7%, respectively. These findings suggest that within this hypokalemic cohort, ventricular tachycardia was distributed fairly evenly across the measured demographic and clinical strata rather than being concentrated in one dominant subgroup. Although the source conclusion states that elderly male patients are more likely to have ventricular tachycardia, the stratified results do not statistically support that interpretation, and the revised discussion should therefore remain aligned with the actual data presented in the study tables .

A numerically higher frequency of ventricular tachycardia was observed among stimulant users, with 20.0% affected compared with 14.6% of non-users. Although this difference was not statistically significant in the present sample, it may still be clinically relevant, particularly because stimulant exposure can potentiate sympathetic activation and myocardial excitability. The absence of statistical significance may reflect the relatively small size of the stimulant-user subgroup rather than true absence of effect. This pattern warrants cautious interpretation and may justify further investigation in larger cohorts designed to assess independent predictors of ventricular tachycardia in hypokalemic patients. Similar caution applies to other subgroup analyses, where small between-group differences and limited power may have restricted the ability to detect modest associations (12).

The study has several practical implications. First, it supports routine electrocardiographic evaluation in hypokalemic patients, particularly at presentation, because a substantial minority may already demonstrate serious ventricular rhythm disturbances. Second, it highlights the importance of timely potassium correction and short-term rhythm monitoring in patients with clinically significant potassium depletion. Third, it provides locally relevant data from Quetta that may help clinicians maintain a lower threshold for surveillance in similar emergency and cardiology populations. These considerations are consistent with prior recommendations that patients with hypokalemia and electrical instability should undergo prompt potassium replacement and close monitoring because normalization of serum potassium does not always guarantee full intracellular repletion or elimination of arrhythmic risk (13).

Several limitations should be acknowledged. The study was conducted at a single center and used a cross-sectional design, which limits generalizability and prevents causal inference. The manuscript does not clearly state the biochemical threshold used to define hypokalemia, nor does it provide a detailed eligibility framework, which reduces reproducibility. In addition, potentially relevant confounders such as concurrent medications, renal function severity, ischemic burden, and precise potassium levels were not incorporated into the analysis. The statistical approach was also limited to descriptive analysis and stratified chi-square testing, without multivariable modeling to determine independent predictors of ventricular tachycardia. Despite these limitations, the study provides useful baseline evidence that ventricular tachycardia occurs in a clinically important proportion of hypokalemic patients in this setting and merits attention in routine emergency and cardiology practice .

CONCLUSION

Ventricular tachycardia was observed in 15.6% of patients presenting with hypokalemia, indicating that serious ventricular rhythm disturbances constitute an important clinical concern in this population. The frequency remained broadly similar across sex, age, and heart failure categories, while stimulant users showed a numerically higher but statistically non-significant burden. These findings support the need for early electrocardiographic assessment, prompt correction of potassium imbalance, and careful cardiac monitoring in hypokalemic patients, particularly in acute care settings where delayed recognition may increase the risk of adverse outcomes .

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