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# FREQUENCY OF HYPOKALEMIA AMONG PATIENTS PRESENTING WITH ACUTE MYOCARDIAL INFARCTION

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## ABSTRACT

**Objectives**: To find out the frequency of hypokalemia in patients presenting with acute myocardial infarction (AMI) at NICVD, Karachi, Pakistan.

**Study design and setting**

A descriptive Cross-Sectional Study was conducted at the Department of Cardiology during the period October 2, 2021, to April 1, 2022, at the National Institute of Cardiovascular Diseases, Karachi, Pakistan.

**Materials and methods**

The study comprised all patients who attended NICVD, Karachi, and met the inclusion criteria. Following an explanation of the process, risks, and advantages of the research, informed consent was obtained. Every individual had a fresh blood sample drawn, which was then sent to the lab for analysis. An auto-analyzer was used to measure the serum potassium levels to evaluate the outcome variable i.e., hypokalemia. All of the information gathered was electronically used for research purposes and recorded into the proforma that was provided at the conclusion.

**Results:** The mean ± SD of age was 49.18±8.85 years. In the distribution of gender, 73 (48.7%) were male while 77 (51.3%) were female. Hypokalemia was noted in 77 (51.3%) patients.

C**onclusion:** It is to be concluded that hypokalemia is highly prevalent in patients with acute myocardial infarction (AMI). Patients with AMI should be worked up for the presence of hypokalemia to ensure adequate treatment. To verify the present findings, more well-controlled, prospective studies are required.

**Keywords:** Prevalence, Acute Myocardial Infarction, Hypokalemia, dysrhythmias

## Introduction

Chronic obstructive pulmonary disease (COPD), diabetes, osteoporosis, arthritis, obesity, central nervous system degenerative disorders, inflammatory bowel disease, and some malignancies are among the most prevalent chronic illnesses that affect people globally. In addition to being major

causes of morbidity and mortality, COPD and CVD also significantly increase the financial burden of the health care system both domestically and globally [1-2].

One type of cardiovascular illness that is frequent is ischemic heart disease (IHD). Acute myocardial infarction and angina are the two primary indicators of IHD. Acute myocardial infarction (AMI) is one of the subgroups of IHD that includes unstable angina and AMI with or without ST elevation [3]. One prevalent comorbidity after an acute myocardial infarction (AMI) is congestive heart failure (CHF)., and the prognosis is poor if CHF exacerbates AMI. Retention of salt and water are the main pathophysiological mechanisms that lead to "congestion" in CHF [4].

It is now evident that the heart, kidneys, and vasculature are all involved in the systemic neurohormonal response that causes CHF [3–4]. The primary cation in cells, potassium is crucial for controlling heart rate and muscle contraction. Potassium is essential for neuron transmission because it forms the other half of the electrical pump that maintains electrolyte balance and permits conductivity between cells [5–6]. One frequent electrolyte imbalance that can cause dangerous and even deadly cardiac dysrhythmias is hyperkalemia [7].

The relationship between hyperkalemia and poor cardiovascular outcomes has been shown by earlier research [6–8]. These days, hyperkalemia is linked to an increasing number of cases of diabetes and chronic renal disease [9–10].

Low blood potassium levels, often less than 3.5 mEq/L, have been linked in several studies to an increased incidence of ventricular arrhythmias in individuals suffering from acute myocardial infarction (AMI) [8–12]. According to research, 24% of AMI patients have hypokalaemia [13].

Because all of these medications raise blood K+ levels and so counteract hypokalemia, it is more plausible that the frequency was higher in patient groups that were investigated before the advent of beta-blockers, ACE-inhibitors, and AT1-antagonists as routine HF treatment [14]. Another study reported the prevalence of hypokalemia at 52.6% among the subjects of the AMI group. [15]. The use of diuretics and the stimulation of the renin-angiotensin-aldosterone pathway, which results in a loss of K+ in the urine, are the primary causes of hypokalemia in heart failure. The primary factor influencing the resting membrane potential is the potassium gradient created by the Na+/K+ adenosine triphosphatase (sodium pump) that is found in all human cells [16–18].

**Operational definition**

**Acute myocardial infarction**

According to European guidelines [19]; it was defined as, a unique increase in the ST segment in at least two adjacent leads, with an ST-segment elevation of at least 2.5 mm in males under 40, at least 2 mm in men over 40, or at least 1.5 mm in women in leads V2–V3 and/or 1 mm in the remaining leads.

**Hypokalemia**

It was defined as a serum potassium level < 3.5 mEq/L [14].

**Effect modifiers / confounders hypertension**

Patients with a documented history of hypertension either (controlled / uncontrolled) and on anti-hypertensive drugs for at least 6 months were labeled as hypertensive.

**Methodology**

**Study setting:**

The study was carried out at NICVD, Karachi.

**Study duration:**

Duration of study from October 2, 2021, to April 1, 2022

**Sampling procedure:**

Consecutive Sampling.

**Sample size:**
The sample size was computed by applying the W.H.O. sample size calculator version 2.0. Consider frequency of hypokalemia (52.6%) [15] among AMI patients, the margin of error (d)=8%, confidence level (C.I)=95% then the estimated sample was n=150 patients.

**Inclusion criteria:**
- Age (40-70 years)
- Gender. Both sexes male/female
- According to the operational criteria, patients with acute myocardial infarction (AMI) were present.
- Individuals experiencing chest discomfort for more than half an hour.

- **Exclusion criteria:**
- A patient who has already undergone heart surgery or intervention.
- If you had thrombolytic treatment before going to the hospital.
- Individuals who have previously had ventricular tachycardia or malfunction. Bundle branch block patients are evaluated on an ECG.
- Individuals who have undergone recent surgery and a history of any type of cancer, including myeloproliferative diseases, should be considered.
- Individuals that have a history of cardiomyopathies recorded.

**Data collection:**
The study was started after approval of the synopsis from the Research Department of the College of Physicians and Surgeons Pakistan.
those patients who presented at the emergency department of NICVD and fulfilled the inclusion criteria were included in the study. Verbal informed consent was taken by the principal investigator at the time of inclusion in the study after explaining the purpose, procedure, risk, and benefits of the study. Those who gave the consent were included in the study. Demographic information like gender, age (year), hypertension, diabetes mellitus, family history of CAD, weight, height was recorded. By dividing the weight in kilograms by the square of the height in meters, the BMI was computed. During the visit, a stadiometer and a weight machine were used to measure the visitor's height in centimeters and weight in kilograms, respectively. Every individual had fresh blood drawn, which was then sent to the lab for analysis. An auto-analyzer was used to measure serum potassium levels to evaluate the outcome variable, or hypokalemia (according to the operational definition). The pre-designed proforma (attached) was filled out with all of the data that was gathered. To prevent bias in the study's findings and cofounders, the exclusion criteria were rigorously adhered to.

**Result**s:
In this study, 150 patients were included to assess the hypokalemia in patients presenting with acute myocardial infarction (AMI) at NICVD, Karachi, Pakistan, and the results were analyzed as:
The distribution of continuous variables was tested by applying the Shapiro-Wilk test for age (P=0.063), weight (P=0.078), height (P=0.071), and body mass index (P=0.085) as shown in **TABLE 1**.
Mean ± SD of age was 49.18±8.85 with C.I (47.75…….50.61) years as shown in **TABLE 2**.
The mean ± SD of weight was 77.21±11.45 with C.I (75.36…….79.06) kg as shown in **TABLE 2**.
The mean ± SD of height was 1.68±0.08 with C.I (1.67…….1.69) m as shown in **TABLE 2**.
Mean ± SD of body mass index was 27.25±4.40 with C.I (26.54…….27.96) kg/m2 as shown in **TABLE 2**
In demographic and other distribution of gender, 73 (48.7%) were male while 77 (51.3%) were female, while diabetes mellitus and hypertension were documented in 71 (47.3%)and 56 (37.3%) patients respectively, as shown in FIGURE 3**.**
Out of 150 patients, the frequency of positive family history of IHD and

positive hypokalemia was noted in 42 (28.0%) and 77 (51.3%) patients respectively, while 65 (43.3%) were smokers while 85 (56.7%) were non-smokers as shown in **FIGURE 3**.
Stratification of age group, gender, BMI, diabetes mellitus, hypertension, smoking status, and family history of IHD was done concerning hypokalemia patients as shown in **TABLE [4]**.

**Discussion:**
Chronic illnesses like diabetes, cardiovascular diseases, osteoporosis, arthritis, obesity, chronic obstructive pulmonary disease, inflammatory bowel disease, degenerative nervous system disorders, and certain malignancies are prevalent globally, causing morbidity and death, and putting significant financial strain on the healthcare system. [1,20].
Ischemic heart disease (IHD) is a common kind of cardiovascular disease. Angina and acute myocardial infarction are the two main signs of IHD. Within the spectrum of IHD, unstable angina, and AMI with or without ST elevation are subtypes that include acute myocardial infarction (AMI) [21–23]. One frequent electrolyte imbalance that can cause dangerous and even deadly cardiac dysrhythmias is hyperkalemia. The relationship between hyperkalemia and unfavorable cardiovascular outcomes has been well-established by earlier research [24–26]. These days, hyperkalemia is linked to an increasing number of cases of diabetes and chronic renal disease [27, 28]. Practises that raise the risk of hyperkalemia in acute myocardial infarction survivors with or without event heart failure have also become widely accepted. These treatments include the use of beta-blockers under guidelines [28], mineralocorticoid receptor antagonists [29], and antagonists of the renin-angiotensin-aldosterone system [30–32]. Significant increases in hospitalizations and mortality attributable to hyperkalemia have been linked to the increased usage of these drugs [30, 31–33]. Moreover, procedures like coronary artery bypass grafting and percutaneous intervention, which are frequently used in the modern management of acute myocardial infarction, may indirectly raise the risk of hyperkalemia through the incidence of contrast-induced nephropathy and acute kidney injury, respectively [29, 35].
Following an acute myocardial infarction (AMI), congestive heart failure (CHF) is a common comorbidity, and the prognosis is not good if CHF complicates AMI. The two primary pathophysiological processes that cause "congestion" in CHF are water and salt retention. It is now evident that the heart, kidneys, and vasculature are all involved in the systemic neurohormonal response that causes CHF [33–35].
The primary cation in cells, potassium is crucial for controlling heart rate and muscle contraction. Potassium is essential for neuron transmission because it forms the other half of the electrical pump that maintains electrolyte balance and permits conductivity between cells [39–41]. Low blood potassium levels, often less than 3.5 mEq/L, have been linked in several studies to an increased incidence of ventricular arrhythmias in individuals suffering from acute myocardial infarction (AMI) [36, 42]. Experts and professional bodies have advised keeping potassium levels in AMI patients between 4.0 and 5.0 mEq/L [43,44], or even 4.5 to 5.5 mEq/L, based on this research [42–44].
The findings of our study are comparable to different studies discussed below.
In the present study, the mean age was 49.18±8.85 years. Kast DL, et al noted the mean age to be 48.5 years [13] while Meghwal K, et al found as 48.9 years [15]. In another study, 197 patients were included with a mean age of 59.5 ± 9.5 years [48].
In this study, 73 (48.7%) were male while 77 (51.3%) were female. In the study of Kast DL, et al, males were 13 (52%) and females were 12 (48%) [13] while Meghwal K, et al reported to have 20 (52.63%) males and 18 (47.37%) females [15]. Iqbal R, et al documented to have 55.3% males and 44.7% [48]. In our study, hypokalemia was noted in 77 (51.3%) patients. A study reported the incidence of hypokalaemia (24%) in AMI patients [13]. Another study reported the prevalence of hypokalemia at 52.6% among the subjects of the AMI group [15].
Coronary artery disease (CAD) is a major cause of death in technologically advanced countries and a worldwide health concern affecting people of both genders. In Western countries, the relationship between socioeconomic level and myocardial infarction (MI) result is well-established, showing that those with lower socioeconomic class have a greater burden from the illness [46]. Pakistan and other

countries in South Asia have comparable high rates of CAD prevalence [47]. The most meticulous estimates, based on reliable scientific investigations, indicate that around 100,000 people in Pakistan experienced an acute MI [48].

In the current study, stratification of confounders/effect modifiers concerning hypokalemia revealed significant differences in gender (P=0.863), body mass index (P=0.772), diabetes mellitus (P=0.245), hypertension (P=0.672), and smoking status (P=0.435). Significant differences were also noted in the age group (P=0.025) and family history of IHD (P=0.019).

**Conclusion:**

We find that a significant number of individuals with acute myocardial infarction (AMI) have hypokalemia. To promise proper therapy, patients with AMI should be evaluated for the existence of hypokalemia. To verify the present findings, more well-controlled, prospective studies are required.

**TABLE # 1** DESCRIPTIVE STATISTICS OF SHAPIRO WILK TEST n=150

| VARIABLE | MEAN±SD | P-VALUE |
|---|---|---|
| **Age group** | 49.18±8.85 | 0.063 |
| **Weight** | 77.21±11.45 | 0.078 |
| **Height** | 1.68±0.08 | 0.071 |
| **Body mass index** | 27.25±4.40 | 0.085 |

**TABLE # 2** DESCRIPTIVE STATISTICS OF DIFFERENT VARIABLES

| Variable | Mean ±S.D | 95% C.I | Max | Min | Range |
|---|---|---|---|---|---|
| **AGE** | 49.18±8.859Years | 47.75…..50.61 | 70 | 40 | 30 |
| **Height** | 1.6863±0.08343 | 75.36…79.06 | 1.86 | 1.55 | 0.27 |
| **Weight** | 77.21 ±11.459 | 57.16…….61.83 | 101 | 55 | 46 |
| **BMI(kg/m$^2$)** | 27.2544±4.40057 | 26.5444…….27.9644 | 39.26 | 19.3 | 20.23 |

**TABLE#3** DESCRIPTIVE STATISTICS FREQUENCIES OF DEMOGRAPHIC AND OTHER VARIABLES

| DESCRIPTIVE STATISTICS OF DEMOGRAPHIC AND OTHER VARIABLES | | | |
|---|---|---|---|
| **Gender** | Male | 73 | 48.7% |
| | Female | 77 | 51.3% |
| **History of D.M** | Yes | 71 | 47.3% |
| | No | 79 | 52.7% |
| **History of Hypertension** | Yes | 56 | 37.3% |
| | No | 94 | 62.7% |
| **Family history of IHD** | Yes | 42 | 28.0% |
| | No | 108 | 72.0% |
| **History of Smoking** | Yes | 65 | 43.3% |
| | No | 85 | 56.7% |
| **History of Hypokalemia** | Yes | 77 | 51.3% |
| | No | 73 | 48.7% |

**TABLE 04** STRATIFICATION OF IFFERENT VARIABLES WITH HYPOKALEMIA n=150

| VARIABLES | | IN HOSPITAL MORTALITY | | P-Value |
|---|---|---|---|---|
| | | Yes | No | |
| **AGE GROUP [In Years]** | 40 – 50 | 40(26.7%) | 51(34.0%) | 0.025 |
| | >50 | 37(24.7%) | 22(14.7%) | |
| **Gender** | Male | 38(25.3%) | 35(23.%) | 0.863 |
| | Female | 39(26.%) | 38(25.3%) | |

| | | | | |
|---|---|---|---|---|
| **BMI [kg/m$^2$]** | 19 – 27 | 44(29.3%) | 40(26.7%) | 0.772 |
| | >27 | 33(22.0%) | 33(22.0%) | |
| **HYPERTENSION** | Hypertensive | 30(20.0%) | 26(17.3%) | 0.672 |
| | Non-Hypertensive | 47(31.3%) | 47(31.3%) | |
| **DIABETES MELLITUS** | Diabetic | 40(26.7%) | 31(20.7%) | 0.245 |
| | Non-Diabetic | 37(24.7%) | 42(28.0%) | |
| **FAMILY HISTORY OF IHD** | Positive | 28(18.7%) | 14(9.3%) | 0.019 |
| | Negative | 49(32.7%) | 59(39.3%) | |
| **SMOKING STATUS** | Smoker | 31(20.7%) | 34(22.7%) | 0.435 |
| | Non-Smoker | 46(30.7%) | 39(26.0%) | |

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