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Cardiovascular Outcomes in Hemodialysis Patients Resulting Hypokalemia: An Observational Prospective Study

Nimavat Jay Kumar, Sugreev Dwivedi Anuj*, Anshul J Harnawa, Chinmay Jain, Shreyansh R Rai, Nilesh Tripathi

Parul Institute of Pharmacy and Research, Waghodia, Vadodara-391760, Gujarat, India

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ABSTRACT

In those with underlying CKD, cardiovascular disease (CVD) is a leading source of considerable disability and low life quality and mortality. Electrolyte abnormalities, particularly dyskalemia, are among the many variables that lead to morbidity and death. Potassium imbalance is common in patients with renal impairment. Dyskalemia, both hyperkalemia and hypokalemia, can cause life-threatening ventricular arrhythmias, leading to a high frequency of cardiovascular illness in dialysis patients, and even abrupt death. The most prevalent cause of mortality in the 4D experiment, the cause of sudden cardiac mortality in diabetics receiving hemodialysis (HD) was not myocardial infarction, but fatal arrhythmias. Following the data collection, the Chi-Square test for categorical variables and the Mann-Whitney U test for continuous non parametric variables with interquartile range in square brackets & for parametric variables, chi square test will be performed. For blood potassium levels below and equal to The distribution of causes of mortality was comparable over the whole trial at 4.5mmol/L. Patients undergoing hemodialysis who have a high potassium level in their blood levels greater than 4.5 mmol/L were more likely to die of CVD than those with serum potassium levels less than 4.5 mmol/L. The overall mortality rate in the study population was 24 percent, with cardiovascular disease (CVD) accounting for 62 percent of deaths. Finally, there is little correlation between the cause of death and the serum potassium groups.

*Corresponding Author

Name: Sugreev Dwivedi Anuj
Phone: +91 7874178718
Email: Anujdwivedi0108@gmail.com

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INTRODUCTION

In those with underlying CKD, cardiovascular disease (CVD) is a leading cause of significant impairment, poor quality of life, and mortality. Electrolyte abnormalities, particularly dyskalemia, are among the many variables that lead to morbidity and death. Many organs, including the gut, kidney, and brain, control potassium content in the blood through numerous neurohormonal systems in humans that maintain potassium homeostasis and a transmembrane potential of 85 mV [1, 2]. The delicate and tight control extracellular potassium concentration is necessary for cardiac and skeletal muscle function, protects this membrane potential. Membrane potential anomalies in skeletal and cardiac myocytes can be caused by acute and chronic hypokalemia, as well as hyperkalemia resulting in muscular paralysis and deadly arrhythmias. Dyskalemia is a leading cause of mortality in persons with hypertension, diabetes, heart failure, and chronic kidney disease (CKD).

Dyskalemias are prevalent and closely linked to cardiovascular and all-cause mortality, especially in people with CKD or heart disease. Because of

decreased potassium excretion by the kidneys [2–4], these illnesses increase the risk of hyperkalemia [5–7]. Angiotensin-converting enzyme inhibitors, -blockers, angiotensin receptor blockers, angiotensin receptor blocker nephrilysin combinations, kidney disease, heart disease, diabetes mellitus, potassium-sparing diuretics, angiotensin converting enzyme inhibitors, -blockers, angiotensin receptor blocker nephrilysin combinations, age, high potassium intake in the diet, muscle injury, and acidosis are all risk factors for hyperkalemia. Although hyperkalemia is widespread in persons with CKD and heart disease, and many of them are treated with medicines that inhibit the renin-angiotensin-aldosterone pathway, affecting the kidney's capacity to eliminate potassium, hypokalemia is less well known in these groups. Hypokalemia and low normal blood potassium levels have been associated to an increased risk of mortality and progression to ESRD in individuals with CKD who are not on dialysis according to Korgaonkar et al. [8]. They also observed a U-shaped relationship between blood potassium levels and overall mortality, with hypokalemia and mortality having a stronger correlation than hyperkalemia and death. Alderman et al. [3] discovered that hypokalemia was connected to an increased risk of mortality and hyperkalemia was linked to an increased risk of death in the Antihypertensive and Lipid Lowering Treatment Study was linked to an increased risk of cardiovascular events. Furthermore, both low and high urine potassium levels—a proxy for dietary potassium intake—were linked to an elevated risk of mortality or cardiovascular events in a recent research of over 100,000 persons recruited in the Prospective Urban Rural Epidemiology Observational Cohort [9].

Krogager et al. [4] recently published a study involving over 2600 individuals who had suffered a myocardial infarction and found a U-shaped connection between entrance serum potassium levels and 90-day mortality. They also observed that normal serum potassium levels might be low or high levels were linked to a significantly higher risk of death. In the Veterans Administration health system, Einhorn [10] found a substantial link between a hyperkalemic episode (inpatient or outpatient), hyperkalemia, and mortality among persons CKD patients versus non-CKD patients. These studies suggest that low and high potassium levels in diet and blood are related & linked to a higher risk of death. Although these studies do not prove a causative relationship between dyskalemia and death, they do suggest that serum potassium should be closely monitored, especially in high-risk groups.

In this issue of the Clinical Journal of the American Society of Nephrology, Hughes-Austin et al. [11] investigate the link between serum potassium and mortality in individuals participated in the Multi-Ethnic Study of Atherosclerosis (MESA) and the Cardiovascular Health Study (CHS). They looked examined the links between hyperkalemia and CVD events and mortality in community-dwelling people, as well as whether comorbid diseases or drugs influenced those links. They accurately point out that the majority of research on hyperkalemia and outcomes comes from hospitalised patients or patients with acute medical problems. Hyperkalemia as a risk factor for poor outcomes appears to be reported everywhere these days, including large-scale treatment trials [12, 13], prospective observational studies in large populations, and retrospective evaluations of selected groups (see above).

Hughes-Austin et al. [11] discovered that, regardless of renal function or other CVD risk factors, a high blood potassium level is closely linked to an elevated risk of all-cause mortality. Furthermore, they claim that in the aggregate, similar correlations were observed for both CVD and non-CVD mortality. Individuals with blood potassium levels below 5.0 mEq/L had the strongest association; however, even those with serum potassium levels in the typical range of 4.0–4.9 mEq/L had an elevated risk of all-cause death (CVD and non-CVD). The relationships were also consistently greater in individuals who reported taking any diuretic at the start of the study. The researchers discovered no link between a high potassium level in the blood as well as cardiac arrest. Although the authors were surprised by this, it might indicate a problem in the approach used to establish link long-term effects given the research's single baseline blood potassium level. Although the authors make no remark on this, they did find (Figure 1) a U-shaped curve connecting serum potassium content to death, similar to other recent publications described above. As a result, while their fully adjusted Cox model found no significant links between hypokalemia and death, there is a tendency toward increased mortality with lower serum potassium levels. This believes, is an essential aspect that should be highlighted. Multiple studies have already been published that show both low and high potassium levels cause an increase in mortality. Although the authors identified a greater association between high serum potassium and mortality in their analysis, placing this study in the context of others should raise awareness of the importance of serum potassium and outcomes in general groups like the MESA and CHS.

The high number of participants in two well-

designed prospective observational studies with long-term follow-up and centrally adjudicated outcomes, as well as statistical approaches to assist control for comorbidities, are significant strengths of this study. Another advantage is that the MESA and CHS were community-based observational studies, and while their findings do not represent the whole US population, they are more generalizable than clinical trials and retrospective analysis. With a history of CVD at baseline, a single blood potassium level at baseline, no information on serum potassium at the time of adjudicated events, and no information on baseline, nearly half of the CHS cohort members were removed and ECG abnormalities.

The link potassium levels in the blood and mortality is investigated in this study. Despite the fact that MESA's population was young, whereas CHS's was elderly. When compared to younger people, older persons have greater incidences of renal reduce plasma renin and aldosterone levels, as well as heart disease. Despite the addition of age in the fully adjusted model, The study used aggregated data and did not look into the CHS independently results of an electrocardiogram. Despite the fact that this research does not prove causality, the findings of clinicians should pay special attention to patients with blood potassium levels more than 5.0 mEq/L, since this might be a risk factor for both cardiovascular and non-cardiovascular death. There are several inquiries about how to treat dyskalemia in the outpatient setting, particularly in persons with cardiac and renal illness, remain unsolved. These factors include the frequency with which they occur potassium should be measured, as well as what to do, when to do it, and how to do it manage serum potassium abnormalities. Future study aiming to provide answers to these concerns is crucial, because of the ageing population and the high prevalence of diabetes, CKD, and heart disease.

Potassium imbalance is common in patients with renal impairment. Hyperkalemia and hypokalemia are both types of dyskalemia cause life-threatening ventricular arrhythmias, leading to a high frequency of cardiovascular illness in dialysis patients, and even abrupt death. The most prevalent cause of mortality in the 4D experiment, the cause of abrupt cardiac mortality in diabetics receiving hemodialysis (HD) was not myocardial infarction, but fatal arrhythmias [14].

While individuals with ESRD stands for end-stage renal disease were susceptible to potassium imbalances, the occurrence of dyskalemia is dependent on the kind of dialysis used. Hyperkalemia is extremely prevalent and deadly in HD patients, according to most previous publications [2, 3]. Predialysis blood potassium values of more than 6 mmol/L were found in 6.3–20.0 percent of HD Dialysis Outcomes and Practice Patterns Study patients database [4]. Ethnic differences are to blame for the vast range. Similarly, the link between potassium levels in the blood and mortality differs by patient ethnicity. Hyperkalemia has been linked to increased death from all causes and cardiovascular disease in Caucasians and African-Americans [5], whereas hypokalemia has been linked to increased mortality in Chinese patients HD is getting maintenance [6]. Patients undergoing peritoneal dialysis (PD) are more prone to be hypokalemic than HD patients [11]. Additionally, Hypokalemia has been linked to an increased risk of death and peritonitis. According to a latest research found a link between decreased blood potassium levels and infectious-caused death in Parkinson's disease patients [15].

Studies of blood potassium levels and dialysis-related death have had various drawbacks to date, like as retrospective design [13], single-center cohort [14], and limited sample size [8] are only a few examples.

The current research is a prospective observational cohort study in which we investigated the relationship between serum potassium and death rate in dialysis mode.

METHODOLOGY

Aim of the Study

To find the cardiovascular outcomes in hemodyalysis patients resulting hypokalemia.

Objectives

1. To study the probability of hemodialysis causing hypokalemia and to interrelate the hemodialysis and cardiovascular problems.
2. To study the significance of hypokalemia on cardiovascular outcomes.
3. To study the Mortality rates in hemodialysis patients and cause of death.

Need of the Study

Study Place

A tertiary care hospital, Vadodara, Gujarat, India.

Study Design

An observational prospective study.

Study Population

60 patients.

Table 1: Patient Demographic Details and Physical Examination Details

Characteristics	Frequency	P-Value
Age (M)	Avg 59	<0.001
Male (C)	(36) 60%	<0.05
Female (M)	(24) 40%	
Body Mass Index (M)	Avg 22.5	<0.001
Systolic Blood Pressure (M)	Avg 145	<0.001
Diastolic Blood Pressure (M)	Avg 78	<0.001
Dialysis Vintage Period	2.95 years	

(M): Mann Whitney U test carried out for the non-parametric variables; (C): Chi-square test carried out for the parametric variables

Study Period

6 months.

Inclusive Criteria

1. Patients between the age group 45 to 75 both male and female having dialysis.
2. Patients who are interested in taking part in the research.

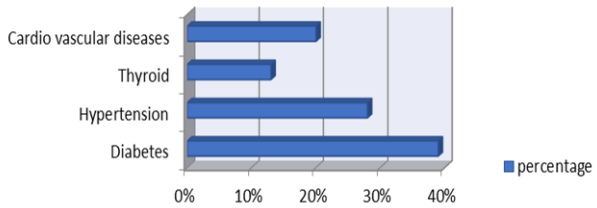
Exclusive Criteria

1. Patients who refuse to engage in the research.
2. Patients below the age group 45 and above 75.
3. Patients who are not on Dialysis.

Method of Study

Clinical information was gathered using web-based medical questionnaires. By analysing medical records or conducting in-person interviews, well-reviewed data will be used to fill the questionnaire items. Data on pre-existing comorbidities was gathered. Various dialysis-related parameters, such as the aetiology and type of ESRD, as well as the length of dialysis, were also documented. The interval time between the start of dialysis and the time the patient was enrolled for the study was called dialysis vintage. Serum potassium levels were assessed at the time of enrolment and at the 3-month visit, and the data was then utilised every 6 months if it was available. For hemodialysis patients, blood tests were conducted prior to dialysis.

The arithmetic average of the data obtained across the years that followed, omitting the starting point levels, was used to establish a typical potassium level in the blood (at the time of enrollment). The below mentioned blood tests will be performed: serum albumin, haemoglobin, cholesterol, uric acid, alkaline phosphatase, and C-reactive protein with a high sensitivity (hs-CRP).



	Diabetes	Hypertension	Thyroid	Cardio vascular diseases
percentage	39%	28%	13%	20%

Figure 1: Prevalent Co-Morbidities of the Patients

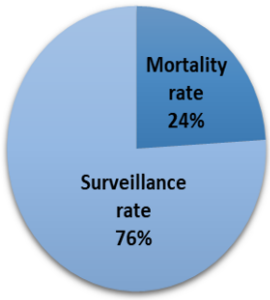


Figure 2: Mortality Rate in Dialysis Patients

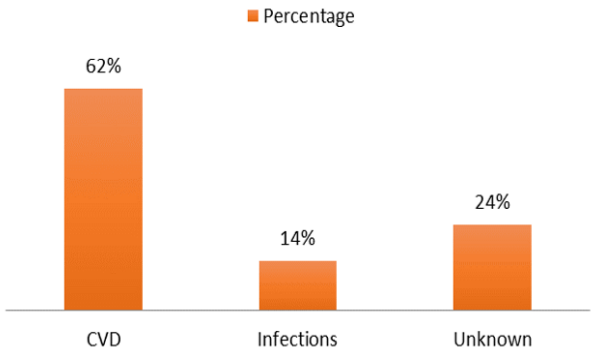


Figure 3: Cause of Death

Table 2: Laboratory Data

Variables (Units)	Average Lab values	P Value (Mann Whitney Test)
Hb (g/dl)	9 (8-11)	<0.001
Potassum (mmol/L)	4.9 (4.5-5.3)	<0.001
Albumin (g/dl)	3.7 (3.2-4.6)	<0.15
Uric acid (mg/dl)	7.5 (6.2-8.9)	<0.001
ALP (IU/L)	80 (61-112)	<0.001
Total Cholesterol (mg/dl)	155 (1225-179)	<0.001

Table 3: HTN patients with CKD using Medication details

Medication	Percentages
Angiotensin Receptor Blockers	17.2%
Angiotensin converting enzyme Inhibitors	12.1%
ACE with Diuretics	54.9%
ARB with Diuretics	15.8%

Statistical Analysis

The particular cause each patient's chance of death enrolled in the research was obtained from the controlling hospital's medical records. All death causes were classified into one of six groups: Myocardial infarction/ischemia, congestive heart failure, pulmonary oedema, sudden cardiac death, and cerebrovascular disease are among conditions that can cause mortality. Disease were among the causes of cardiovascular death.

Mann-Whitney for continuous non parametric variables, the U test will be used with and Chi-square test will be used for categorical parametric variables, whereas the interquartile range will be in square brackets.

RESULTS AND DISCUSSION

Table 1 contains the patient's demographic information as well as the results of the physical examination. In Figure 1, the patients' common comorbidities are depicted. Medication information for HTN patients with CKD are summarized in Table 2 and Table 3. The death rate was depicted in Figure 2, and the cause of death was depicted in Figure 3.

CONCLUSION

For blood values of potassium below and equal to 4.5mmol/L, the distribution of death causes was comparable over the whole trial. Patients on hemodialysis with serum potassium levels greater than those with blood potassium levels of 4.5 mmol/L were more likely to die of CVD than those with lower potassium levels Less than 4.5 mmol/L. The overall mortality rate in the study population was 24 percent, with cardiovascular disease (CVD) accounting for 62 percent of deaths. These findings suggest that potassium-lowering treatment should be used with caution in hemodialysis patients who have normal or low blood potassium levels prior to the dialysis session. Furthermore, because a low pre-dialysis blood potassium level can be caused by malnutrition, the linked mortality risk highlights the necessity of addressing nutritional issues in hemodialysis patients. Finally, there is little correlation between the cause of death and the serum potassium groups.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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