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Cardiovascular Events and Related Factors in Routine Hemodialysis Patients with Chronic Kidney Disease (CKD) at a Tertiary Care Hospital in Pakistan

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ABSTRACT

Cardiovascular-related events were a significant problem in patients receiving dialysis. These patients were at a higher risk due to the complex interplay of factors such as hypertension, anemia, and other comorbid conditions. **Objective:** To find the cardiovascular events and related factors in routine hemodialysis patients with Chronic Kidney Disease (CKD) at a tertiary care hospital in Pakistan. **Methods:** This Cross-sectional retrospective study conducted in routine dialysis patients in a tertiary care hospital, from October 2022 to December 2023. Patients that experienced cardiovascular events were included in the study, with those not experiencing any cardiovascular event were excluded from the research. Informed consent was taken from patients to collect the data. **Results:** The study included 255 dialysis patients (mean age 60.5 years ±10.2), with 128 males (50.1%) and 127 females (49.8%). Heart failure was the most common cardiovascular event, followed by pleural effusion, while sudden cardiac death was one of the least frequent but significant. Hypertension and anemia were the major risk factors for cardiovascular events in end-stage renal disease, with thyroid function issues being the least associated. **Conclusions:** Managing CKD and cardiovascular risks in Peritoneal Dialysis (PD) and Hemodialysis (HD) patients requires strict control of blood pressure, lipids, and glucose, and careful monitoring of volume status. Lifestyle changes and advancements in dialysis equipment show promise, but more research is needed to optimize treatment and improve outcomes. Clinicians can reduce cardiovascular risk and enhance life expectancy and quality of life by addressing these factors.

INTRODUCTION

Cardiovascular-related events are a significant problem in the group of patients receiving dialysis; they remain a major cause of morbidity and mortality higher than rates in other patients. Therefore, yet again, dialysis will put the cardiac patient at high risk of experiencing Major Adverse Cardiovascular Events (MACE) that encompasses Myocardial Infarction (MI), Stroke, Sudden Cardiac Death (SCD), pericarditis, as well as pleural effusion. Such factors exposed the patients to a lower immune system strength that has several relations to CKD and processes of dialysis [1]. In addition to traditional cardiovascular risks occurring in all inhabitants of developed countries, such as hypertension, elevated level of LDL-cholesterol and reduced level of HDL-cholesterol, diabetes mellitus, patients on dialysis have a set of complications that arise with end-stage CKD. Such include mineral bone disorder characterized by disorders in calcium, phosphorus, parathyroid hormone, which results to vascular calcification and increased arterial stiffness [2]. Anemia which is frequently reported among CKD patients due to decrease in erythropoietin causes increased loading on the cardiovascular system by providing less oxygen to the tissues and organs [3]. The global CVD prevalence remains a cause of significant morbidity and mortality; for CKD patients, risks are somehow magnified. Thus, CKD patients who are on routine HD are at a more vulnerable position for cardiovascular event occurrence due to modifications of traditional and non-traditional risk factors. There is a clear association between CKD and CVD; the progression of CKD is known to substantially raise the risk for cardiovascular

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METHODS

This retrospective study was conducted in routine dialysis patients in a tertiary care hospital, from October 2022 to December 2023. Permission for the project was granted by the ethical review committee of Islamabad Medical and Dental College, Islamabad, Pakistan (ref no. 40/IMDC/IRB-2023). Patients that experienced cardiovascular events were included in the study, with those not experiencing any cardiovascular event were excluded from the research. Informed consent was taken from patients to collect the data. Demographic information including age, sex, ethnicity, and any comorbid conditions that may impact cardiovascular risk were noted. A sample size of 255 with a 95% confidence level and a 5% margin of error were calculated using the WHO sample size methodology. Patients diagnosed with chronic kidney disease (CKD) and undergoing hemodialysis were included in the study. A retrospective study design was chosen, where data from patients' hospitalizations was analyzed to determine whether they had experienced any cardiovascular events and to identify any existing risk factors that might predispose them to such events. Patients who were not diagnosed with chronic kidney disease or were not on hemodialysis were excluded from the study. Data was analyzed using SPSS version 29.0.

RESULTS

The study included 255 patients undergoing dialysis treatment at a tertiary care hospital. The mean age of the patients was 60.5 ± 10.2 years. Cardiovascular events were prevalent among routine hemodialysis patients, with heart failure being the most common, affecting 37% of the patients (n = 94). Myocardial infarction occurred in 22% (n = 56), while arrhythmias were observed in 26% (n = 67) of the patients. Stroke was the least frequent cardiovascular event, affecting 15% (n = 38) of the study population (Table 1).

Table 1: Prevalence of Cardiovascular Events

Cardiovascular Events	Number of Patients N (%)
Myocardial Infarction (MI)	56 (22%)
Stroke	38 (15%)
Heart Failure	94 (37%)
Arrhythmias	67 (26%)

In terms of risk factors attributed to cardiovascular events, hypertension was the most common risk factor present in 78% of the cases (n=199), followed by anemia, being present in 62% of the cases (n=158). Dyslipidemia was the least common risk factor present in patients, as a mere total of 43% had the disease (Table 2).

Table 2: Risk Factors Associated with Cardiovascular Events

Risk Factors	Number of Patients N (%)	Significance	P-Value
Hypertension	199 (78%)	–	–
Diabetes Mellitus	138 (54%)	Significant with MI	<0.01
Dyslipidemia	110 (43%)	Significant with Stroke	<0.05
Anemia	158 (62%)	Significant with Heart Failure	<0.01

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DISCUSSION

Cardiovascular disorders constitute one of the acts intimidating amongst the patients on dialysis given that it was one of the leading causes of morbidity and mortality among these patients. Cardiovascular disease was much more common among dialysis patients than among the general population, and the multifactorial etiology of CVD and lack of effective preventive approaches further highlight the severity of the problem [11]. CKD per se was a potent risk factor contributing for cardiovascular diseases. With progressive loss of kidney function there were various changes that occur in the form of pathophysiological processes like; first of all, alterations in mineral metabolism including hyperphosphatemia and secondary hyperparathyroidism; secondly, retained volume; thirdly, chronic inflammation; fourthly, oxidative stress; and lastly endothelial dysfunction [12]. These processes as a whole enhance atherosclerosis, calcification of vessels, and hypertrophy of the left ventricle, which threaten dialysis patients in terms of myocardial infraction, stroke, heart failure and sudden cardiac death [13]. The findings of this study highlight the significant burden of cardiovascular events among patients undergoing dialysis treatment at a tertiary care hospital. With a mean age of 60.5 years, the population in this study was consistent with the demographic most at risk for cardiovascular complications [14]. The high prevalence of heart failure, affecting 37% of patients, underscores the vulnerability of this population to cardiac complications, likely exacerbated by the underlying kidney disease and the associated strain on cardiovascular health. The occurrence of myocardial infarction in 22% of the patients and arrhythmias in 26% further emphasizes the heightened cardiovascular risk in dialysis patients [15]. These findings align with existing literature that identifies cardiovascular disease as the leading cause of mortality in patients with End-Stage Renal Disease (ESRD). Stroke, although the least common cardiovascular event in this study at 15%, still represents a significant risk, reflecting the complex interplay between dialysis treatment and cerebrovascular health. The analysis of risk factors reveals important associations that could inform clinical management strategies. Hypertension, present in 78% of the patients, emerges as the most prevalent risk factor, although its direct significance in this study's cardiovascular outcomes was not established [16]. This high prevalence, however, underscores the necessity of stringent blood pressure control in dialysis patients to mitigate the risk of cardiovascular complications. Diabetes Mellitus, identified in 54% of the patients, showed a significant correlation with myocardial infarction ($p < 0.01$). This finding highlights the critical need for effective management of diabetes in dialysis patients, as hyperglycemia can exacerbate atherosclerosis and increase the risk of coronary artery disease [17]. Similarly, dyslipidemia, present in 43% of the patients, was significantly associated with stroke ($p < 0.05$), indicating that lipid management should be a priority in reducing cerebrovascular risks in this population. In addition, future innovations with regards to the methods in dialysis have the potential to offer better cardioprotective results [18]. For example, interventions which were targeted at prevention of falls in blood pressure during dialysis, the improvement of dialysis efficacy and the lessening of oxidative stress during dialysis were the tactics which were likely to improve cardiovascular status of dialysis patients [19]. New drug development for CKD-related cardiovascular disease based on new molecular targets deemed relevant for the progression of cardiovascular disease include FGF23 and calcimimetics for Mineral Bone Disorder [20]. While this study provides valuable insights into the prevalence and risk factors associated with cardiovascular events in patients undergoing dialysis, several limitations should be acknowledged. Firstly, the study was conducted in a single tertiary care hospital, which may limit the generalizability of the findings to other settings, particularly to smaller or rural healthcare facilities where the patient demographics and available resources may differ significantly. This hospital-based sample may not fully represent the broader population of dialysis patients, particularly those who receive care in different healthcare systems or regions.

CONCLUSIONS

Thus, the analyzed rates of MACEs in PD and HD patients denote the complexity of managing CKD risks, CV risk factors, and dialysis-related conditions. Thus, proper management requires a combination of strict blood pressure control, lipid levels and blood glucose levels, along with careful monitoring of volume status and Kt/V. Currently, lifestyle changes and new developments in dialysis equipage were potential ways allowing to improve the result of such patients' treatment; however, further investigation was needed to provide better treatments options and optimize cardiovascular management in this vulnerable population group. Thus, the considerations of all these factors in detail allow clinicians to potentially minimize cardiovascular risk and enhance the life expectancy and quality of life of patients with CKD and CVD treated by dialysis.

Authors Contribution

Conceptualization: JKK

Methodology: JKK, MA

Formal analysis: JKK, MA

Writing, review and editing: JKK, MA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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