

Chronic Kidney Disease Patients on Maintenance Hemodialysis: Clinical Profile and Complications

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Abstract

Chronic kidney disease (CKD) is a progressive and irreversible condition that frequently advances to end-stage renal disease (ESRD), requiring maintenance hemodialysis for survival. Despite therapeutic advances, patients on hemodialysis (HD) remain highly vulnerable to a wide spectrum of complications influenced by comorbid conditions and treatment-related factors. A descriptive, cross-sectional study was conducted in the Department of Nephrology, Community Based Medical College, Bangladesh (CBMC,B) Hospital, Mymensingh, Bangladesh, from January to December of 2025, to evaluate the clinical profile, comorbidities, and complication patterns among CKD patients undergoing maintenance hemodialysis. A total of 197 CKD patients receiving maintenance hemodialysis were included using purposive sampling. Data was collected through structured interviews and medical record review. The mean age of participants was 52.6±13.8 years, with a male predominance (61.4%). Hypertension 85.3% and diabetes mellitus 56.9% were the most common comorbidities. Arteriovenous (AV) fistula was done in 67% of patients, while central venous catheter (CVC) was used in 33%. Anemia was the most frequent complication 77.7%, followed by intradialytic hypotension (49.7%), muscle cramps (37.6%), hyperkalemia (26.4%), and infection (20.8%). Significant associations were observed in between diabetes mellitus and intradialytic hypotension ($p=0.032$), and in between type of vascular access and infection ($p=0.001$). CKD patients on hemodialysis usually have comorbidities and they also experience multiple complications. Effective management of diabetes and hypertension, along with prioritization of arteriovenous fistula, is essential to improve patient outcomes.

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Introduction

Chronic kidney disease (CKD) is a progressive public health problem characterized by irreversible loss of renal function, ultimately leading to end-stage renal disease (ESRD) requiring renal replacement therapy such as maintenance hemodialysis. CKD is associated with high morbidity, mortality, and healthcare burden worldwide, particularly in low- and middle-income countries where late presentation and limited access to specialized care remain major challenges.^{1,2} According to global epidemiological data, the prevalence of CKD continues to rise due to increasing rates of diabetes mellitus, hypertension, and aging populations.²

Hemodialysis is the most commonly utilized renal replacement modality for patients with ESRD. It plays a vital role in removing metabolic waste products, correcting electrolyte imbalance, and maintaining fluid homeostasis.^{1,2} However, despite its life-sustaining benefits, maintenance hemodialysis is associated with a wide range of complications that significantly

affect patient outcomes and quality of life.³ Some complications are acute, such as intradialytic hypotension and muscle cramps, or chronic, including anemia, infections, and cardiovascular instability.⁴ Anemia is one of the most frequent complications in CKD patients undergoing hemodialysis, primarily due to reduced erythropoietin production, iron deficiency, and chronic inflammation.⁵ Cardiovascular complications, including hypotension during

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dialysis sessions, remain a major clinical concern and are associated with increased mortality risk. Intradialytic hypotension is influenced by multiple factors such as ultrafiltration rate, autonomic dysfunction, and comorbid conditions like diabetes mellitus.⁶ Similarly, vascular access type plays a crucial role in patient outcomes. Arteriovenous (AV) fistula is considered the preferred access due to lower infection and complication rates, whereas central venous catheters are associated with significantly higher risks of bloodstream infections and hospitalization.⁷ The burden of comorbidities such as hypertension and diabetes mellitus further complicates the clinical management of CKD patients on hemodialysis. These conditions not only contribute to disease progression but also increase the risk of dialysis-related complications and poor prognosis.^{5,8} Therefore, understanding the clinical profile and complication patterns in this population is essential for improving therapeutic strategies and patient care outcomes. However, data from resource-limited settings remain insufficient, particularly regarding the association between vascular access type, comorbidities, and dialysis-related complications. This study aims to evaluate the clinical and complication profile of CKD patients undergoing maintenance hemodialysis in a tertiary care setting, with special emphasis on the prevalence of common complications and their association with key clinical factors such as diabetes mellitus and vascular access type. The findings are expected to contribute to improved risk stratification and clinical management strategies in hemodialysis patients.

Methods

This descriptive, cross-sectional study was conducted in the Department of Nephrology, Community Based Medical College, Bangladesh (CBMC,B) Hospital,

Mymensingh, Bangladesh, from January to December of 2025. The study population included patients diagnosed with CKD and who were receiving regular maintenance hemodialysis at the dialysis unit of the Department of Nephrology during the study period.

Patients were included in this study, if they had a confirmed diagnosis of chronic kidney disease, undergoing maintenance hemodialysis for at least three months and voluntarily participated in the study. However, our exclusion criteria were: patients who were acutely ill or admitted for only emergency dialysis, having incomplete clinical records, and declined participation in the study. Finally, a total of 197 patients were included in the study. A purposive sampling technique was used to recruit eligible patients who met the inclusion and exclusion criteria during the study period. Data was collected using a semi-structured data collection sheet. Information was obtained through direct patient interviews, reviewing of medical and dialysis record in the patient data sheet.

We collected data including demographic characteristics, comorbid conditions (such as diabetes mellitus and hypertension), type of vascular access, and dialysis-related complications. Data was scrutinized, coded and then analyzed using IBM SPSS Statistics for Windows, version 26 (IBM Corp., Armonk, NY, USA). Data was expressed as mean $\pm$ SD (standard deviation) as well as frequency and percentage. Chi-square test was applied to determine associations between categorical variables. A p-value of <0.05 was considered statistically significant. This study was approved by the Ethical Review Committee of Community Based Medical College, Bangladesh (CBMC,B), Mymensingh, Bangladesh.

Results

A total of 197 patients with chronic kidney disease (CKD) undergoing maintenance hemodialysis were included in this study. The mean age of the participants was 52.6 ± 13.8 years. The majority of patients belonged to the 50–69 years age group (44.7%), followed by 30–49 years (31.5%), 70 years and above (14.7%), and below 30 years (9.1%). Regarding gender distribution, 61.4% of the patients were male and 38.6% were female, indicating a male predominance in the study population. In terms of clinical characteristics, hypertension was found in 85.3%, while diabetes mellitus was present in 56.9% of patients. Most of the patients (67%) were on hemodialysis through arteriovenous (AV) fistula, while central venous catheter (CVC) was used in 33% (Table-I). Complications observed during hemodialysis were: anemia, as the most frequent (77.7%), intradialytic hypotension (49.7%), muscle cramps (37.6%), hyperkalemia (26.4%) and infection (20.8%) (Fig. 1).

Table-I: Demography and clinical profile of the study patients (N=197)

Variables	Frequency	Percentage
Age group		
<30 years	18	9.1
30–49 years	62	31.5
50–69 years	88	44.7
≥70 years	29	14.7
Gender		
Male	121	61.4
Female	76	38.6
Comorbidities		
Diabetes mellitus	112	56.9
Hypertension	168	85.3
Vascular access for hemodialysis		
A-V fistula	132	67.0
Central venous catheter	65	33.0

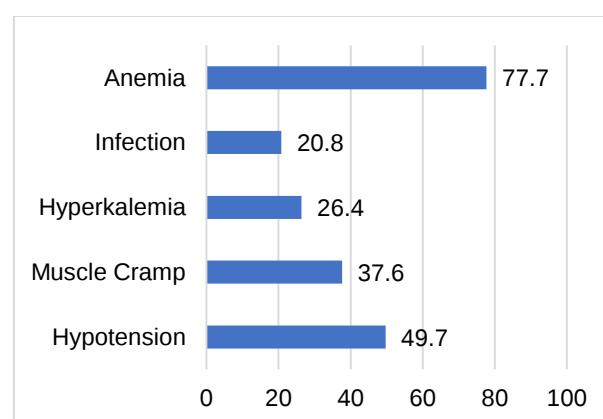


Fig. 1: Bar chart showing complications during hemodialysis.

A statistically significant association was observed between diabetes mellitus and intradialytic hypotension ($p=0.032$), indicating patients with diabetes had a higher incidence of hypotension during dialysis compared to non-diabetic patients (Table-II). Similarly, significant association was found between vascular access type and infection ($p=0.001$), where patients using catheter access had a higher risk of developing infections compared to those with AV fistula (Table-III).

Table-II: Association between diabetes mellitus and intradialytic hypotension

Diabetes mellitus	Intradialytic hypotension		p-value
	Yes Frequency (Percentage)	No Frequency (Percentage)	
Yes	68 (60.7)	44 (39.3)	0.032 ^S
No	30 (35.3)	55 (64.7)	

Chi-square test was applied; S=significant.

Table-III: Association between vascular access and infection

Types of vascular access	Infection		p-value
	Yes Frequency (Percentage)	No Frequency (Percentage)	
CVC	28 (43.0)	37 (57.0)	0.001 ^S
AV fistula	13 (10.0)	119 (90.0)	

Chi-square test was applied; S=significant.

Discussion

In the present study, the mean age of patients was 52.6 ± 13.8 years, with the highest proportion in the 50–69 years age group. Our patients' age distribution aligns with findings from previous reports, indicating that CKD requiring dialysis predominantly affects middle-aged and older adults due to cumulative exposure to risk factors such as hypertension and diabetes mellitus.⁹⁻¹¹ Moreover, we noted an increasing burden of CKD in economically productive age groups, reflecting the growing epidemiological transition in developing countries.¹¹ Male predominance (61.4%) observed in this study is consistent with previous literature indicating higher CKD prevalence among males. Evidence suggests a more balanced gender distribution, indicating possible similar socio-cultural and access-related variations in healthcare utilization.^{10,11} Hypertension (85.3%) emerged as the most common comorbidity, followed by diabetes mellitus (56.9%). These findings are strongly supported by global CKD data, which identifies hypertension and diabetes as the leading etiological and comorbid conditions in ESRD patients.¹² Similar prevalence rates were reported in earlier studies that emphasized on uncontrolled blood pressure, which significantly accelerates renal deterioration in conjunction with other cardiovascular issues.^{10,13}

Regarding vascular access, AV fistula was used in 67% of patients, while 33% had central venous catheter (CVC). This distribution is consistent with previous study recommending AV fistula as the preferred vascular access due to lower complication rates.¹⁴ Previous studies demonstrated improved survival and reduced infection risk with AV fistula compared to catheters.^{14,15} However, in resource-limited settings, higher catheter usage has been reported due to late referral and delayed fistula

maturation.¹⁶ Anemia was the most frequent complication (77.7%) in this study, which is consistent with the pathophysiology of reduced erythropoietin production in CKD. Similar high prevalence rates have been reported in previous studies highlighted anemia as a universal complication in ESRD patients.^{17,18} Intradialytic hypotension (49.7%) was another major complication observed in this study. This is comparable to other reports of nearly 30–50% of hemodialysis patients experiencing intradialytic hypotension episodes.^{6,19,20} The higher prevalence in the present study may be due to underlying diabetes and autonomic dysfunction, which impair vascular response during fluid removal. Besides, muscle cramps (37.6%) and hyperkalemia (26.4%) were also frequently observed, consistent with studies signifying fluid and electrolyte imbalance as major contributors to dialysis-related morbidities.^{4,8,20} Overall, the findings of this study reinforce the global evidence that CKD patients on maintenance hemodialysis experience a high burden of comorbid conditions and procedure-related complications.⁸ The strong influence of vascular access type on infection risk and the impact of diabetes on hemodynamic instability highlight the importance of individualized patient management.

However, this study has several limitations. Being a single-center study, the findings may not be fully generalizable to other settings. The cross-sectional design limits the ability to establish causal relationships between variables. Data was obtained from medical records and patient interviews, which may be subject to documentation and recall bias. In addition, important factors such as dialysis adequacy, nutritional status, and medication adherence were not fully assessed. The relatively short study duration also limits evaluation of long-term outcomes. Despite those limitations, the study provides useful insights

into the clinical profile and complications of CKD patients on hemodialysis.

Conclusion

Our study highlights a significant burden of comorbidities and complications among chronic kidney disease (CKD) patients undergoing maintenance hemodialysis. Hypertension and diabetes mellitus were the most prevalent risk factors and associated with adverse clinical outcomes. Anemia was the most common among complications, followed by intradialytic hypotension, muscle cramps, hyperkalemia, and infection. Vascular access type played a crucial role in infection risk, with catheter use showing a higher complication rate compared to arteriovenous fistula. Overall, the findings indicate that hemodialysis patients experience multifactorial complications that negatively impact morbidity and quality of life. Early identification and optimal management of comorbid conditions, along with prioritization of arteriovenous fistula and strict metabolic control, are essential to improve patient outcomes

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