



The Determinants of Acute Intradialytic Complications among Adult Patients on Maintenance Hemodialysis at Kenyatta National Hospital, Kenya

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Abstract

Background: Acute intradialytic complications remain a major challenge among patients undergoing maintenance hemodialysis and contribute substantially to morbidity, treatment interruption, and poor patient outcomes. Understanding the factors associated with these complications is essential for improving dialysis care and patient safety.

Objective: To identify the determinants of acute intradialytic complications among patients undergoing maintenance hemodialysis at Kenyatta National Hospital (KNH).

Methods: The study was conducted in Kenyatta National Hospital main renal unit using a descriptive cross-sectional study design. Approval was sort from Kenyatta National Hospital-University of Nairobi ethics and research committee (p144/02/2025). Simple random sampling was used to select 40 nurses. Data was collected through interviewer-administered questionnaires that included both open and close-ended questions. Analysis was done using statistical package for social sciences (SPSS) version 26.

Results: The most reported Intradialytic complications included restlessness, chest pain, and chills. Patient related factors significantly associated with complications were diabetes mellitus and cardiovascular disease ($p < 0.05$). Alpha -blocker use was the only treatment related factor significantly associated with complications ($p = 0.000$). Despite 97.4% ($n = 37$) of nurses demonstrating good knowledge and skill levels, none of the nurse related factors, including demographics, training, or experience, showed a statistically significant relationship with occurrence of intradialytic complications ($p > 0.05$). Similarly, treatment and care protocol related factors such as access to standard operating procedures (SOPs), training frequency, and perceived autonomy did not show significant associations with complication occurrence ($p > 0.05$).

Discussion: Diabetes mellitus, cardiovascular disease, and use of alpha-blockers were significantly associated with intradialytic complications, while patient, nurse, and institutional protocol factors showed no statistical significance, suggesting that comorbidity burden and specific pharmacologic regimens may play a greater role in complication risk than staff competence or general protocol availability.

Conclusion: Acute intradialytic complications remain prevalent at KNH, with diabetes, cardiovascular disease, and alpha-blockers use being key contributors. Nurse and institutional protocol related factors did not significantly influence complication rates, indicating a need for individualized patient level interventions and stronger implementation of evidence based protocols.

Introduction

Hemodialysis is an extracorporeal kidney replacement therapy that facilitates exchange of solutes and fluids via diffusion, osmosis, ultrafiltration, adsorption or convection depending on the solute's physical properties and the structural characteristics of the membrane [1]. The three primary hemodialysis modalities are standard hemodialysis (three times weekly, lasting 3-6 hours), daily hemodialysis (shorter, more frequent sessions, typically 2-3 hours, five to six times per week), and nocturnal hemodialysis (longer sessions, 6-8 hours, performed overnight) [2].

Acute intradialytic complications are common among patients undergoing maintenance hemodialysis and remain a major challenge to treatment safety and effectiveness worldwide. Studies from Asia have consistently reported hypotension as the most frequent complication, with prevalence ranging from 12.6% to 28.7%, followed by hypertension, nausea, and vomiting [3,4]. In the United States, patients, patients commonly experience fatigue (62%), muscle cramps (44%), and symptoms related to hypotension (42%), with these complications contributing to prolonged recovery times, early termination of dialysis sessions, and missed treatments [5].

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In Africa, intradialytic complications continue to impose a substantial burden on patients receiving maintenance hemodialysis. In Nigeria, hypotension (20.6%) and hypertension (19.8%) were the most frequently reported complications, while fever, chest pain, muscle cramps, and seizures were also observed [6]. Similarly, a study in Eritrea reported that 30.7% of dialysis sessions were complicated by one or more adverse events, predominantly hypotension (10%), nausea and vomiting (5.2%), hypertension (5.1%), muscle cramps (4.7%), and headache (4.5%) [7].

Locally, acute intradialytic complications are also prevalent among patients receiving maintenance hemodialysis at Kenyatta National Hospital (KNH). The most commonly reported complications include muscle cramps (20.7%), headaches (20.3%), hypertension (17.7%), nausea (10.2%), fever with chills (7.9%), vomiting (7.5%), chest pain (6.4%), hypoglycemia (5.3%), and hypotension (3.8%) [8].

Justification

Acute intradialytic complications are common among patients undergoing maintenance hemodialysis and contribute to increased morbidity, treatment interruptions, and poor patient outcomes. Identifying the incidence and determinants of these complications at Kenyatta National Hospital (KNH) is essential for improving the safety and quality of dialysis care. The findings of this study will provide evidence on patient and treatment related factors associated with acute intradialytic complications, enabling healthcare providers to implement targeted preventive and management strategies.

The study will be particularly valuable to nurses and other dialysis care providers by enhancing understanding of risk factors and strengthening patient monitoring during hemodialysis sessions. In addition, the findings will contribute to the existing body of knowledge on intradialytic complications and serve as a basis for future research and evidence based practice.

Furthermore, the results may inform the development of institutional guidelines and policies aimed at improving dialysis care, optimizing resource allocation, and reducing the burden of complications among patients with end stage kidney disease. Ultimately, the study seeks to enhance patient safety, treatment outcomes, and quality of life among individuals undergoing maintenance hemodialysis at KNH.

Main objective

To find out the determinants of acute intradialytic complications among adult patients on maintenance hemodialysis at Kenyatta National Hospital.

Specific objectives

1. To establish patient related factors associated with acute intradialytic Complications among adult patients on maintenance hemodialysis at Kenyatta National Hospital.
2. To assess Nurses' related factors associated with occurrence of acute intradialytic complications among adult patients on maintenance hemodialysis at Kenyatta National Hospital.
3. To find out treatment and care protocol related factors associated with acute intradialytic complications among adult patients on maintenance hemodialysis at Kenyatta National Hospital.

Methods

Study design

The study adopted a descriptive cross-sectional study design with a quantitative approach. The study design was considered appropriate for the study because it enabled the researcher to assess the prevalence of acute intradialytic complications and examine their associated determinants among patients undergoing maintenance hemodialysis at a single point in time. This design allowed for the simultaneous collection of data on patient characteristics, clinical factors, dialysis related variables, and the occurrence of acute intradialytic complications without the need for prolonged follow-up.

Study setting

This study was carried out in the Renal Unit at KNH. The renal unit at Kenyatta national Hospital was selected as the study site because it is the largest national teaching and referral hospital in Kenya and manages a high volume of patients with end-stage kidney disease (ESKD) requiring maintenance hemodialysis. As a level 6 referral facility, KNH receives patients from across the country, providing a diverse patient population with varying demographic and clinical characteristics. This diversity enhanced the representativeness of the study findings. The choice of KNH was also informed by its role as a national Centre for specialized clinical care, teaching, and research, where standardized hemodialysis protocols are implemented and comprehensive patient records are maintained. These characteristics ensured access to reliable clinical information and enhanced the quality and credibility of the data collected.

Study population

The study targeted all ESKD patients undergoing dialysis sessions in Main Renal Unit as well as the Nurses that run the dialysis sessions only

Sample size and sampling

A sample size of 59 patients was calculated using Fisher's formula based on a prevalence of 4% reported in previous studies. Patients were selected through simple random sampling using a lottery method from the dialysis register. All eligible nurses working in the renal unit during the study period were recruited using convenience sampling.

Inclusion and Exclusion criteria

Eligible participants included adult patients (≥ 18 years) undergoing maintenance hemodialysis and nurses working in the renal unit who provided informed consent. Patients unable to respond to interview questions and nurses on leave during the study period were excluded.

Data collection tool and procedure

Data was collected using structured questionnaires. Nurses completed self-administered questionnaires assessing nurse related and institutional factors, while patients were interviewed using researcher administered questionnaires to obtain information on patient related factors and intradialytic complications. The first section of the interviewer administered patient questionnaire collected data on patient related characteristics, including demographic information, duration on maintenance hemodialysis, frequency of dialysis sessions per week, presence of coexisting chronic illness, occurrence of acute intradialytic complications during the current dialysis session, the specific symptoms experienced and the actions taken by patients in response to these complications. The second section assessed treatment and care protocol related

factors. Variables collected included the use and class of antihypertensive medications, duration of each hemodialysis session, type of vascular access and mechanical ventilation status.

Self-administered nurses questionnaire contained two sections with the first section covering demographic and professional information, evaluation of nurses knowledge and self reported competencies regarding hemodialysis care, early recognition of intradialytic complications, development of nursing care plans, operation of hemodialysis machines, vascular access management, monitoring and documentation of patient vital signs, and troubleshooting dialysis machine alarms. The second section assessed treatment and healthcare system related factors that could influence the occurrence and management of acute intradialytic complications. Information collected included the availability of standard operating procedures, clinical guidelines and work instructions, accessibility of these documents by nurses, attendance of professional development activities related to intradialytic complications, perceived autonomy in detecting and managing complications, and health system factors such as staffing levels, equipment availability, administrative support, nephrologist involvement, and nurse to patient ratios.

Quality assurance

The interviewer-administered patient questionnaire and data abstraction form were developed based on the study objectives, an extensive review of the literature, and established nephrology clinical guidelines.

Content validity of the data collection instruments was established through evaluation by an expert panel comprising five specialists with expertise in nephrology nursing, and clinical research. Each expert independently assessed every questionnaire item for its relevance, clarity, and adequacy in measuring the intended study constructs using a four Likert rating scale, where 1 indicated not relevant, 2 somewhat relevant, 3 relevant, and 4 highly relevant.

The Item Level Content Validity Index (I-CVI) was calculated as the proportion of experts assigning a rating of either 3 or 4 to each item. I-CVI values ranged from 0.80 to 1.00, demonstrating a high level of agreement among the reviewers regarding the relevance of the questionnaire items. Overall content validity was determined using the Scale-Level Content Validity index based on the averaging approach) S-CVI(Ave), which yielded a value of 0.93.

Comments and recommendations from the expert panel were incorporated to strengthen the quality of the questionnaire. Warranted questions were revised to improve clarity and reliability as well as eliminate redundancy and improve precision.

Study Variables

The dependent variable was the occurrence of acute intradialytic complications. Independent variables included patient related factors (sociodemographic and clinical characteristics), nurse related factors (knowledge, skills, experience, and competence), and treatment-related factors (dialysis protocols, equipment availability, workload, and dialysis frequency).

Data Analysis

Data was entered and analyzed using SPSS version 26. Descriptive statistics including frequencies, percentages, means, and standard deviations was used to summarize

data. Associations between variables and acute intradialytic complications was assessed using Chi-square tests, independent t-tests, and ANOVA where appropriate. Variables significant at bivariate analysis were entered into multivariable logistic regression models to identify independent predictors. Statistical significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the KNH-UoN Ethics and Research Committee (P144/02/2025), and KNH management granted administrative permission. Written informed consent was obtained from all participants. Confidentiality was maintained through anonymization of data and secure storage of study records.

Limitations and delimitations

The study was conducted at a single tertiary referral hospital, which may limit the generalizability of the findings to other healthcare facilities with different patient populations, dialysis practices, and resource availability. However, Kenyatta National Hospital is the largest national referral and teaching hospital in Kenya and receives patients from across the country and neighboring East African countries, providing a diverse population of maintenance hemodialysis patient and enhancing the applicability of the findings to similar tertiary healthcare settings.

Secondly, data collection was undertaken within a busy hemodialysis unit where patients were receiving treatment, posing logistical challenges in accessing participants without interrupting routine clinical care. To minimize this challenge, data collection was scheduled at times that were convenient for both patients and healthcare providers, and flexibility was maintained to accommodate dialysis schedules and clinical procedures.

Results

The response rate was 100% for both nurses ($n=38$) and patients ($n=59$).

Table 1: Sociodemographic characteristics of the study participants.

Sociodemographic characteristics	Percentage/frequency N=59
Patient's gender	
Male	57.6 (34)
Female	42.4 (25)
Total	100.0 (59)
Age of the respondents	
0-20 years	3.4 (2)
20-40 years	27.1 (16)
40-60 years	50.8 (30)
Above 60 years	18.6 (11)
Total	100.0 (59)
Number of hemodialysis sessions	
2 sessions	98.1 (58)
3sessions	1.7 (1)
Total	100.0 (59)

Socio-Demographic Characteristics of Patients

The majority of patients were male 57.6% (n=34). Most were aged 40-60 years 50.8% (n=30), with a mean age of 48.44 years (SD±14.33). Nearly all patients 98.1% (n=58) were on twice weekly hemodialysis.

Comorbidities among patients

Most patients 93.2% (n=55) had at least one comorbidity. Hypertension was the most common 79.7% (n=47), followed by diabetes mellitus 28.8% (n=17). Cardiovascular and autoimmune disorders each accounted for 13.6% (n=8).

Occurrence of intradialytic complications

A high proportion 93.2% (n=55) experienced at least one intradialytic complication. The most common symptoms were restlessness 91.5% (n=54), chest pain 83.1% (n=49), blurred vision 83.1% (n=49), rigors/chills 79.7% (n=47), dizziness 64.4% (n=38), and headache 64.4% (n=38). Nausea and vomiting (47.5%) were also frequently reported.

Action taken by patients

Most patients 77.97% (n=46) reported symptoms to nurses during dialysis. A minority 15.25% (n=9) did not report symptoms, while 5.08% (n=3) reported to doctors during dialysis.

Nurse Demographics

Among 38 nurses, 60.5% (n=23) were female. Most were aged 41-50 years 39.5% (n=15). Over half 55.3% (n=21) held higher diplomas, and 47.4% (n=18) had more than 18 years of experience.

Table 2: Nurse demographics at Kenyatta National Hospital Renal Unit

Nurse characteristics	Percentage/frequency
Gender	
Male	39.5(15)
Female	60.5(23)
Total	100%(38)
Age	
21-30 years	15.8(6)
31-40 years	18.4 (7)
41 -50 years	39.5 (15)
Above 50 years	26.3 (10)
Total	100.0% (38)
Educational qualification	
Diploma	13.2 (5)
Higher education	55.3 (21)
BscN	28.9 (11)
MscN (Nephrology Nursing)	2.6 (1)
Total	100.0% (38)
Years of experience	
2- 5 years	26.3 (10)
6-10 years	7.9 (3)
11-15 years	18.4 (7)
Above 16 years	47.4 (18)
Total	100.0% (38)

Nurses' knowledge and skills

Nurses' knowledge regarding intradialytic complications was assessed using five Likert scale items covering ability to formulate care plans, detect acute complications early, anticipate potential complications, and competence in initiating and completing dialysis sessions. Each item was scored on a 5-point scale, with total scores ranging from 5 to 25. Composite knowledge scores were computed and categorized as poor (5-11). Moderate (12-18) and good (19-25). Among the 38 nurses, the majority 97.4%, (n=37) demonstrated good knowledge, while only 2.6%, (n=1) had poor knowledge; none fell within the moderate category.

Nurses skills related to hemodialysis procedures were assessed using four competency based Likert scale items addressing the ability to operate the hemodialysis machine, insert venous catheters without supervision, monitor and chart patient's vital signs, and troubleshoot machine alarms. The majority of respondents strongly agreed with each statement: 84.2%, (n=32) for operating the hemodialysis machine, 65.8%, (n=25) for catheter insertion, 78.9%, (n=30) for vital sign monitoring, and 76.3%, (n=29) for alarm troubleshooting. Based on the aggregated scores, skill levels were categorized as poor (4-9), moderate (10-15), and good (16-20). Among the 38 nurses, 97.4%, (n=37) demonstrated good skill levels, while only 2.6%, (n=1) had moderate skills.

Treatment and care protocol factors

Most respondents 97.37% (n=37) reported absence of standard operating procedures. Despite this, 92.1% (n=35) of them indicated access to relevant guidelines. Over half 57.9% (n=22) had attended relevant training, while 81.6% (n=31) reported autonomy in decision-making. Regarding continuing professional development, 57.89%, (n=22) of participants had attended a scientific conference or training session related to infection prevention. In terms of frequency of scientific conferences or training attendance, 44.82%, (n=16) reported attending once a year, while smaller proportions attended monthly 7.89%, (n=3) or once in six months 7.89%, (n=3). Finally, 81.58%, (n=31) of participants indicated that the nursing staff had autonomy in decision-making regarding catheter care, while 18.42%, (n=7) reported a lack of autonomy.

Perceived causes of intradialytic complications

The main contributing factors identified were inadequate nurse to patient ratio 92.11%, nephrologists 92.1%, equipment availability 81.58%, and nurse in charge workload 57.89%. Few respondents 2.63% attributed complications to fellow nurses.

Association between patient factors and occurrence of intradialytic complications

The null hypothesis for this analysis stated that there is no relationship between patient related factors and the occurrence of acute intradialytic complications among adult patients on maintenance hemodialysis at Kenyatta National Hospital. One-way ANOVA showed significant associations between intradialytic complications and diabetes mellitus ($p=0.016$) and cardiovascular disorders ($p=0.000$). No significant associations were observed for age ($p=0.920$), gender ($p=0.086$), hypertension ($p=0.592$), or other comorbidities. These findings indicate that the null hypothesis was rejected for diabetes mellitus and cardiovascular disorders, but retained for the other patient related factors

Nurse competence and occurrence of intradialytic complications

The null hypothesis for this analysis stated that there is no relationship between nurse competence and the occurrence of acute intradialytic complications among adult patients on

maintenance hemodialysis at Kenyatta National Hospital. There was no statistically association between nurse competence and intradialytic complications ($\chi^2=6.743$, $p=0.345$). These findings indicate that the null hypothesis was retained.

Treatment protocol factors and occurrence of intradialytic complications

The null hypothesis for this analysis stated that there is no relationship between treatment and care protocols of dialysis and the occurrence of acute intradialytic complications among adult patients on maintenance hemodialysis at Kenyatta National Hospital. No significant associations were found between intradialytic complications and SOP availability ($p=0.872$), access to guidelines ($p=0.774$), training attendance ($p=0.401$), training frequency ($p=0.843$), or autonomy ($p=0.641$). This suggested that the null hypothesis was retained.

Discussion

Patient related factors and intradialytic complications

The study found that diabetes mellitus and cardiovascular diseases were significantly associated with intradialytic complications, while age, gender, hypertension, and other comorbidities were not. This finding is consistent with studies by [9] in Eritrea and [10] in Nigeria, which identified diabetes and cardiovascular conditions as major predictors of intradialytic instability, including hypotension and other symptoms.

However, the absence of a significant association with age contrasts with findings from [11] and [12], who reported that older age increased susceptibility to complications such as cramps and chest pain. The difference may be attributed to the relatively uniform age distribution and high dialysis adherence in the present study population.

Similarly, the non-significant association between hypertension and complications differs from findings in Cameroon and Nepal [13,14], where hypertension was a major contributor to intradialytic events. This variation may reflect differences in blood pressure management practices, antihypertensive timing, and dialysis protocols across settings.

The overall high prevalence of complications (93.2%) is comparable to findings in Eritrea and Brazil, where intradialytic symptoms were also frequently reported [15,16]. However, symptom patterns differed slightly, with restlessness, chest pain, and blurred vision being more prominent in the current study.

Nurse competence and occurrence of intradialytic complications

This study found no statistically significant relationship between nurse competence and occurrence of intradialytic complications. This contrasts with studies from Ethiopia and Brazil [17,18], which reported that higher nursing competence, experience, and adherence to protocols improved dialysis outcomes and reduced complications.

The lack of association in this study may be explained by the uniformly high levels of knowledge and skills among nurses, as over 97% demonstrated good competence. The limited variability may have reduced the ability to detect statistical differences. Additionally, patient comorbidities and institutional constraints such as staffing and equipment may have stronger influence on outcomes than individual nurse competence in this setting.

Treatment and care protocol related factors and intradialytic complications

The study found no statistically association between treatment related factors (Including SOP availability, access to guidelines,

training, and autonomy) and intradialytic complications. This finding differs from studies by [19] and [20], which reported that dialysis parameters such as ultrafiltration rate, dialysate composition, and treatment frequency significantly influence intradialytic hypotension and other complications.

Similarly, [13] and [16] demonstrated that structured protocols and dialysis prescription variables significantly affect patient stability during hemodialysis. The discrepancy may be due to differences in implementation fidelity, local clinical adjustments, and resource constraints at KNH, where protocols may exist but are inconsistently applied.

Despite the absence of statistical significance, the study identified important systemic gaps, including lack of standardized operating procedures, inadequate staffing, and variability in training exposure. These factors have been widely associated in literature with increased risk of adverse events, suggesting that their impact may be indirect or mediated through other clinical variables.

Conclusion

Diabetes mellitus and cardiovascular disease were the only patient related factors significantly associated with intradialytic complications, indicating increased vulnerability among patients with these comorbidities. Other variables, including age, gender, hypertension, and autoimmune disorders were not significantly associated.

Among treatment related factors, alpha-blocker use was significantly associated with intradialytic complications, while other medication classes and dialysis session factors showed no significant relationships.

Nurse related factors, including knowledge, skills, experience, and training, were not significantly associated with the occurrence of complications despite generally high competence levels among respondents.

Similarly, institutional factors such as availability of SOPs, access to guidelines, training frequency, and staff autonomy did not show statistically significant associations with intradialytic complications.

Recommendations

The dialysis unit should develop and fully implement standardized, evidence-based protocols for hemodialysis care, ensuring accessibility, regular use, and compliance monitoring through audits and checklists.

Routine clinical audits, supervisory reviews, and structured feedback mechanisms should be strengthened to improve adherence to protocols and enhance patient safety.

Hospital management should address staffing challenges by optimizing nurse to patient ratios, particularly during high-risk dialysis sessions, to improve monitoring and timely response to complications.

Patients with diabetes and cardiovascular disease should receive individualized dialysis care plans, including enhanced pre dialysis assessment and close monitoring during treatment.

Continuous professional development programs, including simulation-based training should be implemented to strengthen nurses' preparedness in managing acute intradialytic complications.

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