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Intradialytic Complications and its Associated Factors Among Chronic Kidney Disease Patients in a Tertiary hospital

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ABSTRACT

Introduction

Chronic kidney disease is a public health problem affecting millions of people worldwide. Hemodialysis is a life-saving renal replacement therapy for patients with chronic kidney disease(CKD), but it is not without risks. Intradialytic complications, which occur during hemodialysis sessions, can have a significant impact on patients' well-being, treatment outcomes, and overall quality of life. This article aims to identify the intradialytic complications and its associated factors in patients with chronic kidney disease undergoing hemodialysis in a tertiary hospital of eastern Nepal.

Methods

An observational cross-sectional study design was employed among 72 patients receiving hemodialysis treatment at Birat Medical College Teaching Hospital from 28 January to 20May 2023. Total enumeration sampling technique with a structured questionnaire via interview and observation technique was used for data collection. Collected data was entered in Microsoft Excel sheet and transferred to SPSS version 17. Frequency, mean, range, and standard deviation was calculated. Chi square test was used to determine the association. P-value <0.05 was considered statistically significant.

Results

All patients undergoing hemodialysis experienced at least one intradialytic complication. The most common complications reported were nausea/vomiting 59(81.9%) and chills/rigor 57(79.2%). Hypoglycemia was observed in 23.6% of patients, hyperglycemia in 12.5%, hypotension in 8.3%, and arrhythmia in 2 patients.

Conclusions

Intradialytic complications are common among chronic kidney disease patients undergoing hemodialysis.The associations between age, dialysis frequency, preexisting diabetes, hypertension, and specific complications emphasize the need for individualized care and tailored interventions.

Keywords: chronic kidney disease; hemodialysis; hypoglycemia; hypotension.

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INTRODUCTION

Chronic kidney disease (CKD) is defined as abnormalities of kidney structure or function, present for at least 3 months, with Glomerular Filtration Rate (GFR) of less than 60 ml/min/1.73 m^2 with implications for health.[1] It affects millions of people worldwide. Early identification and effective treatment prevent development, reduce complications, improve survival and quality of life.[2] Hemodialysis (HD) is a common renal replacement therapy for CKD patients in which kidney's function is supplemented by artificial equipment. It removes excess water, solutes, toxins and maintainshomeostasis.[3] Despite its benefits, HD can lead to various intradialytic complications, which can impact patient outcomes and overall treatment efficacy.[4,5] We have paucity of study in this field which helps for better clinical decision making. So, we aim to identify intradialytic complications and associated factors among CKD patients undergoing hemodialysis at Birat Medical College Teaching Hospital, Morang, Nepal.

METHODS

An analytical cross sectional study was conducted from 28 January 2023 to 20 May 2023 at the hemodialysis unit of the Department of Internal Medicine, Birat Medical College Teaching Hospital. Patients diagnosed with chronic kidney disease and age above 18 years undergoing hemodialysis were included in the study. Hemodialysis sessions in patients with acute kidney injury, end stage renal disease, patients undergoing emergency dialysis, age below 18 years and unwilling to participate in the study were excluded from the study. A total of 72 patients were enrolled using total enumeration sampling. Ethical approval was obtained from the institutional review committee (IRC) of Birat Medical College Teaching Hospital (IRC-PA-253/2078-79) and informed written consent was obtained from each patient before they were enrolled for the study. A specifically designed pro forma wasused for data collection. Data collection was conducted using a combination of a patient's interview and observation technique during hemodialysis session for identifying intradialytic complications.

Independent variables include potential factors associated with intradialytic complications such as age, sex, dialysis related factors like duration and frequency of dialysis sessions, vascular access, comorbidities. These were investigated by face to face interviews from the patients. Dependent variables include intradialytic complication (nausea/vomiting, muscle cramps, chills, fever, headache, back pain, hypotension, hypertension, hypoglycemia and lifethreatening complications like arrhythmia, seizure, dialyzer reaction, and sudden cardiac death) during hemodialysis session. These were identified based on clinical assessments of blood pressure, blood glucose level and reports from patients. Intradialytic hypotension was defined as a fall of ≥ 20 mm of Hg in systolic blood pressure from the baseline or a decrease in mean arterial BP>10 mm of Hg.[6] Intradialytic hypertension is defined as an increase in systolic BP (SBP) >10 mm of Hg from baseline pre to post dialysis.[7]

Intradialytic hypoglycemia was defined as blood glucose level less than <5.55 mmol/l in patients during the HD session in previously maintained blood glucose level.[7] Collected data was entered in Microsoft excel 2016, checked for completeness and accuracy. The anonymity and confidentiality of data was maintained. Data cleaning and coding was done using SPSS17. In the descriptive statistics for the categorical variable frequency and percentage was calculated while for continuous variables mean and standard deviation was calculated. While in the inferential statistics Chi square test was used

to find the association between independent variables and dependent variables. P value <0.05 was considered statistically significant.

RESULTS

A total of 72 patients with chronic kidney disease who underwent hemodialysis were studied. The mean ±SD of age was 47.68 ±13.46 years with a range of 19-78 years. Forty two (58.3%) patients were male and 30(41.7%) were female. More than half 40 (55.6%) wereJanajati by ethnicity. The duration of dialysis varies from 1 month to 7 years (Table 1).

Table 1. Baseline characteristics of patients (n=72).

Characteristics	Frequency (%)
Age (Years)	
≤ 40	24(33.3)
> 40	48(66.7)
Age in years (Mean ± S.D.= 47.68 ±13.46)	
Gender	
Male	42(58.3)
Female	30(41.7)
Ethnicity	
Janajati	40(55.6)
Brahmin/Chhetri	13(18.1)
Madhesi	8(11.1)
Dalit	7(9.7)
Muslim	4(5.6)
Duration of dialysis (range 1 month - 7 years)	
< 6 months	24(33.3)
6 months to 1 year	17(23.6)
1 - 2 years	17(23.6)
2-3 years	13(18.1)
6-7 years	1(1.4)

The most common clinical cause for chronic kidney disease in hemodialysis patients was hypertension 39(54.1%). Twentyfour (33.3%) patients had both diabetes and hypertension other clinical causes are listed in (Table 2).

Table 2. Clinical causes of chronic kidney disease (CKD) in hemodialysis patients (n = 72).

Causes	Frequency (%)
Hypertension	39(54.1)
Both Diabetes and Hypertension	24(33.3)
Unknown	8(11.1)
Nephrotic syndrome	1(1.4)

The most commonly performed vascular access for hemodialysis was arteriovenous fistula (AV Fistula). The anticoagulant medicine used during hemodialysis was heparin in all patients. Per session dialysis was four hours in majority 68 (94.5%). The mode of dialyser used in all patients was Bicarbonate. Forty one (61.1%) underwent twice a week and 28(38.9%) underwent thrice a week hemodialysis (Table 3).

Table 3. Vascular access among patients (n=72).

Vascular access	Frequency (%)
Arteriovenous fistula	66(91.6)
Permanent catheter	2(2.8)
Subclavian catheter	2(2.8)
Internal jugular catheter	1(1.4)
Anticoagulant used	
Heparin	72(100)
Duration of dialysis per session	
3 hours	4(5.5)
4 hours	68(94.5)
Modes of dialyser used for hemodialysis	
Bicarbonate	72(100)
Frequency of hemodialysis	
Twice a week	44(61.1)
Thrice a week	28(38.9)

All patients 72(100%) had the presence of at least one intradialytic complication. Majority 59(81.9%) had nausea/vomiting followed by chills/rigor 57(79.2%) and headache 54(75%).

Hypoglycemia was seen in 17(23.6%), hyperglycemia in 9(12.5%), hypotension in 6(8.3%) and arrhythmia in 2 patients. None of the patients had intradialytic hemorrhage, stroke and sudden cardiac death (Table 4).

Intradialytic complications were most commonly present in CKD patients with clinical causes of hypertension followed by diabetes and hypertension both (Table 5).

Table 4. Intradialytic complication (n=72).

Complications*	**Frequency (%)**
Nausea/vomiting	59(81.9)
Chills/rigor	57(79.2)
Headache	54(75)
Hypertension	46(63.8)
Muscle cramps	45(62.5)
Back Pain	40(55.6)
Chest pain	25(34.7)
Dialyzer reaction	18(25)
Hypoglycemia	17 (23.6)
Hyperglycemia	9(12.5)
Hypotension	6(8.3)
Arrhythmia	2(2.8)

*Multiple responses

Table 5. Intradialytic complications stratified by clinical causes of CKD among patients undergoing hemodialysis.

Complications	**HTN**	**Both DM and HTN**	**Nephrotic syndrome**	**Unknown**
	n(%)	**n(%)**	**n(%)**	**n(%)**
Nausea vomiting	31(52.5)	20(33.8)	1(1.7)	7(11.9)
Chills/rigor	29(50.8)	20(35.1)	1(1.7)	7(12.3)
Headache	29(53.7)	18(33.3)	1(1.8)	6(11.1)
Hypertension	26(56.5)	19(41.3)	0(0)	1(2.2)
Muscle cramps	24(53.3)	17(37.8)	1(2.2)	3(6.7)
Back Pain	17(42.5)	18(45)	0(0)	5(12.5)
Chest pain	10(40)	12(48)	0(0)	3(12)
Dialyzer reaction	8(44.4)	7(38.9)	1(5.5)	2(11.1)
Hypoglycemia	8(47.1)	2(11.7)	0(0)	7(41.2)
Hyperglycemia	2(22.2)	7(77.7)	0(0)	0(0)
Hypotension	1(16.7)	2(33.3)	0(0)	3(50)
Arrhythmia	0	1(50)	0(0)	1(50)

HTN = Hypertension DM = Diabetes,

There was a significant statistical association between age group and presence of intradialytic muscle cramps (p-value =0.039), chest pain (p-value=0.023), frequency of dialysis and chest pain(p-value =0.011), preexisting diabetes and hypertension with presence of arrhythmia(p-value =0.040) (Table 6).

We found 6(8.3%) patients having intradialytic hypotension (IDH). IDH was the most common complication identified in other studies.[5,8] The incidence of IDH ranged from 10-70% among dialysis patients depending upon the cut off value used for the diagnosis.[9] In a study from a hemodialysis center in Eritrea, intradialytic hypotension was present among 10% of patients.[4] There was no statistical significant association between age (p-value 0.169), frequency of dialysis (P value 1.000), per session duration of dialysis(P value 0.299) and combined diabetes and hypertension state(P Value 1.000) with presence of intradialytic hypotension in our study. A study from China reported contrast finding which showed that IDH was

Table 6. Association of intradialytic complications with baseline parameters (n=72).

Category	Intradialytic complications											
	Hypotension n(%)		Hypertension n(%)		Hypoglycemia n(%)		Hyperglycemia n(%)		Muscle cramp n(%)		Chest pain n(%)	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Age (Years)												
≤ 40	0(0)	24(100)	15(62.5)	9(37.5)	4(16.7)	20(83.3)	1(4.2)	23(95.8)	11(45.8)	13(54.2)	4(16.7)	20(83.3)
> 40	6(12.5)	42(87.5)	31(64.6)	17(35.4)	13(27.1)	35(72.9)	8(16.7)	40(83.3)	34(70.8)	14(29.2)	21(43.8)	27(56.3)
P value	0.169*		0.862		0.327		0.256*		0.039		0.023	
Frequency of dialysis (in a week)												
Twice	4(9.1)	40(90.9)	30(68.2)	14(31.8)	12(27.3)	32(72.7)	8(18.2)	36(81.8)	25(56.8)	19(43.2)	10(22.7)	34(77.3)
Thrice	2(7.1)	26(92.9)	16(57.1)	12(42.9)	5(17.9)	23(82.1)	1(3.6)	27(96.4)	20(71.4)	8(28.6)	15(53.6)	13(46.4)
P value	1.000*		0.451		0.408		0.081*		0.318		0.011	
Duration per session (hour)												
4	5(7.4)	63(92.6)	44(64.7)	24(35.3)	15(22.1)	53(77.9)	9(13.2)	59(86.8)	43(63.2)	25(36.8)	24(35.3)	44(64.7)
3	1(25)	3(75)	2(50)	2(50)	2(50)	2(50)	0(0)	4(100)	2(50)	2(50)	1(25)	3(75)
P value	0.299*		0.616*		0.235*		1.000*		0.628*		1.000*	
Pre-existing diabetes and hypertension												
Yes	2(8.3)	22(91.7)	19(79.2)	5(20.8)	2(8.3)	22(91.7)	7(29.2)	17(70.8)	17(70.8)	7(29.2)	12(50)	12(50)
No	4(8.3)	44(91.7)	27(56.3)	21(43.8)	15(31.3)	33(68.8)	2(4.2)	46(95.8)	28(58.3)	20(41.7)	13(27.1)	35(72.9)
P value	1.000*		0.071		0.031		0.005*		0.439		0.069	

*Fisher's exact test was applied

DISCUSSION

Among 72 patients, all of them had at least one intradialytic complication. Nausea/vomiting 59(81.9%), chills/rigor 57(79.2%), headache 54(75%), hypertension 46(), muscle cramps 45(62.5%) and back pain 40(55.6%) were the common intradialytic complications present. More than one fifth (23.6%) had intradialytic hypoglycemia. Two patients had arrhythmia.

significantly lower in twice-weekly(12.6%) than thrice-weekly HD(27.5%) with a *p*-value < 0.05[10]. IDH occurs when the rate of fluid removal during dialysis outpaces the rate of plasma refill and is associated with cardiovascular and neurohormonal compensatory responses.[11] Patient-reported symptoms, incomplete dialysis intervention, vascular access thrombosis, end-organ ischemia and increased mortality are the consequences of IDH.[11,12] Hence it is important for healthcare providers to closely monitor patients undergoing dialysis for signs of IDH and take appropriate measures to prevent and manage its occurrence. Forty six (63.8%) out of 72 patients had intradialytic hypertension in our study. Patients aged above 40 years (64.6%), twice weekly dialysis (68.2%), four hour duration per session (64.7%) and preexisting combined diabetes and hypertension(79.2%) had increased incidence of intradialytic hypertension but no statistical significant association was seen in our study. Studies have reported 5 to 20% of intradialytic hypertension.[13–15] The intradialytic increase in blood pressure may be present in patients without hypertension which is also seen in our study. Multifactorial causes like increased fluid volume overload, activation of renin renin-angiotensin aldosterone system, sympathetic over activity, endothelial cell dysfunction, dialysis specific factors like net sodium gain, high ionized calcium, hypokalemia, sudden change in dose or withholding pre-dialysis antihypertensive medicines and vascular stiffness are associated with intradialytic hypertension.[15] It is associated with adverse clinical outcomes contributing to increased duration of hospital stay, delay prognosis and two fold increase in mortality in patients undergoing hemodialysis.[14,16,17] Hence close monitoring of a blood pressure during dialysis is an effective management strategy for early recognition and treatment of such complications.

Nearly one in four(23.6%) patients had intradialytic hypoglycemia and a significant association was seen in the patients with pre-existing diabetes and hypertension (P value 0.040) in our study. Diabetes mellitus is one of the leading causes of chronic kidney disease.[18] In our study one third (33.3%) patients had diabetes as a risk factor for chronic kidney disease. Other studies also support our findings where hypoglycemia was common in those with preexisting diabetes mellitus.[19,20]

We found 9 (12.5%) patients having hemodialysis associated with hyperglycemia in our study. Preexisting diabetes and hypertension had significant association with the occurrence of intradialytic hyperglycemia (P value <0.005). Similar findings were observed in other studies which indicate that HD induces fluctuations in glucose levels with both decreased, increased and unaffected mean glucose levels on dialysis versus non dialysis days.[21,2223] It is because HD induces a number of physiological changes that affect plasma glucose level.[24,25] Haemodialysis-induced hypoglycemia is associated with various factors like reduced caloric intake due to uremia, decreased renal gluconeogenesis, decreased insulin clearance by kidneys, use of glucose-free dialysate, glucose loss into dialysate, increased erythrocyte uptake of glucose, and improved insulin sensitivity due to removal of uremic toxins and correction of acidosis.[18,26] Hyperglycemia and impaired glucose tolerance may occur as a result of increased insulin resistance and decreased insulin secretion in CKD patients including those on hemodialysis.[27,28] Also the low reliability of blood glucose testing marker hemoglobin A1c (HbA1c) may be associated with variability in glucose test.[29]

The most common complication present in

this study was nausea/vomiting 59(81.9%), chills/rigor 57(79.2%) and headache 54(75%). Compared to our study, very few percentage of patients had nausea and vomiting (5.24%), hypertension (5.06%), muscle cramps (4.71%), and headache (4.54%) in a study from Eritrea[4] A study done in hemodialysis unit, Lahore found hypotension (37.5%), Cramps (12.5%), Itching (15%), Vomiting (22.5%) and dialysis reaction(5%) as most common intradialytic complication.[30] Acute complications like nausea/ vomiting, headache, muscle pain are associated with rapid shift of fluid, electrolytes and drop in blood pressure.[11]

In our study, the second most common complication was chills/rigor which was present in 57(79.2%) patients. Compared to our study very few patients had chills/rigor in other studies.[4,31] A study done in the hemodialysis unit, B.P. Koirala Institute of Health Sciences, Dharan found chills and rigor (44.3%), backache (30.7%), and hypotension (27.2%) as the common complication. Intradialytic complications were significantly associated with increasing age (P <0.001) and irregular HD (P <0.001)[32]. Chills/ rigor during hemodialysis is associated with infection associated with vascular access site, anemia among patients with hemodialysis and dialysate associated reaction which hinder the dialysis process and prompt management is required. Chest pain was present in more than one third 24(34.7%0 patients in our study which was higher compared to other studies.[4,31],We found that the patients undergoing three times a week hemodialysis had an increased rate of chest pain (53.6%) compared to those undergoing twice a week(22.7%) and it was statistically significant in our study. Chest pain may be associated with fluid shift, or as a sign of infection and inflammation.

The strength of this study is that the findings of this study have significant implications for clinical practice and patient care. Understanding the presence of intradialytic complication and factors associated with it among CKD patients will help healthcare professionals optimize hemodialysis treatments and enhance patient outcomes. Based on the study results, recommendations can be made to improve the delivery of hemodialysis services, enhance patient education and awareness, and strengthen infection control measures in dialysis units. We also recommend for future research to further investigate the long-term outcomes and effectiveness of interventions in reducing intradialytic complications to enhance the quality of care for these patients.Although our study provided important findings, there are some limitations too. This was a single center experience with a small population and relatively shorter period which could hinder making a robust inference.

CONCLUSIONS

Intradialytic complications are common among CKD patients undergoing hemodialysis.The associations between age, dialysis frequency, preexisting diabetes, hypertension, and specific complications emphasize the need for individualized care and tailored interventions.

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