Original Article

Blood Pressure Control and its Determinants among Patients with Chronic Kidney Disease in a Nigerian Tertiary Hospital: A Cross-Sectional Study

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Abstract

Background: Hypertension is a common cardiovascular risk factor associated with adverse renal and cardiovascular outcomes in chronic kidney disease patients. Significant reduction in these adverse outcomes could be achieved through adequate blood pressure control in those with hypertension. This study aimed to determine the prevalence of poor blood pressure control and associated factors among chronic kidney disease patients with hypertension in a Nigerian tertiary hospital.

Methodology: This was a cross-sectional study that determined the prevalence of poor blood pressure control and its associated factors among chronic kidney disease patients with hypertension. Poor blood pressure control was defined as blood pressure ≥ 140/90mmHg. Factors associated with blood pressure control were determined on multivariate analysis. P-value less than 0.05 was considered significant.

Results: A total of 494 chronic kidney disease patients with hypertension were studied. The mean age of patients was 48.77±13.06 with a range of 17-95 years. There were 303 (61.3%) males and 191 (38.7%) females. A total of 44.5% of the patients had end-stage renal disease while all patients were on antihypertensive medications. The common causes of chronic kidney disease were hypertension (35%), diabetes mellitus (26.5%), and chronic glomerulonephritis (12.1%).Poor blood pressure control was found in 74.4% of chronic kidney disease patients. The predictors of poor blood pressure control were age (AOR: 0.65; CI: 0.45-0.94; p=0.02), use of multiple anti-hypertensives (AOR: 1.99; CI: 1.36-2.90; p=<0.001) and the presence of significant proteinuria (AOR: 1.47; CI: 1.02-2.14; p=0.04).

Conclusion: The majority of patients with chronic kidney disease had poor blood pressure control. Those who were young had significant proteinuria, and those who used≥ 3 antihypertensive medications were more likely to have poor blood control. There is a need to optimize BP management in chronic kidney disease patients in order to reduce adverse outcomes.

Keywords: Blood Pressure; Control; Chronic Kidney Disease.

Introduction

Cardiovascular disease is the leading cause of hospitalisation and mortality in patients with chronic kidney disease (CKD). [1,2] The burden of cardiovascular disease is high in CKD.[3] This is corroborated by previous studies that showed that both traditional and non-traditional cardiovascular risk factors such as hypertension, anaemia, hypocalcaemia, hyperphosphataemia, hyperuricaemia, and dyslipidaemia were highly prevalent in CKD.[4,5]

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Hypertension is a common traditional cardiovascular risk factor in CKD.[4-6] It may occur primarily as aetiology of the disease or secondarily from the disease. It is a leading cause of CKD within and outside Africa.[7,8] Some previous reports showed that the prevalence of hypertension in CKD was between 8 5.7 - 96.1 %. [4,6,8,9] The pathophysiologic mechanisms of hypertension in CKD include sympathetic nervous system over activity, endothelial dysfunction, activation of the renin-angiotensin-aldosterone pathway, fluid and salt retention, and extracellular fluid expansion.[10]

Hypertension-related morbidity in CKD patients includes left ventricular hypertrophy, heart failure, and ischaemic heart disease. [11, 12] Hypertension is associated with an increased rate of progression of CKD to end-stage renal disease.[13,14] It is a predictor of mortality and adverse cardiovascular outcomes in both pre-dialysis CKD patients and those on renal replacement therapy. [14,15] There is a significant reduction in hypertension-related morbidity and mortality in both CKD and non-CKD populations when blood pressure is optimally controlled.[16-18]

The report of a systematic review and meta-analysis by Ethehad et al, [16] showed that there was significant reduction in cardiovascular diseases such as heart failure, stroke and coronary artery disease following reduction in blood pressure. There is evidence that blood pressure control in CKD patients was associated with reduction in adverse renal outcomes and mortality.[17,18] The beneficial effects of blood pressure control in CKD patients are more pronounced in those with significant proteinuria.[17]

Despite the benefits of optimal control of blood pressure, majority of patients with hypertension including those with CKD are not optimally controlled.[5,6,19-22] The magnitude of poor blood pressure control is higher in low-income and middle-income countries compared to high-income countries.[21] Therefore, there is a need to regularly assess whether patients with hypertension on treatment are achieving the desired therapeutic goal. This may provide useful information to improve practice and overall patients' outcomes. This study determined the prevalence of poor blood pressure control and associated factors among CKD patients with hypertension in a tertiary hospital in Abuja.

Method

This cross-sectional study was carried out in the nephrology unit of the University of Abuja Teaching Hospital, Gwagwalada located in Nigeria. The nephrology unit of the hospital started and kept a database of adults attending or referred to the nephrology outpatient clinic since January 2009.The present study is a review of the database of CKD patients with hypertension aged 18 years and above between January 2010 and December 2021. We excluded CKD patients without hypertension, participants with missing values for serum creatinine or missing blood pressure readings, those with only one recorded blood pressure and missing variables with more than 10% of missingness.

Definition of Variables

Hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg and/or self-report treatment of hypertension using antihypertensive medications.[23]We estimated the glomerular filtration rate (GFR) for all participants using the CKD-EPI equation.[24]The diagnosis and staging of CKD were done according to the Kidney Disease Improving Global Outcome guideline.[25] Occupations were classified as high-skilled, medium-skilled or low-skilled, and undefined or non-specific. [26]

Dyslipidaemia was defined as presence of any or combination of elevated triglyceride (TG)levels of ≥ 1.7 mmol/L, reduced high-density lipoprotein-cholesterol (HDL-C) of <1.04 mmol/L, elevated low-density lipoprotein (LDL-C) level of >3.37 mmol/L, and total cholesterol (TC) level of ≥ 5.2 mmol/L. [27]Haemoglobin concentration of less than 12 g/dl was defined as anaemia.[28] Hypocalcaemia was defined as serum calcium below 2.2 mmol/l.[29] Hyperphosphataemia was serum phosphate greater than 1.45mmol/l.[30]Hyperuricaemia was defined as serum uric acid greater than 404µmol/l. [31] For this study, the presence of at least ≥2+ of protein in urine was considered significant.

Outcome

Blood pressure was measured using a mercury sphygmomanometer by the nursing staff in the clinic. We noted the blood pressure measured on the first presentation to the clinic (initial BP) and the blood pressure after 3-4 months from the first visit (subsequent BP). Good blood pressure control was defined as subsequent BP of<140 mmHg and <90mmHg for systolic and diastolic blood pressures respectively while greater values were considered as poor BP control.[32]

Ethical Statement

Ethical clearance was obtained from the Health Research and Ethics Committee of the University of Abuja. The study was conducted in accordance with the National HREC code and with the Helsinki Declaration of 1975, as revised in 2013.Informed consent was waived because the study was a review of data already collected. Strict confidentiality of data was maintained.

Statistical Analysis

Categorical variables were expressed as proportions with percentages and continuous variables were expressed as mean and standard deviation (SD). Multivariate logistic regression was used to determine the association of demographic and clinical characteristics with hypertension control. Multivariate models included predictors significantly associated with poor control in unadjusted analysis ($p<0.05$). Adjusted odds ratios (AORs) with 95% confidence intervals (CI) were reported. All tests were two-tailed and p-values of <0.05 were considered significant. Analyses were done using SPSS 20.0.

Results

A total of 494 CKD patients with hypertension were studied. The mean age of the patients was 48.77±13.06 with a range of 17-95 years. There were 303 (61.3%) males and 191 (38.7%) females. About one-third were medium-skilled workers while about 30% were not currently working (retired, students, applicants, or full-time housewives). Only 4% and 1% claimed the use of alcohol and tobacco, respectively (table 1).

Table 1: Socio-demographic profile of the patients (n=494)

Variable	Mean ± SD or Frequency (%)
Age	
Mean(years)	48.77±13.07
<40 years	142(28.7)
40-60 years	263(53.2)
>60 years	89(18.0)
Sex	
Male	303(61.3)
female	191(38.7)
Occupation	
Highly Skilled	46(8.9)
Medium Skilled	167(33.8)
Low Skilled	48(9.7%)
Undefined	84(17.0)
Not currently working	149(30.2)
Alcohol ingestion	
Yes	20(4.0)
No	474(96.0)
Tobacco use	
Yes	05(1.0)
No	489(99.0)

The common causes of CKD were hypertension (35%), diabetes mellitus (26.5%) and chronic glomerulonephritis (12.1%) (Fig 1).

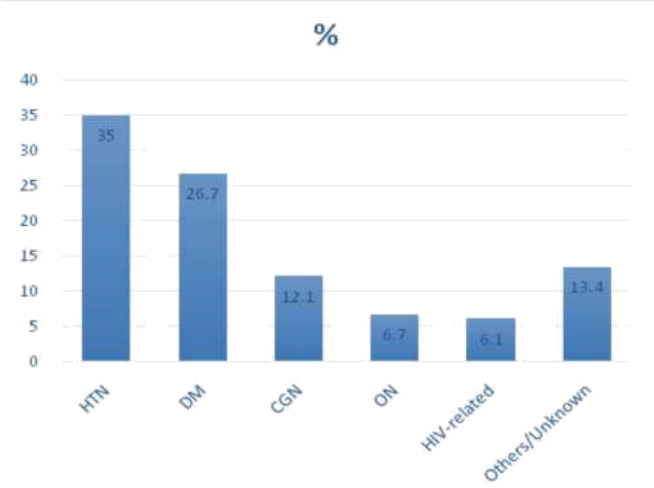

Fig 1: Causes of CKD among the participants.

Abbreviations: HTN-hypertension, DM-diabetes Mellitus, CGN-chronic glomerulonephritis, ON-obstructive nephropathy, HIV - human immunodeficiency virus.

About 45% of the patients were already in end-stage kidney disease (ESKD). Approximately half of the patients had other chronic co-morbidities. Hyperuricemia, dyslipidaemia. hyperphosphatemia and hypocalcaemia occurred in 89.1%, 85.4%, 66.8% and 39.7%, respectively (table 2).

Table 2: Clinical and Biochemical profile of the

patients

Variable	Mean ± SD or Frequency (%)
CKD stage	
Stage 1	69(14.0)
Stage 2	20(4.0)
Stage 3	89(18.0)
Stage 4	96(19.4)
Stage 5	220(44.5)
Known diabetic: Yes	151(30.6)
No	343(69.4)
Presence of co-morbidities	
Yes	244(49.4)
No	250(50.6)
Haemodialysis done	
Yes	203(41.1)
No	291(58.9)
Serum calcium: Mean (mmol/l)	2.31±0.47(2.2-2.6)
Hypocalcaemia: present	196 (39.7)
Hypocalcaemia: absent	298 (60.4)
Serum uric acid: Mean (µmol/l)	458.62±128.07
Hyperuricaemia: present	418(84.5)
Hyperuricaemia: absent	76(15.4)
Serum phosphate: Mean (mmol/l)	1.71±0.65
Hyperphosphataemia: present	348(70.4)
Hyperphosphataemia: absent	146(29.6)
Dyslipidaemia: present	427(86.4)
Dyslipidaemia: absent	67(13.6)
Haemoglobin concentration: Mean (g/dl)	9.40 ± 5.97
Anaemia present	415(84.0)
Anaemia absent	79(16.0)

Abbreviations-CKD chronic kidney disease, SD standard deviation

More than 40% of the patients have had haemodialysis therapy at some point as treatment. A total of 74.4% of the patients had poor blood pressure control defined as SBP of ≥140 mmHg and/or DBP ≥ 90mmHg at a subsequent clinic visit. Calcium channel blockers followed by diuretics were the commonly used anti-hypertensive medications. Over half of the patients used more than two different classes of anti-hypertensive medications simultaneously (table 3).

Table 3: Blood pressure-related variables among the CKD patients

Variable	Mean ± SD/ n (%)
Initial presenting BP (mmHg)	
Mean Systolic	161.59±29.74
Mean Diastolic	96.77± 20.23
Subsequent BP (mmHg)	
Mean Systolic	139.21±23.91
Mean Diastolic	85.40± 15.19
Class of BP medications	
Ca^{2-} channel blockers	356(72.1)
Diuretics	327(66.2)
ACEIs	227(45.6)
ARBs	162(32.8)
Beta blockers	147(29.8)
Centrally acting drugs	81(16.4)
Others	13(2.5)
Total daily antihypertensives (based on medication class)	
0	32(6.5)
1-2	182(36.8)
3-4	254(51.4)
≥5	26(5.3)
BP control on Subsequent meeting	
Poor	368(74.5)
Good	126(25.5)

Abbreviations- CKD-chronic kidney disease, SD standard deviation, BP Blood pressure, Ca^{2+}calcium, ACEIs-angiotensin converting enzyme inhibitors, ARBs- angiotensin receptor blockers.

The predictors of poor blood pressure control in the study were age, use of multiple anti-hypertensives, and the presence of marked proteinuria. Patients older than 45 years old were about 60% less likely to have poor BP control compared with younger patients. Similarly, participants who were on three or more anti-hypertensive medications were twice more likely to present with poor BP control while those with marked proteinuria were 1.5 times more likely to have poor control (table 4). The other socio-demographic and biochemical variables tested showed no association with poor BP control (Table 4).

Table 4: Factors associated with Blood Pressure control among the CKD patients

Variable	OR (95%CI)	P-value	AOR (95%CI)	P-value
	0.61(0.42-0.88)	0.007*	0.65(0.45-0.94)	0.023*
Sex: Male	1.07(0.74-1.55)	0.713		
Co-morbidities: Yes	0.83(0.58-1.18)	0.294		
	2.12(1.48-3.07)	<0.001*	1.98(1.36-2.89)	<0.001*
CKD Stages 1-3				
CKD Stages 4-5	1.12(0.79-1.61)	0.515		
Proteinuria ≥2+	1.68(1.17-2.41)	0.005*	1.47(1.02-2.14)	0.041*
Known Diabetic: Yes	0.94(0,64-1.38)	0.733		
Dyslipidaemia: Yes	0.86(0.51-1.48)	0.581		
Hb conc. (g dl): ≥12	1.14(0.69-1.87)	0.601		
Hypocalcaemia	0.81(0.56--1.17)	0.254		
Hyperphosphatemia	1.34(0.98-1.90)	0.152		
Hyperuricemia	0.93(0.57-1.55)	0.771		

CI-confidence interval, conc. = concentration, Hb= hemoglobin, OR=odds ratio, AOR=adjusted odds ratio

Discussion

This study determined the proportion of CKD patients with hypertension who had poor blood pressure control and associated factors in a Nigerian tertiary hospital. The study found that about three-quarters of CKD patients had poor blood pressure control. The factors associated with poor blood pressure control in this study were proteinuria, a higher number of antihypertensive medications, and younger age.

Optimal blood pressure was found in 25.6% of our study participants. This finding is similar to 25.3% reported by a previous study done in Nigeria. [33] However, it is lower than the 55.3% and 65%

reported by Okaka et al. [20] and Magvanjav et al. [34], respectively. It is also lower than 58.1%, 35.9% and 62.9% reported among the same study participants when different cut-off values were used for definition of good blood pressure control.[22] Our finding is higher than the 18.2% reported by Makusidi et al. [35]The variation in the proportion of those with optimal blood pressure control in the various studies may be partly due to some differences such as cut-off values used to define optimal blood pressure control, severity of CKD amongst the study participants, and whether it was the average blood pressure values over some time or a single value that was considered in the assessment of blood pressure control.

Makusidi et al. [35] studied patients who had stage 3-5 CKD patients, unlike our study which involved stages 1-5 CKD patients. Blood pressure control has been reported to be more difficult in those with advanced CKD.[36] The proportion of CKD patients with optimal blood pressure in our study is lower than what was reported in a study conducted in the United Kingdom using three different cut-off values.[22] This may be supported partly by the observation that blood pressure control is more difficult in blacks compared to Caucasians.[37]This also corroborates the report that the magnitude of poorly controlled BP is more in low- and middle-income countries.[21]

Presently, there is no global consensus on what optimal blood pressure in CKD patients should be. There have been different values recommended as target blood pressure goals in the management of hypertension in CKD. For instance, Kidney Disease Improving Global Outcomes Clinical Practice Guideline that was released in 2021 recommended a systolic blood pressure target of <120mmHg for CKD patients.[38]However, it also emphasized the need to individualize patients, and consider tolerability and patients' characteristics when using this guideline.[38]Joint National Committee-8 recommended a blood pressure value less than 140/90mmHg while International Society of Hypertension recommended less than 130/80mmHg irrespective of the degree of albuminuria as optimal blood pressure for CKD patients.[32,39] In addition, the report of the Systolic Blood Pressure Intervention Trial which was a landmark study has also influenced changes in some hypertension management guidelines despite some identified limitations.[40]Therefore, there is an urgent need to conduct well-powered randomized control trials to determine a universally accepted optimal blood control target in CKD patients that will reduce adverse renal and cardiovascular outcomes and overall mortality in them.

Majority of our CKD patients had poor control despite using a value of below 140/90 mmHg which is less strict when compared to some other recommendations and guidelines.[38,39] This implies that most of our patients are at increased risk of developing hypertension-related morbidity and mortality. Hypertension is a major risk factor for the progression of CKD to ESKD and the development of cardiovascular diseases. Previous studies have established the beneficial effects of lowering blood pressure in CKD patients on their cardiovascular and renal outcomes as well as overall mortality. [17,18]Therefore, physicians need to be more proactive in managing hypertension in patients with CKD to target especially in low- and middle-income countries such as Nigeria where the emphasis should be placed on preventive nephrology because the cost of renal replacement therapy is beyond the reach of most people. [41]

Proteinuria was associated with poor blood pressure control in this study. This finding is similar to reports from some previous studies.[7,20,37] Common causes of proteinuric CKD such as chronic glomerulonephritis and DM have additional mechanisms of contributing to hypertension. These include insulin resistance, systemic inflammation, excessive oxidative stress, and excessive activation of the RAAS and SNS systems.[42,43] These may partly contribute to the association between poor blood control and proteinuria in CKD patients.

Poor blood pressure control was also associated with younger age in this study. This is similar to the report by Fraser et al. [22] This may be explained by the fact that hypertension in the young is more likely to be secondary to CKD compared to older patients. In addition, CGN which is a common cause of CKD in the young usually presents with severe hypertension that may be difficult to control.
This study showed that patients on multiple

antihypertensive medications were more likely to be poorly controlled compared to those on monotherapy or two antihypertensive medications. This is similar to the finding of Okaka et al. [20] This finding may be because those on multiple antihypertensive medications are more likely to be non-compliant due to polypharmacy and or have severe hypertension at first presentation which may be difficult to control compared to those with mild or moderate hypertension.

The limitation of the study was that we could not conclude the temporal relationship between the identified factors and poor blood pressure control due to its cross-sectional design. Secondly, adherence to antihypertensive medication was not considered in this study.

In conclusion, majority of the CKD patients in our study had poor blood pressure control. Those who are young, have proteinuric CKD and are on three or more antihypertensive medications were more likely to have poor blood pressure control. There is need to be more aggressive with BP management in this group of CKD patients in order to reduce adverse renal and cardiovascular outcomes in them. We recommend that physicians should regularly audit their practice to know whether they are achieving the recommended therapeutic goals for their patients.

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