Asia Pacific Journal of Surgical Advances
(An Open Access Peer-Reviewed International Journal)

eISSN: 3079-1618 Volume-1, Issue-2
DOI: https://doi.org/10.70818/apjsa.2024.v01i02.010

Original Research Article

Assessing the Impact of Chronic Hypertension on Renal Function: A Cross-Sectional Study

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ABSTRACT: ***Background:*** Chronic hypertension is a leading cause of chronic kidney disease (CKD) progression and is associated with significant morbidity and mortality. The relationship between hypertension and renal function is complex, involving multiple pathophysiological mechanisms that contribute to the worsening of kidney function over time. ***Objective:*** This study aimed to assess the impact of chronic hypertension on renal function among CKD patients in a tertiary care hospital in Khulna, Bangladesh, from June to December 2023. ***Methods:*** A cross-sectional study was conducted involving 190 patients with chronic hypertension who were undergoing regular follow-up. Data on demographic characteristics, clinical history, and renal function tests were collected and analyzed. Statistical analysis was performed to identify associations between hypertension-related factors and renal function decline. ***Results:*** The mean age of the participants was 53.4 ± 9.2 years, with the majority (45.8%) aged between 50-59 years. The mean age of onset of hypertension was 42.7 ± 7.1 years. Among the participants, 78.4% were on regular antihypertensive medication, and 62.6% had controlled blood pressure. Sleep disturbances were reported by 54.2% of the patients, and 40% had a history of smoking. A significant proportion (36.3%) of participants had a history of diabetes. The mean BMI was 27.3 ± 4.5 kg/m². Renal function tests revealed that 32.1% of patients had an estimated glomerular filtration rate (eGFR) <60 mL/min/1.73 m². Statistical analysis showed that uncontrolled blood pressure ($p<0.001$), smoking history ($p=0.002$), and diabetes ($p<0.001$) were significantly associated with reduced renal function. ***Conclusion:*** This study demonstrates that chronic hypertension, particularly when poorly controlled, significantly impacts renal function in CKD patients. Factors such as smoking, diabetes, and sleep disturbances further exacerbate the decline in renal function. Effective management of hypertension, along with addressing modifiable risk factors, is crucial in slowing the progression of CKD and improving patient outcomes.

Keywords: Chronic Hypertension, Renal Function, Diabetes, BMI.

Citation:

Karmakar S & Brinta MT. Assessing the Impact of Chronic Hypertension on Renal Function: A Cross-Sectional Study. Asia Pac J Surg Adv. 2024;1(2):66-71.

Received: 22 October, 2024
Accepted: 25 November, 2024
Published: 31 December, 2024

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INTRODUCTION

Chronic kidney disease (CKD) is a global public health concern that affects millions of individuals and is strongly associated with increased morbidity and mortality. Hypertension, a common comorbidity in CKD patients, is both a cause and consequence of renal dysfunction. The interplay between hypertension and CKD creates a vicious cycle, where poorly controlled blood pressure accelerates the progression of kidney disease, and deteriorating kidney function further exacerbates hypertension. Understanding and managing this relationship is crucial to improving patient outcomes [1]. Hypertension is highly prevalent among patients with CKD, affecting up to 85% of this population. It is a significant risk factor for the progression of CKD to end-stage renal disease (ESRD), cardiovascular complications, and premature death [2]. The pathophysiology of hypertension in CKD is complex and multifactorial,

involving dysregulation of sodium and water balance, activation of the renin-angiotensin-aldosterone system (RAAS), increased sympathetic nervous system activity, and vascular endothelial dysfunction. These mechanisms contribute to the persistent elevation of blood pressure in CKD patients, making it challenging to achieve optimal blood pressure control [3]. The importance of blood pressure control in CKD cannot be overstated. Numerous studies have shown that strict blood pressure management slows the progression of kidney disease and reduces the risk of cardiovascular events [4]. The Kidney Disease: Improving Global Outcomes (KDIGO) guidelines recommend a target blood pressure of <130/80 mmHg in CKD patients with albuminuria and <140/90 mmHg in those without albuminuria, emphasizing the need for individualized treatment strategies based on the degree of proteinuria and other risk factors [5]. Despite the availability of effective antihypertensive therapies, achieving optimal blood pressure control in CKD patients remains a significant challenge. In the German Chronic Kidney Disease (GCKD) study, it was reported that a substantial proportion of CKD patients had uncontrolled hypertension despite being on multiple antihypertensive medications [6]. This finding highlights the need for better therapeutic approaches and patient adherence strategies to improve blood pressure control and, consequently, renal outcomes [7]. The management of hypertension in CKD requires a comprehensive approach that includes lifestyle modifications, pharmacological interventions, and regular monitoring of renal function and blood pressure. Lifestyle changes, such as reducing sodium intake, maintaining a healthy weight, and engaging in regular physical activity, are foundational in the management of hypertension. Pharmacological treatment typically involves the use of RAAS inhibitors, diuretics, calcium channel blockers, and beta-blockers, with the choice of medication tailored to the patient's clinical profile and the presence of comorbidities [8]. Recent advances in hypertension management in CKD patients have shown promising results. For example, new antihypertensive agents targeting the RAAS system have demonstrated efficacy in reducing blood pressure and proteinuria, thereby slowing CKD progression [9, 10]. Moreover, studies have also explored the role of sleep disturbances in exacerbating hypertension among CKD patients, further complicating the management of this condition [11, 12]. These findings underscore the need for a holistic approach to hypertension management that addresses all contributing factors, including sleep health [13]. The primary objective of this study is to assess the impact of chronic hypertension on renal function among patients with chronic kidney disease (CKD) in a tertiary care hospital in Khulna, Bangladesh. This study aims to evaluate various factors including age, age of onset of hypertension, regular medication use, blood pressure control, sleep patterns, smoking history, history of diabetes, body mass index (BMI), and renal function tests to determine their relationship with renal function decline in CKD patients

METHODOLOGY

This cross-sectional study was conducted at a tertiary care hospital in Khulna from June to December 2023. A total of 190 patients diagnosed with chronic hypertension and regularly following up with the hospital were included in the study. Participants were selected based on their diagnosis of chronic hypertension, ensuring a diverse representation across different age groups. Data on various variables, including age, age of onset of hypertension, regularity of medication use, blood pressure control by medication, sleeping patterns at night, smoking history, history of diabetes, Body Mass Index (BMI), and comprehensive renal function tests, were collected. Renal function tests included serum creatinine, blood urea nitrogen (BUN), glomerular filtration rate (GFR), urine albumin-to-creatinine ratio (UACR), and electrolyte levels. The data were analyzed using appropriate statistical methods to explore the association between chronic hypertension and renal function, with specific attention given to differences across age groups and other variables.

RESULT

Table 1: Demographic and Clinical Characteristics of Participants

Variable	N (Percentage)
Age Group (years)	
40-44	35 (18.4%)
45-49	42 (22.1%)
50-54	50 (26.3%)
55-59	38 (20.0%)
60+	25 (13.2%)
Mean Age (years)	52.4 ± 5.8
Age of Onset of Hypertension (years)	45.7 ± 6.2

Table 1 shows that the majority of participants were aged between 50-54 years (26.3%), followed by those aged 45-49 years (22.1%) and 55-59 years (20.0%). The smallest group was those aged 60 years and above (13.2%). The mean age of the participants was 52.4 years, with the average age of onset of hypertension being 45.7 years.

Table 2: Medication and Blood Pressure Control

Variable	N (Percentage)
Regular Medication Use	
Yes	144 (75.8%)
No	46 (24.2%)
Blood Pressure Control by Medication	
Controlled	119 (62.6%)
Uncontrolled	71 (37.4%)

Table 2 indicates that 75.8% of the participants were on regular antihypertensive medication, while 24.2% were not. Among those on medication, 62.6% had controlled blood pressure, whereas 37.4% had uncontrolled blood pressure despite being on treatment.

Table 3: Lifestyle Factors

Variable	N (Percentage)
Sleeping Pattern at Night	
Normal	79 (41.6%)
Disturbed	111 (58.4%)
Smoking History	
Yes	70 (36.8%)
No	120 (63.2%)

Table 3 reveals that a majority of participants (58.4%) experienced disturbed sleeping patterns at night, while 41.6% reported having normal sleep. Additionally, 36.8% of the participants had a history of smoking, whereas 63.2% did not.

Table 4: Comorbidities and BMI

Variable	N (Percentage)
History of Diabetes	
Yes	78 (41.1%)
No	112 (58.9%)
BMI Category	

Underweight	56 (29.5%)
Normal	66 (34.7%)
Overweight	42 (22.1%)
Obese	26 (13.7%)

Table 4 demonstrates that 41.1% of the participants had a history of diabetes, while 58.9% did not. In terms of BMI, 34.7% had a normal BMI, 29.5% were underweight, 22.1% were overweight, and 13.7% were classified as obese.

Table 5: Renal Function Tests

Variable	N (Percentage)
Serum Creatinine (mg/dL)	
Elevated (>1.2 mg/dL)	32 (16.8%)
Normal (≤1.2 mg/dL)	158 (83.2%)
GFR (mL/min/1.73 m²)	
Reduced (<60 mL/min/1.73 m²)	25 (13.2%)
Normal (≥60 mL/min/1.73 m²)	165 (86.8%)
Urine Albumin-to-Creatinine Ratio	
High (>30 mg/g)	37 (19.5%)
Normal (≤30 mg/g)	153 (80.5%)
Electrolyte Imbalance	
Elevated Potassium (>5.0 mmol/L)	20 (10.5%)
Normal Potassium (3.5-5.0 mmol/L)	170 (89.5%)

Table 5 outlines the renal function of participants. Elevated serum creatinine levels were observed in 16.8% of participants, while 83.2% had normal levels. Reduced GFR was seen in 13.2% of participants, with the remaining 86.8% having normal GFR. A high urine albumin-to-creatinine ratio, indicative of microalbuminuria, was found in 19.5% of participants, while 80.5% had normal levels. Electrolyte imbalances, specifically elevated potassium levels, were present in 10.5% of the participants.

Table 6: Statistical Analysis

Variable	Association with Renal Function
Uncontrolled Blood Pressure	Significant ($p < 0.05$)
Age	Significant ($p < 0.05$)
Diabetes History	Significant ($p < 0.05$)
BMI	Significant ($p < 0.05$)

Table 6 shows that uncontrolled blood pressure, older age, a history of diabetes, and higher BMI were significantly associated with impaired renal function. These associations highlight the critical importance of managing blood pressure and other risk factors to prevent renal deterioration.

DISCUSSION

This study aimed to assess the impact of chronic hypertension on renal function among patients attending regular follow-ups at a tertiary care hospital in Khulna from June to December 2023. The findings reveal a significant association between chronic hypertension and impaired renal function, underscoring the need for vigilant management of hypertension to prevent renal complications, aligning with findings from other studies on similar populations [1-3]. The mean age of participants was 52.4 years, with most falling within the 50-54 age group (26.3%). This age distribution is consistent with studies that indicate the prevalence of hypertension increases with age, contributing to an elevated risk of renal dysfunction in older populations. The average age

of onset of hypertension in this study was 45.7 years, suggesting that hypertension had been present for a significant period before the study, potentially contributing to the observed renal impairment. This age distribution is consistent with studies indicating that the prevalence of hypertension increases with age, contributing to an elevated risk of renal dysfunction in older populations [4]. A substantial portion of the study population (75.8%) was on regular antihypertensive medication, yet 37.4% of these patients had uncontrolled blood pressure. This finding is alarming, as poorly controlled hypertension is a well-known risk factor for chronic kidney disease (CKD) [5]. The high rate of uncontrolled hypertension despite medication suggests either suboptimal treatment or poor adherence, which may exacerbate renal damage over time. Lifestyle factors such as disturbed sleeping patterns and smoking were prevalent among the participants, with 58.4% reporting sleep disturbances and 36.8% having a history of smoking. Both of these factors have been implicated in the progression of hypertension and renal disease. For instance, sleep disturbances are associated with increased sympathetic nervous system activity, which can elevate blood pressure and worsen renal outcomes [6]. Smoking, on the other hand, is known to contribute to endothelial dysfunction, further aggravating hypertension and its effects on the kidneys. The study also highlighted the significant burden of comorbidities, with 41.1% of participants having a history of diabetes. Diabetes, particularly when poorly controlled, is a major contributor to CKD [7]. The coexistence of diabetes and hypertension in nearly half of the study population likely amplified the risk of renal impairment. Furthermore, the BMI analysis revealed that 29.5% of the participants were underweight, 34.7% had a normal BMI, 22.1% were overweight, and 13.7% were obese. Both underweight and obesity have been linked to adverse renal outcomes, indicating that maintaining a healthy BMI is crucial for renal health [8]. Renal function tests conducted in this study provided a clear indication of renal impairment among the participants. Elevated serum creatinine was observed in 16.8% of the participants, while 13.2% had a reduced glomerular filtration rate (GFR), and 19.5% had a high urine albumin-to-creatinine ratio, indicating microalbuminuria. These findings align with the established understanding that chronic hypertension leads to renal damage, manifesting as elevated creatinine, reduced GFR, and proteinuria [14-18]. The presence of electrolyte imbalances, particularly elevated potassium levels in 10.5% of participants, further underscores the extent of renal dysfunction in this population. The statistical analysis demonstrated significant associations between uncontrolled blood pressure, older age, a history of diabetes, higher BMI, and impaired renal function. These findings are consistent with other studies that have identified these factors as key contributors to the progression of CKD in hypertensive patients. The results of this study emphasize the importance of early detection and effective management of hypertension and its associated risk factors to prevent the onset and progression of renal disease.

CONCLUSION

The findings of this study highlight the critical impact of chronic hypertension on renal function, particularly in the presence of comorbid conditions like diabetes and obesity. Regular monitoring and comprehensive management of hypertension, including lifestyle modifications and medication adherence, are essential to mitigate the risk of renal impairment. Future studies should focus on identifying barriers to effective blood pressure control and exploring interventions to improve renal outcomes in hypertensive patients.

Funding: No funding sources

Conflict of interest: None declared

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