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Original Research Article

Study to assess the patterns of hypertension and factors influencing hypertension in chronic kidney disease

Abhishek M. Subramanya[1]*, Mohammed Fahad Khan[1], Aditi Ravindra[2]

[1]Department of Nephrology, Manipal Hospitals, Bangalore, Karnataka, India
[2]Department of Medicine, JSS Mysore, Karnataka, India

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***Correspondence:**
Dr. Abhishek M. Subramanya,
E-mail: abhishekms605@gmail.com

ABSTRACT

Background: A large proportion of CKD patients have inadequate BP control, and the proportions vary from studies to studies. Clinic BP is considered insufficient to diagnose HTN and monitor overall BP control because it does not correlate well with ambulatory blood pressure monitoring (ABPM), which encompasses white-coat or masked HTN. CKD is associated not only with an abnormal dipping pattern but also with white-coat or masked HTN. Objective of this study was to evaluate the factors influencing the blood pressure in chronic kidney disease patients.
Methods: A cross sectional study was conducted at a tertiary hospital in South India from 1st of January 2016 to 31st of July 2017. A total of 124 cases were included in the study.
Results: Among subjects with controlled HTN, 31.4% were overweight and 5.7% were Obese. Among Stage 3 CKD subjects, 53.7% had controlled HTN, 12.2% had masked HTN, 12.2% had persistent HTN. We reported that among those with proteinuria 2+, 38.5% had controlled HTN, 11.5% had masked HTN, 19.2% had persistent HTN and 30.8% had white coat HTN. In the study among diabetics, 17.5% had controlled HTN, 36.8% had masked HTN, 43.9% had persistent HTN and 1.8% had white coat HTN.
Conclusions: Stage of CKD, diabetes mellitus and proteinuria are determinants of hypertension in CKD patients. ABPM is the best method to monitor BP and hence in the proper management of HTN and in prevention of target organ damage in CKD patients.

Keywords: Chronic kidney disease, Hypertension, Diabeties mellitus, Proteinuria

INTRODUCTION

Chronic kidney disease (CKD) is recognized as a major public health problem worldwide. The declaration of World Kidney Day to be observed annually beginning in March 2006 sends a clear message to the public, government health officials, physicians, allied health professionals, patients, and families that CKD is common, harmful, and treatable.[1]

A large proportion of CKD patients have inadequate BP control and the proportions vary from studies to studies.[2] Clinic BP is considered insufficient to diagnose HTN and monitor overall BP control because it does not correlate well with ambulatory blood pressure monitoring (ABPM), which encompasses white-coat or masked HT. CKD is associated not only with an abnormal dipping pattern but also with white-coat or masked HTN .[3]

These abnormal ABPM patterns are considered to be associated with cardiovascular disease and CKD progression.[4] Ambulatory blood pressure monitoring (ABPM) is an effective, non-invasive and portable technique in which blood pressure (BP) is recorded

frequently and automatically over an extended period. The typical monitoring is 24 hours. During the testing period, participants continue to take medications and continue normal participation in daily activities.

In fact, ambulatory BP monitoring (ABPM) provides better insight into a CKD patient's BP than the BP measured in the clinic.[5] High prevalence of white-coat hypertension in patients with CKD likely overestimates the prevalence of uncontrolled hypertension in this patient population, this is likely to be true in CKD patients who have resistant hypertension.[6] Ambulatory blood pressure monitoring (ABPM) is available not only in specialized clinics but also in many segments of primary care. Several studies have demonstrated the better reproducibility and prognostic superiority of BP values obtained using ABPM as compared with BP values obtained from standard clinical measurements.[7]

The correlation between the magnitude of hemodynamic load or BP level and health concerns such as target-organ damage (TOD) and increased CVD risk is better reflected by ABPM compared to standard clinical BP evaluation.[8] There are not many studies in India regarding various clinical factors which can affect the circadian pattern of BP in CKD patients.

To evaluate the patterns of blood pressure and factors influencing the ambulatory blood pressure in chronic kidney disease patients.

METHODS

A cross sectional study was conducted at Karnataka Institute of Medical Sciences, Hubli between 1st of January 2016 to 31st of July 2017. Ethics Committee approval was given by the Institutional ethics committee of Karnataka institute of Medical Sciences – Hubli via Rajiv Gandhi University of Health Sciences.

A Total of 124 patients with CKD included based on the inclusion and exclusion criteria.

All cases diagnosed with chronic kidney disease aged above 18 years who were admitted in the Department of Medicine and Nephrology in the hospital were included in the study. Patients suffering from HIV, cirrhosis, transplant recipients, patients on dialysis, pregnant mothers were excluded in the study.

Patients with CKD diagnosed based on 'KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of CKD' were selected. The history was elicited with special reference to symptoms of CKD, CHF, co morbid condition, duration of diagnosing CKD and hemodialysis. A simple questionnaire was completed by each patient at the time of the ABPM and the questionnaire collected information such as the time the patient went to bed the time the patient got up, Night-time was defined as actual sleep time using the patient's diary.

Patients underwent 24-h ABPM using a TM-2430 monitor. Cuff size was chosen based on arm circumference, and the cuff fixed to the non-dominant arm. Three BP readings were obtained in the morning (7:00 to 10:00 am) concomitant with sphygmomanometric measurements to ensure that the mean of the two sets of values differed by, 5 mmHg. BP was recorded every 20 min from 7:00 am to 10:00 pm, and every 30 min from 10:00 pm to 7:00 am. The daytime and night-time periods were derived from diaries recorded by the patients during ABPM.

Monitoring was always undertaken on a working day. Patients did not have access to values of ABP. Strenuous physical activity was discouraged in all patients during the monitoring period. Their daily activities were comparable. BP series were eliminated from the analysis if >30% of the measurements were missing; data were missing for >3-hr spans.

Office BP measurement

All of the BP measurements were performed by an automated sphygmomanometer after 5 minutes of rest. Three consecutive seated readings were recorded. In our analysis, office BP was the mean of these three readings.

RESULTS

In our study nearly 10.5% of the respondents were less than 30 years of age and 24.2% aged above 60 years. Nearly 71% of the respondents were male.

Table 1: Determinants of hypertension in chronic kidney disease.

		Count	%
Type 2 diabetes mellitus	No	67	54.0%
	Yes	57	46.0%
Body mass index	Underweight (<18.5)	3	2.4%
	Normal (18.5 to 22.9)	33	26.6%
	Overweight (23 to 24.9)	20	16.1%
	Obese (>25)	68	54.8%
Stages of CKD	Stage 3	41	33.1%
	Stage 4	44	35.5%
	Stage 5	39	31.5%
Proteinuria	2+	26	21.0%
	3+	66	53.2%
	4+	32	25.8%

In our study nearly 46% of the respondents were suffering from type 2 Diabetes Mellitus. 54.8% of the

subjects were obese with BMI more than 25. Almost equal number of subjects was seen in Stage 3, 4 and 5 chronic kidney disease (Table 1).

As shown in Table 2, among stage 3 CKD subjects, 53.7% had controlled HTN, 12.2% had masked HTN, 12.2% had persistent HTN and 22% had white coat HTN, among stage 4 CKD subjects, 18.2% had controlled HTN, 50% had masked HTN, 31.8% had persistent HTN and 0% had white coat HTN and among stage 5 CKD subjects, 12.8% had controlled HTN, 23.1% had masked HTN, 64.1% had persistent HTN and 0% had white coat HTN. There was significant association between Stage of CKD and type of HTN.

Table 2: Association between stage of CKD and type of HTN.

		Stage of CKD					
		Stage 3		Stage 4		Stage 5	
		Count	Column N %	Count	Column N %	Count	Column N %
Type of HTN	Controlled HTN	22	53.7%	8	18.2%	5	12.8%
	Masked HTN	5	12.2%	22	50.0%	9	23.1%
	Persistent HTN	5	12.2%	14	31.8%	25	64.1%
	White coat HTN	9	22.0%	0	0.0%	0	0.0%

$\chi 2 = 59.04$, df = 6, p <0.001*.

Table 3: Association between type of HTN and BMI.

		Type of HTN							
		Controlled HTN		Masked HTN		Persistent HTN		White Coat HTN	
		Count	%	Count	%	Count	%	Count	%
BMI	Underweight (<18.5)	0	0.0%	0	0.0%	0	0.0%	3	5.0%
	Normal (18.5 to 22.9)	11	32.4%	4	50.0%	6	27.3%	12	20.0%
	Overweight (23 to 24.9)	7	20.6%	0	0.0%	0	0.0%	13	21.7%
	Obese (>25)	16	47.1%	4	50.0%	16	72.7%	32	53.3%

$\chi 2 = 14.37$, df = 9, p = 0.110.

Table 4: Association between type of HTN and proteinuria.

		Proteinuria					
		2		3		4	
		Count	Column N %	Count	Column N %	Count	Column N %
Type of HTN	Controlled HTN	10	38.5%	22	33.3%	3	9.4%
	Masked HTN	3	11.5%	26	39.4%	7	21.9%
	Persistent HTN	5	19.2%	17	25.8%	22	68.8%
	White coat HTN	8	30.8%	1	1.5%	0	0.0%

$\chi 2 = 50.14$, df = 6, p <0.001*.

Table 5: Association between type of HTN and diabetes mellitus.

		DM			
		No		Yes	
		Count	Column N %	Count	Column N %
Type of HTN	Controlled HTN	25	37.3%	10	17.5%
	Masked HTN	15	22.4%	21	36.8%
	Persistent HTN	19	28.4%	25	43.9%
	White coat HTN	8	11.9%	1	1.8%

$\chi 2 = 12.96$, df = 3, p =0.005*.

Among subjects with controlled HTN, 31.4% were overweight and 5.7% were obese. Among subjects with masked HTN, 52.8% were overweight and 8.3% were obese, among subjects with persistent HTN, 47.7% were overweight and 9.1% were Obese and among white coat HTN, 77.8% were overweight and 11.1% were obese. Overweight and obese were seen in higher proportions among white coat hypertensives, masked hypertensives and persistent hypertensives. However, there was no

significant association between BMI and Type of HTN (Table 3).

As displayed in Table 4, In the study among those with proteinuria 2+, 38.5% had controlled HTN, 11.5% had masked HTN, 19.2% had persistent HTN and 30.8% had white coat HTN. Those with proteinuria 3+, 33.3% had controlled HTN, 39.4% had masked HTN, 25.8% had persistent HTN and 1.5% had white coat HTN. Among those with proteinuria 4+, 9.4% had controlled HTN, 21.9% had masked HTN, 68.8% had persistent HTN and 0% had white coat HTN. There was significant association between proteinuria and Type of HTN.

Table 6: General profile of CKD subjects in the study.

		Count	%
Age	<30 years	13	10.5%
	31 to 60 years	81	65.3%
	>60 years	30	24.2%
Gender	Female	36	29.0%
	Male	88	71.0%
Type 2 diabetes mellitus	No	67	54.0%
	Yes	57	46.0%
Number of antihypertensive uses	1	18	14.5%
	2	37	29.8%
	3	50	40.3%
	4	19	15.3%
Body mass index	Underweight (<18.5)	3	2.4%
	Normal (18.5 to 22.9)	33	26.6%
	Overweight (23 to 24.9)	20	16.1%
	Obese (>25)	68	54.8%
Stages of CKD	Stage 3	41	33.1%
	Stage 4	44	35.5%
	Stage 5	39	31.5%
Proteinuria	2+	26	21.0%
	3+	66	53.2%
	4+	32	25.8%

As discussed in the above table (Table 5), among diabetics, 17.5% had controlled HTN, 36.8% had masked HTN, 43.9% had persistent HTN and 1.8% had white coat HTN. Among non-diabetics, 37.3% had controlled HTN, 22.4% had masked HTN, 28.4% had persistent HTN and 11.9% had white coat HTN. There was significant association between DM status and type of HTN.

DISCUSSION

In our study 28.2% had controlled HTN, 29% had masked HTN, 35.5% had persistent HTN and 7.3% had white coat HTN. In Satoshi et al the frequencies in these categories were respectively 37.6%,30.9%,26%,5.6%. Pogue et al reported that among 617 CKD patients masked HTN 42.9%, persistent HTN 18.1%, controlled HTN 36.6%, white coat HTN 2.2%.[9,10] (Table 2).

In this study well controlled hypertension accounted for 7.3% of all participants. Its prevalence has been reported to be 13% or 18% among the population in general. Bangash and Agarwal performed a meta-analysis of CKD patients (six trials, reported from 2005 to 2008) and reported that the prevalence was 18.3% and 15% among CKD cohort.[11-13] Compared with these previous data, the prevalence of WCHT in this study was very low.

In our study prevalence of controlled HTN was decreasing from 53.7% to 12.8% as stage of CKD progresses, prevalence of masked HTN increases from 12.2% to 23.1%- 50% across various stages of CKD and prevalence of persistent HTN increases from 12.2% to 64.1%. There was significant association between Stage of CKD and type of HTN. In Satoshi et al as for the CKD stage, prevalence of controlled blood pressure decreased from 42.3% to 29.0% and that of persistent HTN rose from 21.7% to 36.1% with advancing CKD stage. [9] (Table 1).

In our study overweight and obese patients were seen in higher proportions among white coat hypertensives, masked hypertensives and persistent hypertensives. However, there was no significant association between BMI and type of HTN. (Table 3). Otero et al in their study showed that there no significant association of obesity with hypertension. [14]

We reported that there was significant association between proteinuria and type of HTN (Table 4). We found that controlled HTN had lesser degree of proteinuria when compared to masked HTN and persistent HTN. Hence, as the spectrum of HTN changes from white coat to controlled to masked and eventually persistent HTN severity of proteinuria also increases.

In Satoshi et al among 1075 patients 926 patients had proteinuria among them 34.1% had controlled HTN, 5.5% had white coat HTN, 32.4% had masked HTN, 28.0% had persistent HTN.[9] Similarly Cha et al in their study showed a similar statistically significant association of hypertension and proteinuria in CKD patients. [15]

In our study among diabetics 17.5% had controlled HTN, 36.8% had masked HTN, 43.9% had persistent HTN and 1.8% had white coat HTN. Among non-diabetics, 37.3% had controlled HTN, 22.4% had masked HTN, 28.4% had persistent HTN and 11.9% had white coat HTN (Table 5). There was significant association between DM status and type of HTN. Prevalence of controlled HTN was less in diabetics and prevalence was high for masked and persistent HTN.

In Satoshi et al among 1075 CKD patients 381 patients were diabetic among them 27.3% had controlled

HTN,6.3% had white coat HTN 32.3% had Masked HTN and 34.1% had persistent HTN. [9]

Hypertension being a common comorbidity, our study included only 124 patients and the small sample size of the study is a limitation of the study. There are confounding variables in this study like smoking, and hence randomised controlled trial would have been an ideal study design for the same.

CONCLUSION

Various factors such as presence of diabetes, severe degree proteinuria is responsible for abnormal circadian patterns of BP in CKD patients. Obesity though showed an increased proportion of masked and persistent hypertension, it did not show any statistical significance. This study also highlights the importance of Ambulatory blood pressure monitoring which showed the increased prevalence of masked hypertension and poorly controlled hypertensives amongst the CKD population thereby highlighting its importance and utility.

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