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Original Research Article

A study to evaluate the factors influencing the Blood Pressure in Chronic Kidney Disease Patients

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Abstract: Background: 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. **Objective** :To evaluate the factors influencing the Blood Pressure in Chronic Kidney Disease Patients. **Materials and Methods:** A Cross Sectional Study was conducted at Department of General Medicine and Emergency Medicine, MS Ramaiah Medical College, Bengaluru from 1st of January 2016 to 31stof 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.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. 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. **Conclusion:** ABPM is the best method to monitor nocturnal BP and to detect non dipping and hence in the proper management of HTN and in prevention of target organ damage in CKD patients.

Keywords: Chronic Kidney Disease, Hypertension,Diabetics 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 frequentlyand automatically over an extended period. The typical monitoring is 24 hours. During thetesting period, participants continue to take medications and continue normal participationin daily activities.

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

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

Objective:

To evaluate the factors influencing the Ambulatory Blood Pressure in Chronic Kidney Disease Patients.

Materials and Methods:

The present cross-sectional study was conducted by the Department of General Medicine and Emergency Medicine at MS Ramaiah Medical College, Bengaluru, between 1st of January 2016 to 31stof July 2017

All the patients who attended the OPD during the study period were included in the study after fulfilling the inclusion criteria.

Since our study was a time bound study from 1st of January 2016 to 31stof July2017 totally 18 months. Total of 124 patients with CKD included based on the inclusion and exclusion criteria.

INCLUSION CRITERIA:

1. Diagnosed patients of CKD.
2. Age ≥18 years.

EXCLUSION CRITERIA:

1. Those not willing for participating in the study.
2. Age <18 years.
3. HIV infected patients.
4. Liver cirrhosis patients.
5. Transplant recipients.
6. Patients who are on dialysis.
7. Pregnant females.
8. Dys-rrythmic patients.

Patients underwent 24-h ABPM using a TM-2430 monitor. Cuff size was chosen on the basis of 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.

NOCTURNAL BP CHANGE AND ITS PATTERNS-

The degree of nocturnal BP change (NBPC) was calculated by the following equation. Degree of NBPC= 100x [(mean day time systolic pressure)-(mean nocturnal systolic pressure)] /(Mean day time systolic pressure).

Patients with NBPC >10% and <20% were classified as "dippers",>20% as "extreme dippers",>0% to<10% as

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"non dippers" and <0% as "risers "or" reverse dippers" Cut-off points are based on the guidelines for ABPM by the Japanese circulation society. 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. Diagnostic Criteria for Hypertension

A diagnosis of hypertension was made if the office BP was >140/90 mmHg or 24-hour average BP from ABPM was >130/80 mmHg, based on the Japanese Society of Hypertension guidelines.

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. Majority 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 2 :**Association between Stage of CKD and Nocturnal Blood Pressure Control**

		Stage of CKD					
		Stage 3		Stage 4		Stage 5	
		Count	Column N %	Count	Column N %	Count	Column N %
Class	Dippers	28	68.3%	6	13.6%	0	0.0%
	Extreme dippers	7	17.1%	0	0.0%	1	2.6%
	Non-dippers	4	9.8%	31	70.5%	25	64.1%
	Risers	2	4.9%	7	15.9%	13	33.3%

χ 2 = 77.96, df = 6, p <0.001*

Among Stage 3 CKD subjects, 68.3% were dippers, 17.1% were extreme dippers, 9.8% were non dippers and 4.9% were risers, among stage 4 CKD subjects, 13.6% were dippers, 0% were extreme dippers, 70.5% were non dippers and 15.9% were risers and among stage 5 CKD subjects, 0% were dippers, 2.6% were extreme dippers, 64.1% were non dippers and 33.3% were risers. There was significant association between Stage of CKD and NBPC class.

Table 3: 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%

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	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*

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 4: **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

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 Hypertensive's, Masked Hypertensive's and persistent Hypertensive's. However there was no significant association between BMI and Type of HTN.

Table 5: 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*

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.

Among 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.

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Table 6: 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%

χ 2 = 12.96, df = 3, p =0.005*

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. 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 this study extreme dippers were 6.5%,dippers were 27.4%, non dippers 48.4%,risers 17.7% In Satoshi et al[9] 9.7%,36.7%,37.9%,15.5% In Otero et al[10] 4.7% ,47.2% ,42.3% ,5.9%. In Yunkyu et al[11] 5.7%,38%,42.3%,14%. In Pogue et al[12] dippers 19.7%, non dippers 41%, reverse dippers 39.2%. In Cha et al[13] dippers 33.3%,non dippers 34.5%,reverse dippers or risers 17.3%,extreme dippers 14.9%.Since our's is a tertiary care centre prevalence of advanced stage of CKD is more when compared to other studies and hence prevalence of non dippers and risers are relatively more when compared to other studies.

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[9] 37.6%,30.9%,26%,5.6%.InYunkyu et al [11] 33.3%,26.9%,29.7%,10.1%. In Pogue et al[12] among 617 CKD patients Masked HTN 42.9%,Persistent HTN 18.1%,Controlled HTN 36.6%,White coat HTN 2.2%.

In this study WCHT accounted for 7.3% of all participants. Its prevalence has been reported to be 13% or 18% [14,15]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%[16] and 15% among CKD cohort[17]. 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% from and prevalence of Persistent HTN increases from 12.2% to64.1%.There was significant association between Stage of CKD and Type of HTN. In Satoshi et al[9] 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.

In our study 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 Hypertensive's, Masked Hypertensive's and Persistent Hypertensive's. However there was no significant association between BMI and Type of HTN.

In Satoshi et al among 1075 CKD patients 260 patients were overweight among them 27.7% had Controlled HTN,5.4 % had White coat HTN,33.5% had Masked HTN and 33.5% had Persistent HTN

In our 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. Among 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

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0% had White coat HTN. There was significant association between Proteinuria and Type of HTN. We found that Controlled HTN had lesser degree of proteinuria when compared to Masked HTN and Persistent HTN so as the spectrum of HTN changes from White coat to Controlled to Masked to Persistent HTN severity of proteinuria also increases.

In Satoshi et al [9] 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.

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. 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[9] 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.

Conclusion:

Various background factors such as presence of diabetes, severe degree proteinuria are responsible for abnormal circadian patterns of BP in CKD patients. ABPM is the best method to monitor nocturnal BP and to detect non dipping and hence in the proper management of HTN and in prevention of target organ damage in CKD patients.

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