International Journal of Advances in Medicine
Kumar SS et al. Int J Adv Med. 2018 Dec;5(6):1337-1341
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: http://dx.doi.org/10.18203/2349-3933.ijam20184678

Original Research Article

Prognostic value of ambulatory blood pressure in chronic kidney disease

S. Senthil Kumar, S. Vithiavathi*, P. Parameswaran

Department of Medicine, Aarupadai Veedu Medical College and Hospital, Kirumampakkam, Puducherry, India

Received: 07 October 2018
Accepted: 29 October 2018

***Correspondence:**
Dr. S. Vithiavathi,
E-mail: drsvv99@gmail.com

ABSTRACT

Background: Hypertension control is essential to prevent macro vascular complications in patients with chronic kidney disease. Ambulatory Blood Pressure Monitoring (ABPM) is the recognized gold standard for the assessment of hypertension and hence in this study ABPM assessment was done in 50 patients with dialysis dependant CKD to evaluate the adequacy of BP control and prevent adverse events.
Methods: This study is a prospective observational study conducted at Aarupadai Veedu Medical College and Hospital, Pondicherry among hypertensive patients with dialysis dependant CKD patients as per standard criteria. A total of 50 patients participated in this study of both gender after obtaining written consent. Patients with coronary artery disease, diabetes mellitus, acute kidney injury were excluded from this study.
Results: Out of the total 50 patients included in this study 72% had early morning dipping in BP and remaining 28% had non-dipping in systolic and diastolic pressure. The mean systolic pressure reached a maximum of 160.95mmHg to a minimum of 113.38mmHg and the mean diastolic pressure with a maximum of 98.47 to a minimum of 62.71mmHg on an overall 24 hours ABPM monitoring. The mean systolic and diastolic pressure was found to be more in the active period than in the passive period.
Conclusions: Nocturnal BP is superior to day time BP in predicting CVD outcomes. This study shows both systolic and diastolic pressure variability over 24hrs maximum during night hours (nocturnal hypertension) and non-dipping of early morning BP. Both non-dipping status and nocturnal hypertension are associated with target organ damage and CV risk.

Keywords: Ambulatory blood pressure, Chronic kidney disease, Hypertension

INTRODUCTION

Hypertension and chronic kidney disease (CKD) are both common in the general population. Hypertension is present in >80% of patients with chronic renal failure. Most patients with hypertension associated CKD die of heart attack and stroke before renal function deteriorates.[1] Hypertension is a common problem in patients with CKD, and its incidence and prevalence increase with declining glomerular filtration rate GFR).[2] Among individuals with hypertension, elevated systolic BP is associated with incident CKD and a more rapid decline in renal function.[3] In patients with CKD the control of hypertension slows the progression to end stage renal disease.[4] Patients with CKD commonly have nocturnal hypertension detectable by 24 hours ambulatory BP monitoring. Ambulatory BP monitoring (ABPM) is the recognized gold standard for the assessment of hypertension. Ambulatory BP (ABP) is superior to office BP for prediction of clinical outcome.[5] Ambulatory BP readings predict cardiovascular events better than office readings do and they overcome many of the pitfalls of

office measurement. In patients with dialysis hypertension is a risk factor for mortality. Isolated nocturnal hypertension, defined as nighttime BP ≥120/70mmHg despite normal daytime BP has been associated with both cardiovascular events and mortality. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) has also recommended ambulatory monitoring for treatment resistance, symptomatic hypotension, autonomic failure, and episodic hypertension.[6]

An individual BP varies widely throughout a 24 hours period. BP normally dips during sleep and increases sharply when a patient awakes and becomes active. The daily BP variation appears to be mediated by the circadian rhythm of sympathetic tone, linked to changes in the waking–sleeping cycle.[7] The morning surge in BP may be related to increased α-sympathetic vasoconstrictor activity in the morning.[8] The fall in BP during sleep is associated with a decrease in sympathetic activity that corresponds to the stages of non-rapid eye movement (NREM) sleep.[9] A diurnal pattern for renin and aldosterone has also been described. Plasma renin activity (PRA) increases during the early hours of the morning, peaking at 8 AM, and gradually decreases during the day, reaching its nadir at 4 PM, followed by a gradual increase overnight.[10] Several factors, including increased sodium and fluid volume retention, impaired baroreceptor sensitivity, altered sympathetic nervous system activity, activation of the renin-angiotensin system (RAS), endothelial dysfunction, oxidative stress, inflammation, and increased arterial stiffness, have been proposed to explain the altered BP circadian rhythm. Increased sodium and fluid retention due to impaired ability of the diseased kidney and intrarenal RAS activation has been proposed as the major factor contributing to nocturnal hypertension and non-dipping BP pattern in CKD

Nocturnal hypertension increases the aggregate hemodynamic load on the cardiovascular system and predicts cardiovascular outcomes better than standard office measurements.[11] Nocturnal hypertension is common in CKD patients because of increased cardiac output and increased systemic vascular resistance. JNC 7 guidelines recommend a lower threshold of 130/90mmHg for high risk patients with Diabetes or CKD.[12] Most patients with hypertension associated CKD die of heart attack or stroke before renal function deteriorates.

Hence this study aims to look for the prognostic value of ambulatory blood pressure in chronic kidney disease patients admitted in Aarupadai Veedu Medical College and Hospital, Puducherry, so that better strategies could be developed to prevent adverse events.

METHODS

This is a prospective observational study conducted at Aarupadai Veedu Medical College and Hospital, Pondicherry among dialysis dependent CKD patients admitted in Medicine wards. The study was started after obtaining clearance certificate from the institutional human ethical committee of Aarupadai Veedu Medical College and Hospital. The study was conducted for duration of 6 months from 1st July 2017 to 31st December 2017. The sample size for this study was 50 patients out of which 36 were males and 14 were females. After explaining about the objectives and study procedures to all the patients written consent was obtained before starting the study.

Inclusion criteria

Chronic Kidney Disease patients on hemodialysis.

Exclusion criteria

- The patients with coronary artery disease or previous Myocardial infarction
- Diabetes mellitus
- Acute kidney injury
- CKD patients not on hemodialysis

Data collection

The detailed demographic information was collected from the patients based on questionnaire. Ambulatory blood pressure recorded over a 24 hours period during the patient's normal daily activities with a properly validated and calibrated monitor. The monitor programmed to obtain readings at one hourly interval between 6 am and 6 am. The monitor recorded BP at a 30 minutes interval for the daytime period and night-time period. Cuff-size was chosen based on arm circumference and fixed to the non-dominant arm.

Recordings were performed on working days and patients were instructed to maintain their usual activities and keep the arm extended and immobile at the time of cuff inflation. They were also instructed to register any symptom during this period of the test and the times each anti-hypertensive medication prescribed was taken. ABPM measurements were considered valid only if more than 65% of measurements were successful. Clinical information collected from medical records included age, sex, stage and etiology of HTN, etiology of CKD, body mass index, smoking, presence of diabetes, dyslipidaemia, target-organ damage, such as left ventricular hypertrophy, and associated clinical conditions including coronary heart disease, cerebrovascular disease and heart failure. Investigations done were renal function test, complete blood count, serum electrolytes, albumin creatinine ratio, blood glucose, electrocardiogram, echocardiogram, chest X-ray, ultrasound abdomen.

Creatinine clearance was calculated using Cockcroft-Gault formula:

$$\frac{(140\text{-age}) \times \text{weight}}{72 \times \text{serum creatinine} \times 0.85 \text{ (if females)}}$$

Statistical analysis

The data was entered in Microsoft excel sheet and results were analyzed in the form of tables and figures. SPSS version 23 (IBM) was used to analyze mean values and data.

RESULTS

A total of 50 patients admitted in Aarupadai Veedu Medical College and Hospital, Pondicherry who met the criteria participated in this study. They had one 24 hours ambulatory blood pressure (ABPM) performed in various medicine wards. The predominant cause of hypertension etiology in this study was related to renal parenchymal disease.

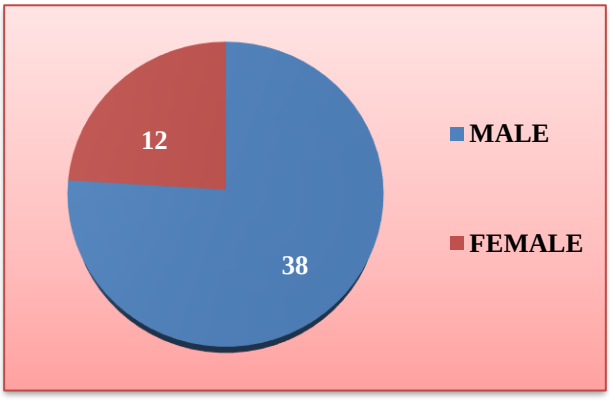

Figure 1: Sex wise distribution of cases in study.

Figure 1 shows sex wise distribution of cases who participated in this study. Among the 50 patients 38 (76%) were males and 12 (24%) were females on hemodialysis.

Table 1: Overall blood pressure recorded in 24 hours.

Blood pressure	Overall mean	Maximum (mean)	Minimum (mean)
Systolic pressure (mmHg)	134.14	161.95	107.38
Diastolic pressure (mmHg)	79.33	99.23	60.09
MAP (mmHg)	96.975	117.25	76.7
PP (mmHg)	56.25	76.3	36.2

Table 1 shows overall blood pressure recorded in 24 hours. Maximum systolic and diastolic blood pressure recorded was 161.95mmhg and 99.23mmhg respectively. Minimum systolic and diastolic pressure recorded during the study was 107.38mmhg and 60.09mmhg. Pulse pressure recorded maximum was 76.3mmHg and minimum was 36.2mmHg.

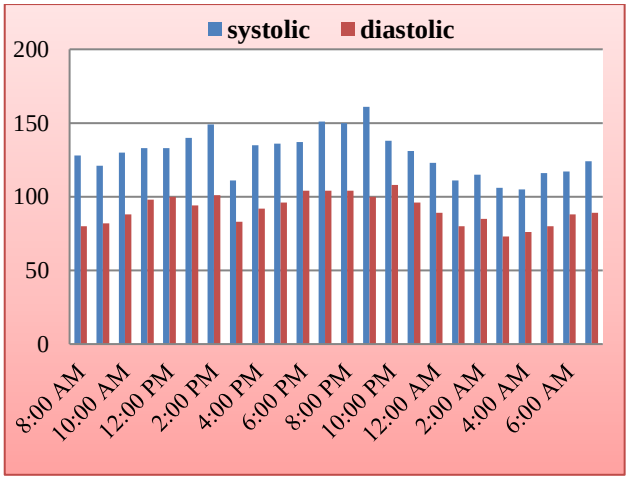

Figure 2: Mean hourly bp recording for 24 hours.

Figure 2 shows systolic and diastolic pressure variability recorded over a period of 24 hrs. The maximum systolic pressure recorded was at 9 pm and diastolic pressure at 10 pm. The minimum systolic and diastolic pressure recorded was at 3am.This figure also shows predominant fall in blood pressure during early morning hours and progressive increase in blood pressure during morning time reaching maximum during night hours.

Table 2 shows blood pressure recorded during active period (during normal physical activity and morning hours). The maximum systolic and diastolic pressure recorded was 160.952mmHg and 98.476mmHg respectively. The minimum systolic and diastolic pressure recorded was 111.35 and 62.714mmHg. Overall mean pulse pressure during active period was 55.47mmHg.

Table 2: Blood pressure during active period.

Blood pressure	Overall mean	Maximum (mean)	Minimum (mean)
Systolic pressure (mmHg)	136	160.952	111.38
Diastolic pressure (mmHg)	81	98.476	62.714
MAP (mmHg)	97.8	115.35	80.25
PP (mmHg)	55.47	74.55	36.4

Table 3: Blood pressure during passive period.

Blood pressure	Overall mean	Maximum (mean)	Minimum (mean)
Systolic pressure (mmHg)	131	145.619	116.047
Diastolic pressure (mmHg)	76.619	87.714	64.523
MAP (mmHg)	94.25	106.1	82.4
PP (mmHg)	55.35	66.55	44.15

Table 3 shows blood pressure recorded during passive period (during rest and early morning hours). Maximum systolic and diastolic pressure recorded was 145.619mmHg and 87.714mmHg respectively. Minimum systolic and diastolic pressure recorded was 116.047mmHg and 64.5mmHg. Overall mean pulse pressure during passive period was 55.35mmHg. Measured systolic and diastolic pressure was high during active period compared to passive period.

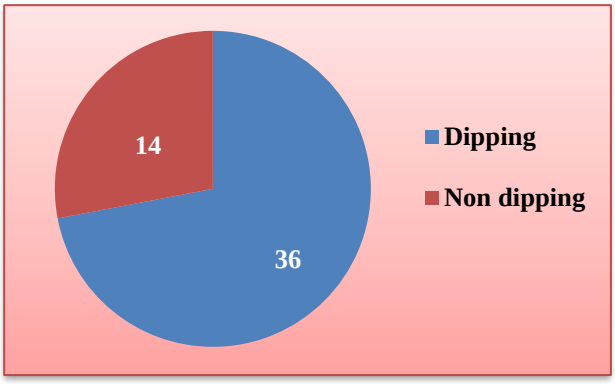

Figure 3: Variations in early morning blood pressure.

Figure 3 shows early morning dipping in blood pressure relatively more compared to non-dipping in the study groups. Out of total 50 CKD patients on hemodialysis 36 patients had early morning dipping and 14 patients had non-dipping of blood pressure.

DISCUSSION

Hypertension plays an important role in cardiovascular events in CKD patients. The major adverse outcomes related to uncontrolled blood pressure in CKD patients are progression of kidney disease and cardiovascular events, including stroke. Microalbuminuria predicts the onset of CKD and is a good predictor of future cardiovascular events in hypertensive patients.[13] Concentric left ventricular hypertrophy and Ischemic dilated cardiomyopathy are associated with declining glomerular filtration rate.[14] KDIGO guidelines on the management of BP in CKD acknowledge the role of ABPM in CKD patients, based on evidence for a better prediction of renal and cardiovascular outcomes with ABPM than with office readings.[15]

ABPM is the recognized gold standard for the assessment of hypertension and detects masked hypertension, isolated nocturnal hypertension and non-dipper pattern of BP, conditions of known cardiovascular risk.[16] In present study, justifications for ABPM were consonant with the current recommendations: to confirm early morning dipping (72%) and non-dipping (28%). In present study mean nocturnal hypertension was maximum at 9 pm. 28% percent of our patients presented a non-dipper pattern of BP, a proportion slightly lower than described in other studies. A cross-sectional study involving 10271 hypertensive patients, enrolled in the Hygeia Project, of which 3227 had CKD, showed a non-dipper prevalence of 61% in hypertensive patients with CKD vs 43% in those without CKD. Non-dipper pattern of BP may be explained by increased sympathetic nervous system activation, more common obstructive sleep apnea, sedentary lifestyle and poor sleep quality, as well as common concurrent comorbidities.[17]

Present study results support the important role of ABPM in the correct evaluation of BP control in CKD patients and a valuable guide to anti-hypertensive adjustments, with an inadequate clinical interpretation. A recent Chinese study also provided evidence of disparate assessment of clinic blood pressure and ABPM in patients with CKD (difference in systolic BP/ diastolic BP between clinic BP and ABPM was 9.8mmHg and 6.65mmHg, respectively, with a more substantial difference in older patients mostly due to higher prevalence of masked hypertension).[18]

Present study results are consistent with literature and stress the important role of ABPM in BP evaluation in CKD patients. More randomized controlled trials are necessary to determine if routine use of ABPM in CKD actually results in a better prognosis for these patients.

CONCLUSION

The introduction of ABPM has enabled a more comprehensive estimate of a patient's true BP and its adverse outcomes. Many studies support the use and superiority of ABPM over clinic BP measurements in making an accurate diagnosis of masked hypertension, assessing target organ damage, predicting outcomes, and evaluating response to therapy in CKD patients. Nocturnal BP is superior to day time BP in predicting CVD outcomes. This study shows both systolic and diastolic pressure variability over 24hrs maximum during night hours (nocturnal hypertension) and non-dipping of early morning BP. Both non-dipping status and nocturnal hypertension are associated with target organ damage and CV risk. Management of hypertension in CKD patients should focus on choosing appropriate use of antihypertensive drugs to reduce the level of nocturnal BP and restore diurnal rhythm of BP.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Victor RG. In: Systemic hypertension: Mechanism and diagnosis: Braunwald's Heart disease: A Textbook of Cardiovascular Medicine. 9th ed. 2011:935-954.

2. US Renal Data System. National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2010.
3. Hanratty R, Chonchol M, Havranek EP, Powers JD, Dickinson LM, Ho PM, et al. Relationship between blood pressure and incident chronic kidney disease in hypertensive patients. Clin J Am Soc Nephrol. 2011 Sep 15:CJN-02240311.
4. Casas JP, Chua W, Loukogeorgakis S, Vallance P, Smeeth L, Hingorani AD, et al. Effect of inhibitors of the renin-angiotensin system and other antihypertensive drugs on renal outcomes: systematic review and meta-analysis. Lancet. 2005 Dec 10;366(9502):2026-33.
5. Mancia G, Verdecchia P. Clinical value of ambulatory blood pressure: evidence and limits. Circulation Res. 2015 Mar 13;116(6):1034-45.
6. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7). Hypertension. 2003;42:1206. Available at: https://www.ncbi.nlm.nih.gov/pubmed/14656957.
7. Clark LA, Denby L, Pregibon D, Harshfield GA, Pickering TG, Blank S, et al. A quantitative analysis of the effects of activity and time of day on the diurnal variations of blood pressure. J Clin Epidemiol. 1987 Jan 1;40(7):671-81.
8. Panza JA, Epstein SE, Quyyumi AA. Circadian variation in vascular tone and its relation to α-sympathetic vasoconstrictor activity. N Eng J Med. 1991 Oct 3;325(14):986-90.
9. Somers VK, Dyken ME, Mark AL, Abboud FM. Sympathetic-nerve activity during sleep in normal subjects. N Eng J Med. 1993 Feb 4;328(5):303-7.
10. Stern N, Sowers JR, McGinty D, Beahm E, Littner M, Catania R, et al. Circadian rhythm of plasma renin activity in older normal and essential hypertensive men: relation with inactive renin, aldosterone, cortisol and REM sleep. J Hypertension. 1986 Oct;4(5):543-50.
11. Fukuda M, Munemura M, Usami T, Nakao N, Takeuchi O, Kamiya Y, et al. Nocturnal blood pressure is elevated with natriuresis and proteinuria as renal function deteriorates in nephropathy. Kidney Int. 2004 Feb 1;65(2):621-5.
12. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, Jones DW, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA. 2003 May 21;289(19):2560-72.
13. Vijayakumar N, Rajesh J, Vithiavathi S. Microalbuminuria in non-diabetic hypertensive's: J Hypertension. 2011 June ;(29):414.
14. Ramya N, Meera KR. Clinicoechocardiographic study of cardiac abnormalities in chronic kidney disease. Int J Med Sci Clin Invention. 2017;4(11): 3328-34.
15. Kidney disease improving global outcome (KDIGO) blood pressure work group. KDIGO clinical practice guideline for the management of blood pressure in chronic kidney disease. Kidney Int Suppls. 2012;2:337-414.
16. Pickering TG, Shimbo D, Haas D. Ambulatory blood-pressure monitoring. N Eng J Med. 2006 Jun 1;354(22):2368-74.
17. Pogue V, Rahman M, Lipkowitz M, Toto R, Miller E, Faulkner M, et al. African American study of kidney disease and hypertension collaborative research group. Disparate estimates of hypertension control from ambulatory and clinic blood pressure measurements in hypertensive kidney disease. Hypertension. 2009 Jan;53(1):20-7.
18. Wang C, Gong WY, Zhang J, Peng H, Tang H, Liu X, Ye ZC, Lou T. Disparate assessment of clinic blood pressure and ambulatory blood pressure in differently aged patients with chronic kidney disease. Int J Cardiol. 2015 Mar 15;183:54-62.

Cite this article as: Kumar SS, Vithiavathi S, Parameswaran P. Prognostic value of ambulatory blood pressure in chronic kidney disease. Int J Adv Med 2018;5:1337-41.