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Original Research Article

Comparative study of ambulatory blood pressure monitoring in hemodialysis and non-dialysis CKD patients and their prognostic value

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ABSTRACT

Background: Hypertension and chronic kidney disease are inextricably intertwined. Most patients with hypertension associated CKD die of heart attack and stroke before renal function. Ambulatory BP monitoring provides automated measurements of BP during a 24hrs period while patients engaged in their usual activities including sleep. Recommended normal value include an average daytime BP <135/85mmHg/night time BP <120/70mmHg and 24 hr BP <130/89mmHg. In patients with chronic kidney disease the control of hypertension slows the progression of end stage renal disease. This study was undertaken to define the prognostic role of ABPM in dialysis dependent and non-dialysis CKD patients so that better treatment strategies could be initiated to prevent adverse outcomes.
Methods: This prospective cross sectional study was conducted at Aarupadai Veedu Medical College and hospital, Puducherry in both dialysis dependent and non-dialysis CKD patients admitted in both ICU and medical wards. APBM was performed by using the properly validated ambulatory blood pressure monitor. The monitor records BP on the non-dominant arm every 20 minutes while awake and hourly while sleep for a total duration 24hrs in both hemodialysis dependent and non-hemodialysis patients. In hemodialysis dependent patients ABPM was recorded on the second day of hemodialysis.
Results: The mean maximum systolic blood pressure in dialysis dependent and non-dialysis CKD patients recorded was 146.23 and 166.12 mmHg respectively. The mean minimum systolic blood pressure in dialysis dependent and non-dialysis CKD patients recorded was 122.11 and 122.45 mmHg respectively. The mean maximum diastolic blood pressure in dialysis dependent and non-dialysis CKD patients recorded was 100.24 and 110.65mmHg respectively. The mean minimum diastolic blood pressure in dialysis dependent and non-dialysis CKD patients recorded was 78.65 and 80.67 mmHg respectively. In our study the prevalence of non-dipping in dialysis and non-dialysis CKD patients were 28% and 16% respectively.
Conclusions: Ambulatory blood pressure monitoring is considered the gold standard for the diagnosis of hypertension. Tight BP control is needed to limit the progression of renal disease and lessen cardiovascular morbidity and mortality. To achieve this goal ABPM should be widely adopted in patients with CKD.

Keywords: Ambulatory blood pressure, Chronic kidney disease, Hemodialysis, Hypertension

INTRODUCTION

Hypertension and chronic kidney disease are inextricably intertwined. Most patients with hypertension associated CKD die of heart attack and stroke before renal function.[1]

An individual BP varies widely therefore a 24hrs. period and is therefore impossible to characterize accurately except by repeated measurement under various conditions. The target BP for high risk patients such as those with CKD, heart failure, diabetes and CKD is

<130/80mmHg.[2-3] The importance of hypertension as a determinant of the progression of CKD has been recognized by official guidelines such as the Joint National Committee 7.

Ambulatory BP monitoring provides automated measurements of BP during a 24hrs period while patients engaged in their usual activities including sleep. Recommended normal value include an average daytime BP <135/85mmHg/night time BP <120/70mmHg and 24hrs BP <130/89mmHg. Prospective outcome studies in both treated and untreated patients have shown that ambulatory BP predicts fatal and nonfatal myocardial infarction and stroke better than standard office measurements.[4] Renal parenchymal disease is most common cause of secondary hypertension, responsible for 2% to 5% cases.

In patients with chronic kidney disease the control of hypertension slows the progression of end stage renal disease[5]. Patients with CKD commonly have nocturnal hypertension detectable by 24-hour ambulatory BP monitoring[6]. In patients on dialysis, hypertension is a risk factor for mortality. In patients receiving maintenance hemodialysis every 48hrs elevated BP tends to fall progressively after dialysis is completed, remain depressed during the first 24hrs and rise again during the second day due to fluid retention. BP normally dips during sleep and increases when a person awakes and become active. Nocturnal hypertension increases the aggregate hemodynamic load on cardiovascular system and predicts cardiovascular outcomes better than day time ambulatory BP or standard office BP measurements[7]. Non-dipping is common in both children and adults with CKD and an inverse relationship between GFR. The prevalence of non- dipping is more than 80%in patients on dialysis.

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.[8] Increased activation of RAS and increased sodium and water retention has been the major factor for nocturnal hypertension. Left ventricular hypertrophy develops early in the course of CKD and is thought to maintain cardiac function and reduce left ventricular wall stress during conditions of increased afterload and preload.[9] This study was undertaken to define the prognostic role of ABPM in dialysis dependent and non-dialysis CKD patients so that better treatment strategies could be initiated to prevent adverse outcomes.

METHODS

This prospective cross sectional study was conducted at Aarupadai Veedu Medical College and hospital, Pondicherry in both dialysis dependent and non-dialysis CKD patients admitted in both ICU and medical wards. The study was started after obtaining clearance certificate from the institutional human ethical committee of Aarupadai Veedu Medical College and Hospital. Patients included in the study group suffered from established CKD according to the kidney disease outcomes quality (KOQI).[10] The study period was from 1st July 2017 to 31st December 2017 of total 6 months duration. A detailed medical history was obtained from each patients and routine physical examination was done. Blood samples were collected potassium and tested for urea, creatinine, sodium, potassium. The eGFR was calculated from modification of diet in renal disease equation (MDRD).[11]

Inclusion criteria

Both hemodialysis dependent and non-dialysis chronic kidney disease patients.

Exclusion criteria

- Diabetes mellitus.
- Acute kidney injury.
- Valvular heart disease.
- Coronary artery disease.

Sample size

The sample size for non-dialysis CKD patients is 25 out of which were 14 males and 11 females. The sample size for hemodialysis dependent CKD patients is 25 out of which 15 were males and 10 were females.

Data collection

APBM was performed by using the properly validated ambulatory blood pressure monitor. The monitor records BP on the non-dominant arm every 20minutes while awake and hourly while sleep for a total duration 24hrs in both hemodialysis dependent and non-hemodialysis patients. In hemodialysis dependent patients ABPM was recorded on the second day of hemodialysis.

Casual BP was also obtained by an oscillometric device immediately before and after dialysis treatment. A minimum of 40 successful daytime readings and 8 successful night time readings were included I the analysis mean ambulatory systolic blood pressure and diastolic blood pressure during the entire 24hour period were calculated. BP load was identified when the day time SBP >135mmHg or DBP >85mmHg and night time SBP >120mmHg or DBP >70mmHg. Nocturnal dipping was defined by a nocturnal BP decrement of $\geq$10% below day time BP.

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 with chronic kidney disease out of which 25 patients on heamodialysis and 25 non dialysis patients admitted in Aarupadi Veedu Medical College and Hospital, Puducherry, who met the inclusion criteria participated in the study. Ambulatory blood pressure monitoring was done to these patients.

Table 1: Dermographic and laboratory data of hemodialysis dependent study population.

Total number of patients	25
Age (Mean±SD in years)	50.97±4.7
Sex (no)	
Male	15
Female	10
Weight (mean±SD in kg)	62.03±10.61
Height (mean±SD in cm)	176.17±5.84
Lab test	
Urea (mg/dl)	142±68.1
Creatinine (mg/dl)	6.2±3.7
Na (meg/L)	140.32±3.5
K (meg/L)	5.8±1.8

Table 1 shows laboratory value in hemodialysis CKD patients and their demographic data. The study included 25 hemodialysis dependent CKD patients. Mean age was 50±4.7 years. Their urea and creatinine value was 142±68.1 and 6.2±3.7 respectively.

Table 2: Dermographic and laboratory data of non-hemodialysis CKD study population.

Total number of patients	25
Age (Mean±SD in years)	45.87±3.7
Sex (no)	
Male	14
Female	11
Weight (mean±SD in kg)	72±10.61
Height (mean±SD in cm)	176±12.1
Lab test	
Urea (mg/dl)	80.6±12
Creatinine (mg/dl)	4.3±2.1
Na (meg/L)	140.2±5.6
K (meg/L)	4.3±2.4

Table 2 shows laboratory value in non-hemodialysis CKD patients and their demographic data. The study included 25 Non-hemodialysis dependent CKD patients. Mean age was 45.87±3.7years. Their urea and creatinine values were 80.6±12 and 4.3±2.1 respectively.

Figure 1 shows comparison of systolic blood pressure in dialysis dependent and non-dialysis CKD patients measured by ambulatory blood pressure monitoring in 24 hours. The mean maximum systolic blood pressure in non-dialysis and dialysis dependent CKD patients recorded was 146.23 and 166.12 mmHg respectively. The mean minimum systolic blood pressure in non-dialysis and dialysis dependent CKD patients recorded was 122.11 and 122.45 mmHg respectively.

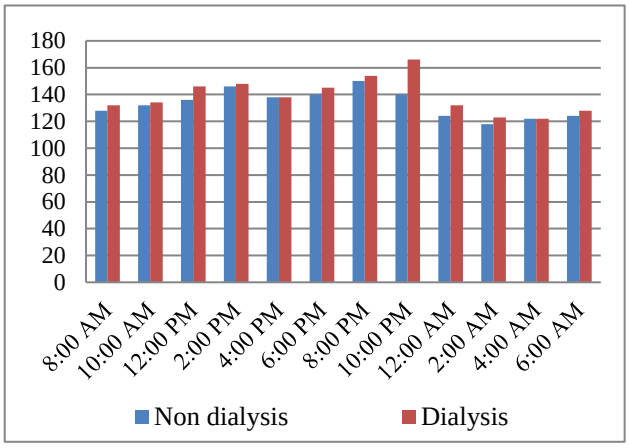

Figure 1: Comparison of systolic blood pressure in hemodialysis and non-dialysis CKD patients.

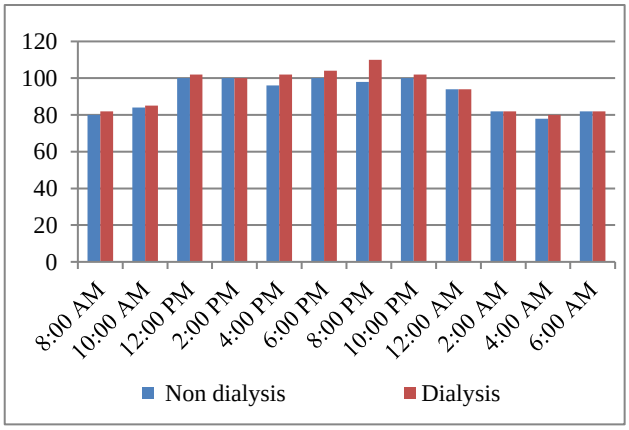

Figure 2: Comparison of diastolic blood pressure in hemodialysis and non-dialysis CKD Patients.

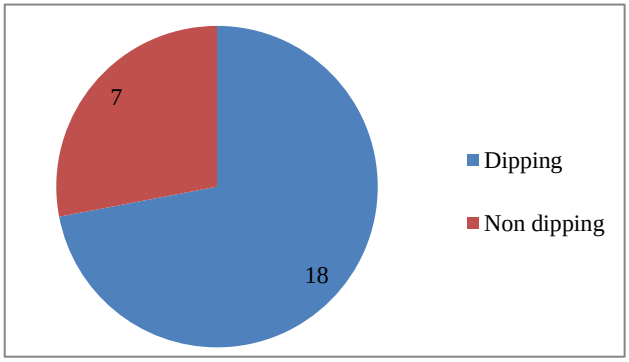

Figure 3: Early morning dipping pattern in hemodialysis CKD patients.

Figure 2 shows comparison of diastolic blood pressure in dialysis dependent and non-dialysis CKD patients

measured by ambulatory blood pressure monitoring in 24 hours. The mean maximum diastolic blood pressure in non-dialysis and dialysis dependent CKD patients recorded was 100.24 and 110.65mmHg respectively. The mean minimum diastolic blood pressure in non-dialysis and dialysis dependant CKD patients recorded was 78.65 and 80.67 mmHg respectively.

Figure 3 shows early morning variations in blood pressure in dialysis dependent CKD patients. In the study population of 25 patients on hemodialysis 18 patients had early morning dipping and remaining 7 patients had non-dipping of blood pressure.

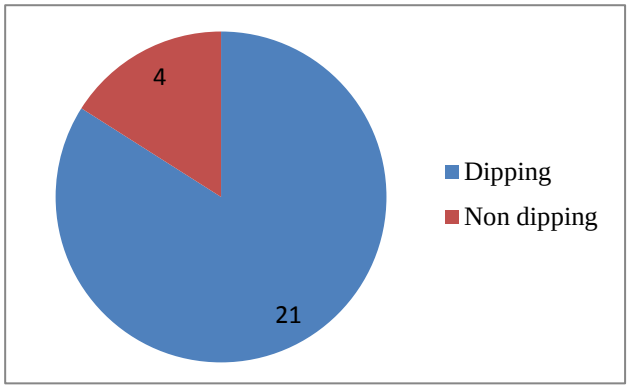

Figure 4: early morning dipping pattern in non-dialysis CKD patients.

Figure 4 shows early morning variations in blood pressure in non-dialysis CKD patients. In the study population of 25 patients 21 patients had early morning dipping and remaining 4 patients had non-dipping of blood pressure.

DISCUSSION

The introduction of 24hrs. ambulatory blood pressure monitoring (ABPM) has enabled a more comprehensive estimate of a patient's true BP and its changes. KDIGO guidelines on the management of BP is 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.[12]

In a study conducted by Anderson et al 30% of patients with CKD had clinic BP that were higher than ABPM, whereas 28% had clinic BP that underestimated ABPM.[13] Hypertension's contribution to cardiovascular morbidity and mortality has been difficult to demonstrate in dialysis patients.[14] Our ABPM report in CKD patients both on dialysis and non-dialysis also showed maximum systolic and diastolic blood pressure recorded during night hours that underestimated clinic BP readings.

Agarwal et al showed pre dialysis BP measurement tends to overestimate BP load, the relationship between post dialysis readings and BP control appears to be more variable.[15] Mitra et al showed 20 minutes post dialysis BP reading was most representative BP control in the interdialytic period compared to pre dialysis and with average 48 hr ABPM measurement.[16] In our study ABPM done on the second day of the hemodialysis patients showed systolic and diastolic blood pressure higher to that of non-dialysis CKD patients.

The poor correlation between dialysis and ABPM readings is explained in past by changes in BP that occurs in the interdialytic period which cannot be captured by measurement made in the dialysis center.[17] The practice of withholding BP medications on the day of dialysis also contribute to the poor correlation between dialysis based readings and ABPM. In general population blood pressure falls on average by 10-20% during sleep (shifting). Non dipping is common in both children and adults with CKD.

Portauppi et al showed nocturnal systolic and diastolic blood pressure increased in patients with diabetic CKD.[18] In a study by Baumgart et al showed nocturnal decline in blood pressure diminished in all patients with CKD, ESRD on dialysis or post renal transplant.[19] Our study result was similar to that of above study which showed 16%patients had non-dipping in non-dialysis group and 28% had non-dipping in hemodialysis CKD patients.

In contrast with the findings of others Van de Borne et al, showed preserved nocturnal decline in BP in select group of ESRD.[20] This study report was not consistent with our results. In ESRD patients, a statistically significant increase in high/day ratio and a statistically significant decrease in the awake-sleep difference in BP have been reported from the first to the second day after dialysis.[21,22]

Our study showed higher prevalence of elevated BP load at night time in both groups which was concordant with results by Chaudhuri et al.[23] In our study the prevalence of non-dipping in dialysis and non-dialysis CKD patients were 28% and 16% respectively. The percentage of non-dippers was higher in dialysis group which was concordant with the results conducted by Farmer et al.[24] Loss of the nocturnal decline in BP has been linked to LVH, adverse cardiovascular outcomes and all cause mortality in patients with ESRD. Present study results were consistent with literature and stress the importance of ABPM in CKD patients.

CONCLUSION

Clinic BP frequently under or overestimate the true BP in CKD patients and dialysis center BP measurements. Ambulatory blood pressure monitoring is considered the gold standard for the diagnosis of hypertension. ABPM is a promising tool in clinical trials in ESRD with hypertension including antihypertensive trails and there are many future clinical research needs and opportunities. This study shows nocturnal hypertension in both non-

dialysis and dialysis dependent CKD patients and non-dipping comparatively more in dialysis group.

Both non-dipping and nocturnal hypertension is associated with target organ damage and cardiovascular risk. Changing the timing of administration of antihypertensive drugs prevents the nocturnal hypertension and non-dipping pattern. Tight BP control is needed to limit the progression of renal disease and lessen cardiovascular morbidity and mortality. To achieve this goal ABPM should be widely adopted in patients with CKD.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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