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Original Research Article.

Study of Blood Pressure Variability and Nocturnal Dipping in Primary Hypertensive Patients by Ambulatory BP Monitoring

Girish C. Rajadhyaksha[1], Vijay R. Mundada[2*]

[1]Professor, Department of Medicine, TNMC & BYL Nair Charitable Hospital, Mumbai, Maharashtra, India.
[2]Senior Resident, Department of Medicine, TNMC & BYL Nair Charitable Hospital, Mumbai, Maharashtra, India.

ABSTRACT

Introduction: Assessment of fluctuation of blood pressure in a time range from minutes to hours is possible through the use of intermittent, noninvasive 24 h ambulatory blood pressure monitoring (ABPM).This study was conducted with the Aims and Objectives of determining BP variability and nocturnal dipping in primary hypertensive patients.

Materials and Methods: The present observational study was conducted at a tertiary care hospital after getting approval from Ethics Committee with 80 patients between August 2016 to October 2017. Schiller BR-102 plus 24 hour ambulatory Blood Pressure Recorder was the equipment used for our study. Statistical analysis of data derived from patients was done.

Results: Out of 80 patients studied, 53 patients had one or more of Target Organ Damage and there was no evidence of Target Organ Damage in 27 patients. In the present study, no significant difference has been found in nocturnal dipping and blood pressure variability in patients with and without target organ damage.

Keywords: Ambulatory Blood Pressure Monitoring, BP Variability, Nocturnal Dipping.

***Correspondence to:**

Dr. Vijay R. Mundada,
Senior Resident,
Department of Medicine,
TNMC & BYL Nair Charitable Hospital, Mumbai, Maharashtra, India.

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INTRODUCTION

Hypertension (HTN) exerts a substantial public health burden on cardiovascular health status and healthcare systems in India.[1] Blood pressure follows a highly reproducible pattern characterized by:

(1) a low period during sleep;

(2) an early morning, postawakening rise, coinciding with the transition from sleep to wakefulness; and

(3) a higher, sustained and more variable period thereafter.

The circadian variation in BP and its association with cardiovascular events are well-established.

The dip is defined as the difference between the mean systolic pressure in the day and mean systolic pressure during the night, expressed as a percentage of the day time mean, with the accepted normal between 10% and 20%.Dips less than 10% are described as absent or blunted and those in excess of 20% are known as exaggerated or extreme.[2,3]

Blood pressure is not a constant variable; rather, it shows marked spontaneous oscillations over short-term (minutes to days) and long-term (month) periods.

TYPES OF BLOOD PRESSURE VARIABILITY

Ultra-short-Term Blood Pressure Variability

Blood pressure shows rapid beat-to-beat oscillation due to the interplay of different cardiovascular control systems, including the baroreceptor reflex, the renin-angiotensin system (RAS), the vascular myogenic response, and the release of nitric oxide (NO) from the endothelium. It is measured by direct continuous intra-arterial recordings coupled to spectral analysis.[4]

Short-Term Blood Pressure Variability

Short-term blood pressure variability is usually defined as the oscillation of blood pressure within 24 hours. Fluctuation of blood pressure in a time range from minutes to hours mainly reflects the influence of central and autonomic modulation and the elastic properties of arteries. Its assessment is possible through the use of intermittent, noninvasive 24 h ambulatory blood pressure monitoring (ABPM).[4]

The key index of short-term BPV is standard deviation (SD) of the 24-hr average BP values.[5]

Long-Term Blood Pressure Variability

Blood pressure also shows long-term variability (day-to- day, visit-to-visit, or seasonal) that has been associated with increased risk of cardiovascular disease. It has been suggested that behavioral changes play a central role in day-to-day variation.[4] More recently, increased arterial stiffness has been found to contribute in long-term BPV as a pathological mechanism. Patient compliance with the prescribed therapeutic regimen and correct dosing and titration of blood pressure lowering medication can influence day-to-day and visit-to-visit BPV. Measurement of day-to-day BPV can be performed using ABPM over consecutive days or by Home Blood Pressure Measurement (HBPM). Increased short-term and long-term BPV are associated with the development, progression, and severity of cardiac, vascular, and renal damage and with an increased risk of cardiovascular events and mortality.

In the present study, we describe our findings of nocturnal dipping and blood pressure variability by ambulatory BP monitoring.

AIMS AND OBJECTIVES

To study BP variability and nocturnal dipping in primary hypertensive patients.

MATERIALS AND METHODS

The present observational study was conducted at a tertiary care hospital after getting approval from Ethics Committee with 80 patients between August 2016 to October 2017. Schiller BR-102 plus 24 hour ambulatory Blood Pressure Recorder was the equipment used for our study.

Inclusion Criteria: Patients of Primary Hypertension of age more than 18yrs willing to give written informed consent.

Exclusion Criteria: Patients with Diabetes Mellitus and those with Secondary Hypertension

Patients were considered as having Target Organ Damage if there was presence of one or more of the following:

Chronic kidney disease, Proteinuria, Hypertensive Heart Disease, Ischaemic Heart Disease, Retinopathy or Stroke.

Statistical Methods

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance.

Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients.

Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters.

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis. Fisher Exact test used when cell samples are very small.

Significant figures:

* Moderately significant (P value: $0.01<P \leq 0.05$)

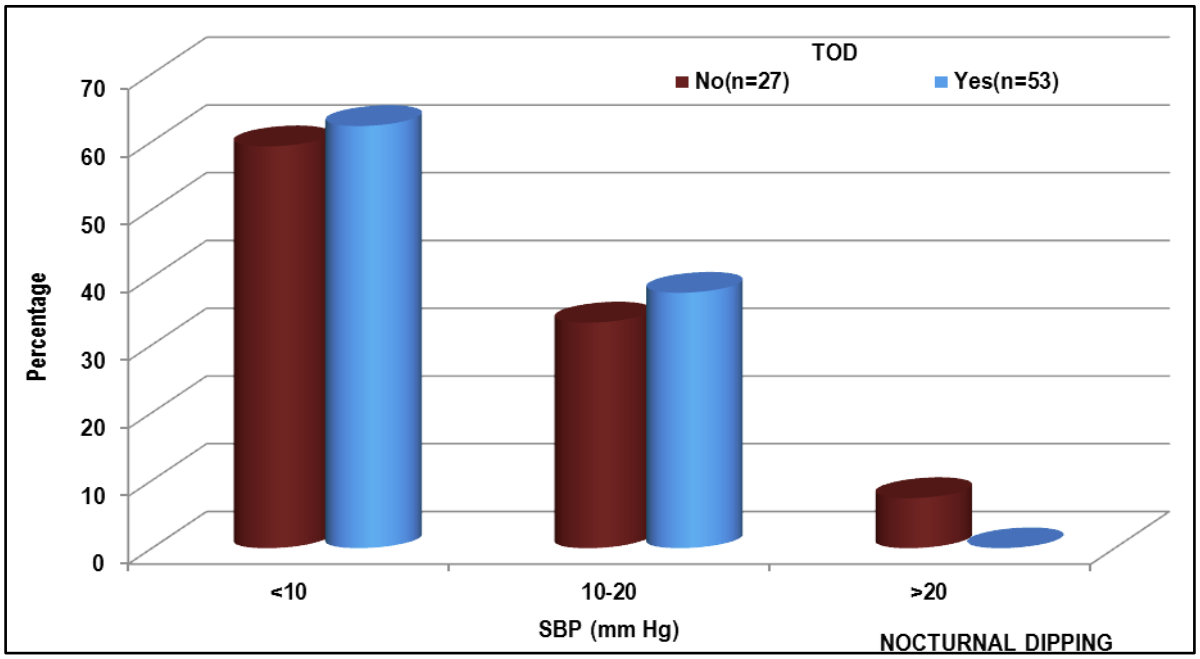
** Strongly significant (P value: $P \leq 0.01$)

Table 1: Nocturnal dipping distribution of patients studied

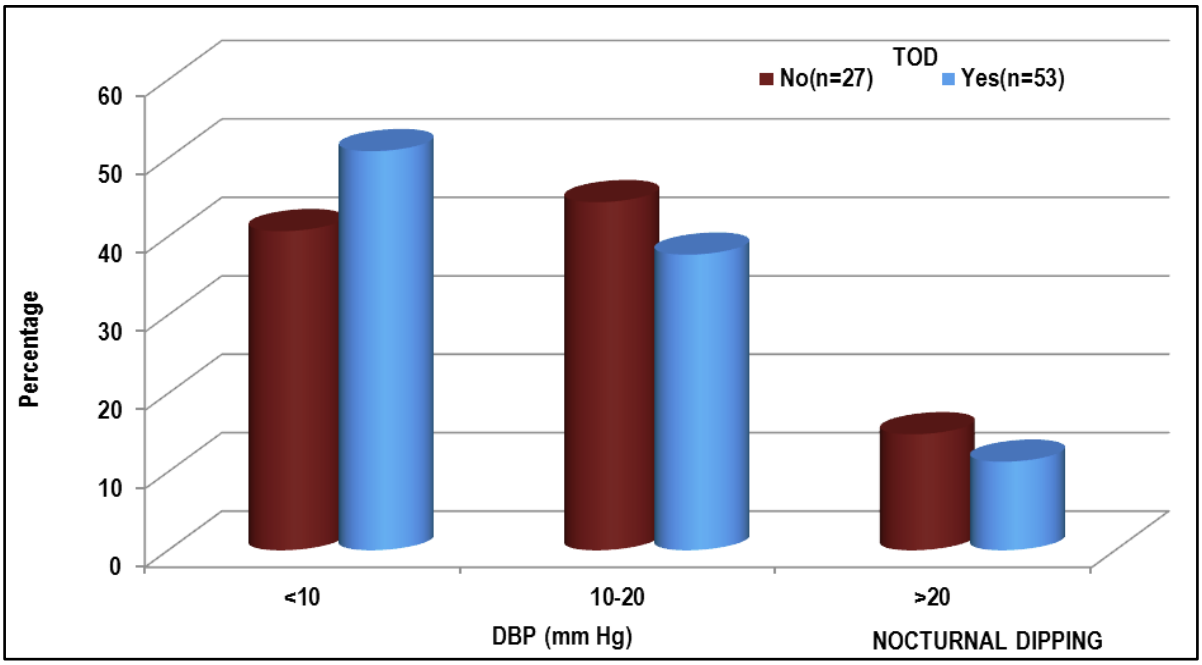
Nocturnal dipping	No. of patients (n=80)	%
SBP (mm Hg)		
<10 (Non-Dippers)	49	61.3
10-20 (Normal Dippers)	29	36.3
>20 (Extreme-Dippers)	2	2.5
DBP (mm Hg)		
<10 (Non-Dippers)	38	47.5
10-20 (Dippers)	32	40.0
>20 (Extreme-Dippers)	10	12.5

Table 2: Correlation of TOD with Nocturnal Dipping of patients studied

Nocturnal Dipping (ND)	TOD		Total (n=80)	P value
	Absence (n=27)	Presence (n=53)		
SBP (mm Hg)				
<10	16(59.3%)	33(62.3%)	49(61.3%)	0.186
10-20	9(33.3%)	20(37.7%)	29(36.3%)	
>20	2(7.4%)	0(0%)	2(2.5%)	
DBP (mm Hg)				
<10	11(40.7%)	27(50.9%)	38(47.5%)	0.681
10-20	12(44.4%)	20(37.7%)	32(40%)	
>20	4(14.8%)	6(11.3%)	10(12.5%)	



Graph 1: Correlation of Target Organ Damage with Nocturnal Dipping in Systolic Blood Pressure (SBP)



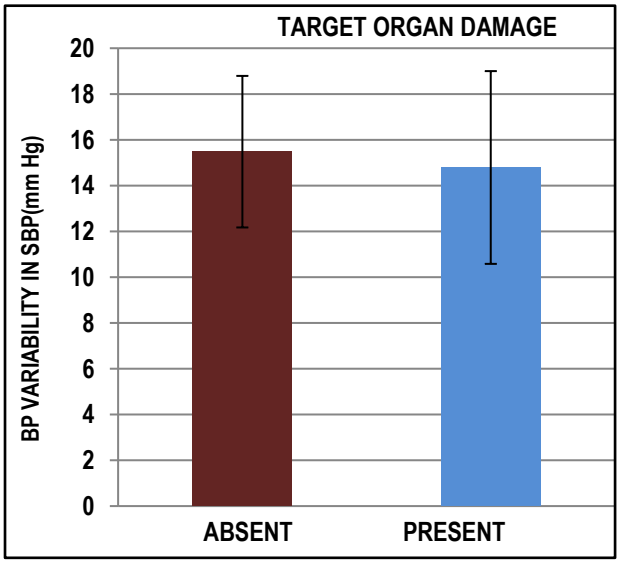
Graph 2: Correlation of Target Organ Damage with Nocturnal Dipping in Diastolic Blood Pressure

Table 3: BPV in terms of Standard Deviation and presence or absence of target organ damage.

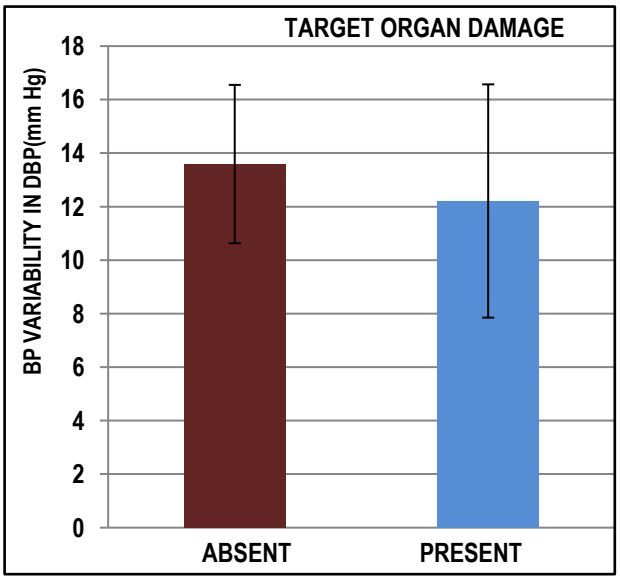
BP Variability in terms of Standard Deviation(SD)	TOD		Total	P value
	Absence	Presence		
SBP (mm Hg)	15.48±3.31	14.79±4.21	15.03±3.92	0.461
DBP (mm Hg)	13.59±2.96	12.21±4.36	12.68±3.98	0.142
MAP (mm Hg)	14.59±3.31	12.85±4.19	13.44±3.98	0.064

RESULTS

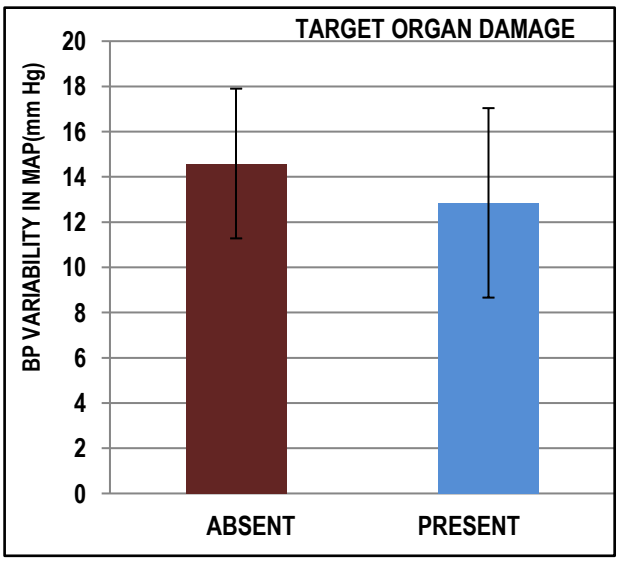
In our study, 80 patients with age ranging from 18 yrs to 80 yrs were included with mean age of 46.66 yrs and SD 14.54 yrs. Out of the 80 subjects, 54 were males and 26 were females. It was found that out of 80 patients studied, 53 patients had one or more of Target Organ Damage and there was no evidence of Target Organ Damage in 27 patients. Table 2 and graphs 1 & 2 shows that there was no significant difference (P value for SBP ND = 0.186 and P value for DBP ND = 0.681) in incidence of TOD in patients with normal nocturnal dipping than those with abnormal nocturnal dipping.



Graph 3: BP Variability In SBP (mm Hg)



Graph 4: BP Variability In DBP (mm Hg)



Graph 5: BP Variability In MAP (mm Hg)

Blood Pressure Variability (BPV)

Table 3 depicts correlation between BPV (in 24 hrs) in terms of Standard Deviation (SD) and presence or absence of target organ damage.

Table 3 and graphs 3,4,5 shows that there was no significant association between BP Variability (in 24 hrs) and incidence of TOD in patients.

DISCUSSION

The WHO rates HTN as one of the most important causes of premature death worldwide. Hypertension is the attributable cause for 57% of stroke and 24% of coronary heart disease deaths in India. Ambulatory measurement is the only commonly used practical method to determine the absence of nocturnal blood pressure dipping and blood pressure variability.

In the present study, no significant difference has been found in nocturnal dipping in patients with and without target organ damage.

However, findings of our studies are discordant with following studies:

Faye S Routledge et al[6] in a study entitled 'Night-time blood pressure patterns and target organ damage: A review' found that non-dippers with hypertension have more advanced left ventricular hypertrophy, left ventricular mass and left ventricular mass index, stroke and microalbuminuria.

Yamamoto Y et al[7] in a study entitled 'Adverse Effect of Nighttime Blood Pressure on the Outcome of Lacunar Infarct Patients' studied 105 patients and concluded that a high average ambulatory BP, especially nighttime BP, and a reduced nocturnal BP dip may have an adverse effect on the development of silent ischemic lesions and symptomatic stroke attack in patients with lacunar infarcts.

In the study 'Ambulatory blood pressure monitoring: an essential tool for blood pressure assessment in uraemic patients' by Adrian Covic and David Goldsmith , the investigators found a significantly higher rate of cardiovascular complications in 'non- dippers' compared with 'dippers'.[8]

In the present study, no significant difference has been found in blood pressure variability in patients with and without target organ damage. However, most studies show that increased BP variability increases incidence of TOD.

Jiwon Ryu , Ran-hui Cha et al[9] in a study 'The Clinical Association of the Blood Pressure Variability with the Target Organ Damage in Hypertensive Patients with Chronic Kidney Disease' with 1173 subjects, 63% of which were males demonstrated that BPV has a positive relationship with LVH , but there was no relation found between BPV and kidney injury. Our study too had no relationship between BPV and kidney injury.

LIMITATIONS

Several limitations in a no. of available studies may have prevented from determining the actual prognostic relevance of nocturnal dipping and short-term BPV within 24 hrs which are as follows:

1. Methodological differences in setting the frequency of the discontinuous measurement.
2. Methodological differences in the definition of daytime and night-time stop periods. While in some studies, definition of day and night time sub periods have been based on the information

from individual patients; other studies have considered wide fixed criteria by considering day from 6 am to 10 pm & night from 10 pm to 6 am OR narrow fixed criteria by excluding a few hours in the evening and in the early morning to skip periods of transition between wakefulness and sleep which may vary between individuals and may thus be inconsistent in a population.

3. Methodological differences in estimating BPV, making use of different indices i.e. Standard Deviation, Coefficient of Variation, Average Real Variability, Residual BP, etc.

4. Differences in the characteristics of study population among different studies (Age, Gender, Ethnicity, BP levels, presence or absence of antihypertensive treatment, etc.)

5. This study has been conducted with 80 patients while previous studies have included more number of patients.

CONCLUSIONS

In the present study, no significant difference has been found in nocturnal dipping and blood pressure variability in patients with and without target organ damage.

Future work should focus on the clinical implications of assessment of variability and dipping in blood pressure and avoid the common confounding pitfalls observed to date.

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