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Ambulatory blood pressure monitoring and its utility in management of hypertensive patients in tertiary care centre

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Introduction

Cardiovascular disease remains a leading cause of death globally, and hypertension is a major risk factor for cardiovascular mortality and morbidity. According to NFHS-5, 24% of men and 21.3% of women aged 15-54years in India are hypertensive[1], increasing from the previous prevalence of 13.6% and 8.8% respectively (NFHS-4)[2]. Despite the increasing prevalence, significant proportion of individuals remain either undiagnosed or untreated or undertreated[3]. The first step towards reducing the burden of hypertension is accurate BP measurement.

In clinical practice, the definition of controlled BP is often based on office BP measurements. However recent studies have shown that office BP may not reflect the true BP levels of an individual. This is because the single reading of office BP fails to detect the variations in BP throughout the day and night. This drawback is overcome by Ambulatory Blood Pressure Monitoring (ABPM). Many studies show that ABPM has a better potential in detecting abnormal BP[4,5,6].

ABPM provides a superior insight into variations such as nocturnal dipping, diurnal variations. It can also detect abnormal BP at night and early mornings which are directly linked to adverse cardiovascular outcomes[7]. Certain challenges associated with office BP such as white coat hypertension and masked hypertension can be easily diagnosed using ABPM.

Thus, this study set out to determine the proportion of controlled and uncontrolled hypertensives using both office BP and ABPM and comparing their efficacy.

Aims and objective:

To determine the efficacy of ABPM over office BP in diagnosing hypertension.

To determine the utility of ABPM in deciding the management of hypertension.

Materials and methodology:

This is a cross -sectional descriptive study involving 200 patients who were hypertensives.

The study was carried out in Dr MK Shah Medical college for the duration of 4 months from November 2025 to February 2026.

The key demographic parameters such as age, sex, BMI, ASCVD status and drug history were noted and evaluated. Based on AHA 2025, a target of <=130/80mmHg was set as controlled BP[8].

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Office BP was measured using a manual sphygmomanometer. Sound heard at Korotkoff phase 1 was taken as systolic BP (SBP) and sound heard at Korotkoff phase 5 was taken a diastolic BP(DBP). Patients were measured in the sitting position in the right arm, kept at the level of the heart, after 15mins of complete rest. 3 readings, 5 min apart were taken and the average was taken as the final value. The patients were then consulted and counselled according to their bp readings and were put on ABPM for 24 hours.

ABPM:

ABPM was performed using the WatchBP O3 software.

Cuff was fixed on the nondominant arm and readings were taken every 30 mins during the day and every 60 mins during the night. Duration of day and night was defined as per the patients self-reported data of going to bed and waking up. Patients were instructed to continue with their usual routine activities and keep the arm immobile during a BP measurement (when the cuff gets inflated).

Interpretation of the ABPM was done in accordance with the British HTN society[9].

Exclusion criteria:

Normotensive patients

Uncontrolled hypertension

Hypertensive patients not on medical management

Patients of hypertension less than 18 yrs of age

RESULTS

Table 1: Shows the average with SEM, the minimum values and maximum values of the various parameters studied

Parameters	Mean with SEM	MIN	MAX
Male	117		
Female	83		
Age	50.03±1.25	20	83
BMI	27.9 ± 0.31	18.8	35.02
Office SBP	137.98 ±19.01	100	194
Office DBP	83.81± 10.8	60	112
24hr SBP	135.85± 1.11	110	186
24hr DBP	82.85±0.81	61	108
SBP awake	135.29± 1.61	111	199
DBP awake	83.6± 0.87	60	133
SBP asleep	122.6 ± 1.27	98	182
DBP asleep	73.8 ± 0.87	54	113
Heart rate (24hr)	75.35 ± 0.98	48	105
SBP load awake	36.7± 2.78	0	100
DBP load awake	30.5± 3.26	0	100
Systolic dip	86.3± 0.74	-10	35.7
Diastolic dip	9.2 ± 0.80	-8	36.8

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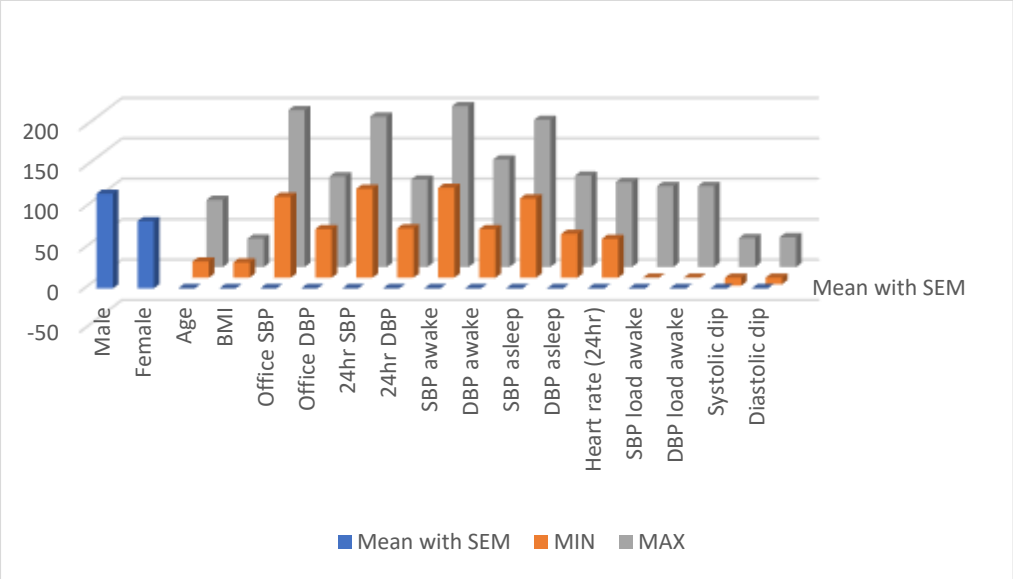

Table 2: Demonstrates the number of individuals with controlled and uncontrolled BP using the OBPM

Parameter	Number	Percentage
Office BP good control	81	40.5
Office BP not controlled	119	59.5
Total	200	100

Table 3: Demonstrates the number of patients out of the total 200, having the normal ABPM values of the various parameters. It also tells us about the statistical significance of these numbers against OPBM

Parameters	Number	percentage	P value
Normal Awake ABPM	64	32	**<0.0001**
Normal Asleep ABPM	49	24.5	**<0.0000**
Normal Total ABPM	50	25	**0.0000**
Normal Awake BP load	63	31.5	**0.000**
Normal Asleep BP load	54	27	0.70
Normal Systolic dip	26	13	**0.0001**
Normal Diastolic dip	44	22	0.9
Reverse dip	40	20	0.17
All ABPM parameters satisfied	16	8	**0.0007**

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We then estimated the number of patients out of the group of patients who had a controlled OBPM(n=81) having the normal ABPM values of the various parameters and its statistical significance. This is shown in table 4:

Parameters	number	percentage
Normal Awake ABPM	43	53.08
Normal Asleep ABPM	31	38.27
Normal Total ABPM	39	48.14
Normal Awake BP load	42	51.85
Normal Asleep BP load	40	49.38
Normal Systolic dip	21	25.9
Normal Diastolic dip	18	22.22
Reverse dip	8	9.8
All ABPM parameters satisfied	9	11.1

Table 5: Demonstrates the number of individuals falling into the various dipping patterns

Dipping percentage	Systolic dip(n)	Diastolic dip(n)
Reverse dippers (<0%)	30	19
Non dippers (0-10%)	135	106
Normal dippers (10-20%)	29	47
Extreme dippers (>20%)	6	28

DISCUSSION

This study was done to analyze the utility of ABPM over office BP in the diagnosis and further management of hypertension. In our study, out of 200 patients, 117(58.5%) were male and 83(41.5%) were females. The mean age was 50.03 years and the average BMI fell in the overweight category (27.9). These demographic parameters are similar to a few previous studies[10,11]. This may infer that demographics of hypertensives are fairly stable with a male preponderance and majority of the patient being in middle age and towards the higher side of the BMI scale.

In our study it was found that out of 200 individuals, more than half of the proportion had an uncontrolled office BP, (59.5%), in spite of being on various anti hypertension drugs, hitherto calling for a more detailed information about their BP variability throughout the day.

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White coat hypertension is a condition in which the BP reading is higher in the doctor's office but normal when measured in at home. Contrastingly, masked hypertension is a condition where a patient has a normal BP in the clinical settings but shows higher readings at home. Our study revealed 37 individuals as masked hypertension and 11 individuals were having white coat hypertension. This was in agreement with a study done by J Mohammed et al[12], highlighting the importance of ability to diagnose both these conditions, as a misdiagnosis can lead to improper treatment. A person with white coat hypertension may be falsely started on anti-hypertension drugs or a person with masked hypertension may not at all receive any treatment if not diagnosed. Thus, this can be prevented by including ABPM in the management of hypertension[13].

Ambulatory BP showed a wide spectrum of domains not recorded by the office BP measurement, which further emphasizes that a good BP control goes beyond the mere systolic and diastolic values. For example, on determining the percentage of individuals having a normal value of the various ABPM parameters, it was found that only 32% of 200 patients had a normal day time ABPM reading(<=135/85mmHg). The number of patients who had a normal night time ABPM(<=120/70mmHg), 24-hour ABPM(<=130/80mmHg) were just 49 and 50 respectively.

BP load is the percentage of 24-hour ABPM readings that exceed the normal limits. It measures cardiovascular strain, with a higher percentage indicating increased risk of organ damage[14.15]. Values less than 15-20% are considered as a normal BP load. In our study only 31.5% and 27% of the total sample size were found to have a normal day time and night time BP load respectively. These findings underscore the proportion of individuals in whom hypertension related cardiovascular adverse effects might be missed due to single office BP measurements.

Blood pressure dipping is a normal physiological 10-20% drop in BP that happens in sleep compared to day time. An individual is called non dipper if the dip is less than 10% and a reverse dipper if its less than 0%, both of which again increases the risk of cardiovascular events such as myocardial ischemia or stroke[16]. Our study showed that 20% individuals were reverse dippers.

Further when all the ABPM parameters were applied together, only 8% of the individuals satisfied all the criteria for a controlled hypertension with minimal cardiovascular strain, against a drastic contrast to the 40.5% when measured via office BP.

Lastly, we then compared the ABPM parameters in the group of individuals who showed a controlled office BP (n=81), 24-hour ABPM could detect 51.8% of these individuals to actually have a high BP. Around 50% of them were found to have a high BP load. This highlights the missed cardiovascular strain due to single reading method. Also, when all the parameters of the ABPM were applied, the percentage of individuals who were able to satisfy all the domains, plummeted to only 11.5%. Similar results were found in the study

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done by Ajayi OE et al[17]. This shows the higher efficacy and sensitivity of ABPM in diagnosing hypertension.

CONCLUSION

To conclude, with the help of ABPM we were able to detect more elaborated details of BP patterns of the patients and hitherto identify those who were at risk of CVD events or any target organ damage. This information was thus helpful in selecting the right class and the dose of antihypertension medication, tailored specifically to each patient as per their BP variability patterns. Thus, ABPM proves to have an important role in the management of hypertension and should be considered to be added in the routine diagnostic algorithm of hypertension.

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