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# Use of ambulatory blood pressure monitoring in hypertensive patient to monitor blood pressure control

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ABSTRACT

**Aim:** To use ambulatory blood pressure monitoring in hypertensive patient for better control of their blood pressure.
**Protocol:** This was a single centre, observational study that included hypertensive patients who visited the out-patient department of tertiary care hospital Nepal. The study was carried out from June, 2021 to June, 2023. All the patients were assessed through ambulatory blood pressure monitoring machine for 24 hours.
**Results:** Total 259 patient were studied with ambulatory 24 hours blood pressure monitoring. Average age was 44.82±13.67 years. 30 to 50 age group was the maximum user of ABPM (41%) 20 patient in this study were ≥65 years of age. 58 % patients were males and 42% were female. All the patient undergoing ABPM were hypertensive. Mean of 24 hours systolic BP was 129.69 ± 12.86 mmHg and diastolic BP was 81.91±9.2 mmHg, awake systolic BP was 134.5 ± 12.5 mmHg and diastolic BP was 86.32±9.44 mmHg, asleep systolic BP was 121± 15.1 mmHg and diastolic BP was 74.46±10.38 mmHg. Only 28 (10.8%) patient of 259 had normal mean daytime blood pressure while 21 patient 8.1% had elevated BP and 210 patient 81.1% had hypertension as per AHA/ACC 2017 classification. Of total hypertensive 210 patient 84% had grade 2 hypertension and 16% had grade 1 hypertension requiring intensification of medication to control blood pressure in majority of the patient.
**Conclusion:** Most of the patient treated with hypertension had inadequate control as seen on ambulatory blood pressure monitoring. ABPM should be utilized in every hypertensive patient to monitor the adequate control of BP.



## 1. Introduction

The most common cardiovascular risk globally is high blood pressure leading to 13% attributable deaths and disability.[1] In Asian population hypertension has higher mortality and morbidity in relation to stroke than to ischemic heart disease with steeper correlation slope between BP and cardiovascular event that in Western populations.[2,3] Indeed, a growing body of evidence suggests that the morning surge in blood pressure is more strongly linked to cardiovascular outcomes in Asian populations compared to Western populations. Additionally, in Asian populations, nocturnal blood pressure has been identified as a more significant factor due to factors such as higher salt intake, salt sensitivity, and/or elevated central blood pressure.[4] In Nepal, the prevalence of high blood pressure and pre-hypertension is reported to be 27% and 35.4%, respectively. It is worth noting that the prevalence of high blood pressure is higher in males compared to females. Furthermore, the prevalence of high blood pressure was significantly higher in individuals aged 40 years and above when compared to younger adults below the age of 40.[5]

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Hypertension (HTN) often presents without noticeable symptoms, making the diagnosis primarily reliant on blood pressure (BP) measurements. While clinic measurement is considered less ideal, it remains a crucial method for diagnosing HTN, especially in developing countries like Nepal. However, for more accurate diagnosis and treatment of HTN, home BP measurement is recommended. Unfortunately, this practice may prove challenging in societies with low literacy rates. An encouraging development in the field is the adoption of Ambulatory Blood Pressure Monitoring (ABPM) as a valuable tool for diagnosing and managing hypertension. Even in Nepal, ABPM has recently been introduced into clinical practice, allowing for more comprehensive monitoring and improved management of hypertension cases.[6]

Ambulatory blood pressure monitoring serves a crucial role in various aspects related to hypertension diagnosis and management. It is employed for diagnosing hypertension itself, as well as detecting conditions like white coat hypertension, masked hypertension, and nocturnal hypertension. Furthermore, this monitoring method is valuable for evaluating the effectiveness of therapeutic interventions in patients with hypertension.[7] In Asia, Ambulatory Blood Pressure Monitoring (ABPM) is mainly utilized for diagnosing white-coat hypertension or masked hypertension. It is also proven invaluable in accurately measuring blood pressure in cases where BP readings fall within the borderline or fluctuate, and when there are discrepancies between clinic and home blood pressure measurements.[8]

At present, Ambulatory Blood Pressure Monitoring (ABPM) is mainly utilized for diagnosing hypertension. While ABPM is readily available in referral centers and the cost is generally considered reasonable across most Asian countries/regions, patient-related factors present the most common barriers to its implementation. Discomfort, sleep deprivation, and issues related to perception or acceptance are frequent hindrances that can affect the willingness of patients to undergo ABPM.[8]

According to a study published in The Lancet, Ambulatory Blood Pressure Monitoring (ABPM) has been identified as the most cost-effective strategy for diagnosing hypertension, particularly when considering the exclusion of white-coat hypertension cases from treatment. This finding suggests that ABPM is a valuable and efficient method for accurately diagnosing hypertension while avoiding unnecessary treatment for individuals with white-coat hypertension, thereby optimizing healthcare resources and patient care.[9]

This study is conducted to evaluate the usefulness of ABPM in monitoring the adequacy of anti-hypertensive treatment in a group of Nepalese patients.

## 2. Materials and Methods

It is a single-center, observational conducted at a tertiary care hospital in Nepal. The study's time-frame spanned from June 2021 to July 2023. Participants comprised hypertensive patients aged 18 to 80, attending the hospital's outpatient department for ambulatory blood pressure monitoring. To ensure relevance, exclusion criteria involved the presence of acute myocardial infarction or any life-threatening condition, as well as patient refusal of informed consent. During the study, participants underwent 24-hour ambulatory blood pressure monitoring using the SCHILLER BR-102 plus device. This monitoring included periodic assessments of systolic and diastolic blood pressure both during daytime activities and throughout nocturnal rest, with hourly measurements facilitated by appropriate arm cuffs. Each participant yielded an average of 40 measurements, resulting in a 24-hour recording mean. Classification of patients into normal, elevated, or hypertensive categories relied on mean daytime systolic and diastolic blood pressure values as per 2017 ACC/AHA guidelines. Furthermore, the phenomenon of nocturnal dipping was examined. This was achieved through automated calculations comparing asleep and awake systolic and diastolic pressure measurements. Data representation involved expressing continuous data as mean values along with their corresponding standard deviations. The analytical phase employed the Statistical Package for Social Sciences (SPSS; Chicago, IL, USA) program, version 15, to scrutinize all gathered data.

## 3. Results

Total 259 patient were studied with ambulatory 24 hours blood pressure monitoring. Average age was 44.82±13.67 years. 30 to 50 age group was the maximum user of ABPM (41%) 20 patient in this study were ≥65 years of age. 58 % patients were males and 42% were female. All the patient undergoing ABPM were hypertensive. Mean of 24 hours systolic BP was 129.69 ± 12.86 mmHg and diastolic BP was 81.91±9.2 mmHg, awake systolic BP was 134.5 ± 12.5 mmHg and diastolic BP was 86.32±9.44 mmHg, asleep systolic BP was 121± 15.1 mmHg and diastolic BP was 74.46±10.38 mmHg. Nocturnal systolic BP dipping was 9.6±8 % and diastolic BP dipping was 13.57±9.67 %. Dipping was absent in 22% of patient, 44.8% had normal dipping, whereas 22.4% had extreme dipping of more than 20%, while 10.8% of patient had negative dipping of nocturnal BP. There was no difference in dipping pattern in hypertensive patient with normal and elevated BP. Mean Heart rate was 76±8 per minute. Maximum systolic blood pressure was 157.94±18.46mmHg. 50% of the patient recorded maximum BP from 8 to 14 hours time. Minimum systolic BP was 100.26±15.11 mmHg. Blood pressure was lowest from 1 am to 7 am present in 49% the

study population. Only 8 patient with daytime normal BP had nocturnal high BP.

Only 28 (10.8%) patient of 259 had normal mean daytime blood pressure while 21 patient 8.1% had elevated BP and 210 patient 81.1% had hypertension as per AHA/ACC 2017 classification. Of total hypertensive 210 patient 84% had grade 2 hypertension and 16% had grade 1 hypertension requiring intensification of medication to control blood pressure in majority of the patient.

## 4. Discussion and Literature Review

In November 2017, the American College of Cardiology (ACC) and the American Heart Association (AHA) updated their definition of hypertension. They now consider a persistent average systolic blood pressure (SBP) of 130 mm Hg or higher, or diastolic blood pressure (DBP) of 80 mm Hg or higher, as indicative of hypertension. This change also applies to the threshold for initiating drug treatment, which is now recommended for adults with a 10-year risk of atherosclerotic cardiovascular disease (ASCVD) of 10% or more, if their SBP is 130 mm Hg or higher or DBP is 80 mm Hg or higher. Furthermore, the target for treatment aims to lower blood pressure to below 130/80 mm Hg, except for individuals aged 65 and older, for whom the SBP goal is set at less than 130 mm Hg.[10]

Conversely, the 2018 guidelines from the European Society of Cardiology (ESC) and European Society of Hypertension (ESH) define hypertension as having a systolic blood pressure (SBP) equal to or exceeding 140/90 mm Hg. However, they suggest treatment for patients with slightly elevated blood pressure, ranging from 130-139 mm Hg for SBP and/or 85-89 mm Hg for diastolic blood pressure (DBP), if they face a very high cardiovascular risk. The treatment goal for those under 65 remains consistent, aiming for blood pressure readings of 130/80 mm Hg or lower. Meanwhile, for individuals aged 65 and above, the recommended SBP target falls within the 130-139 mm Hg range.

In summary, the ACC/AHA guidelines set lower thresholds for defining and treating hypertension, with a more aggressive treatment goal across age groups. The ESC/ESH guidelines have higher thresholds for hypertension diagnosis but recommend treatment for those with elevated blood pressure and high cardiovascular risk, with differentiated treatment goals based on age.

Despite the 2017 ACC/AHA blood pressure (BP) guideline's suggestion to perform Ambulatory Blood Pressure Monitoring (ABPM) throughout a full 24-hour cycle, it advises using daytime BP measurements rather than 24-hour or nighttime BP readings for diagnosing and treating hypertension. Following this guidance, we employed daytime BP values to categorize patients. According to the ACC/AHA 2017 guidelines, an individual without hypertension should exhibit daytime ABPM results below <120/80 mm Hg and nighttime ABPM readings below <100/65 mm Hg.[10] We created a table to classify based on the guideline to classify the daytime ABPM.

We classified the patient according to AHA/ACC and found that 81% had hypertension that was uncontrolled. In Nepal majority of the patient never undergo APBM for initial diagnosis nor for achieving BP target. Majority of the patient are under treated as in our study which is very alarming.

Neither clinic nor home blood pressure measurements demonstrate enough sensitivity or specificity to be recommended as standalone diagnostic tests for hypertension. Relying solely on clinic or home readings for treatment decisions could lead to significant over diagnosis. However, using ambulatory blood pressure monitoring daytime blood pressure as the reference standard before initiating lifelong drug treatment may lead to more precise targeting of treatment, especially near the diagnostic threshold.[11]

Following the commencement of therapy, it is advisable to conduct Ambulatory Blood Pressure Monitoring (ABPM) every 15–20 days initially. This frequency helps gauge the therapy's effectiveness in reaching the desired blood pressure (BP) levels. Once satisfactory control is attained, ABPM can be conducted on an annual or biannual basis. The frequency of ABPM monitoring is contingent upon factors such as the severity of hypertension and the response to treatment adjustments, including dosage or medication changes. However, standardized guidelines for employing ABPM to assess the efficacy of anti-hypertensive treatment remain lacking.[12]

A systematic review conducted by the US Preventive Services Task Force (USPSTF) examined nine studies that assessed the predictive value of 24-hour Ambulatory Blood Pressure Monitoring (ABPM) on long-term health outcomes. These studies followed cohorts of patients over time and reported hazard or risk ratios, incorporating both baseline ABPM and office/home monitoring of blood pressure. Among the analysed studies, four demonstrated that a 10mmHg increase in ambulatory blood pressure, adjusted for office blood pressure, was significantly associated with an elevated risk of fatal and nonfatal strokes. Additionally, six studies found that each 10mmHg increase in ambulatory blood pressure was associated with an increased risk of fatal and nonfatal cardiovascular disease (CVD) events, with hazard ratios ranging from 1.11 to 1.42. The systematic review's overall findings strongly emphasize the significance of consistently utilizing 24-hour ABPM as it independently and accurately predicts stroke and other cardiovascular outcomes, separate from office blood pressure monitoring. In contrast, the diagnostic accuracy of office BP monitoring was found to be unreliable, ranging from 35% to 89% accuracy. Based on these compelling results, the review strongly recommends the adoption of

ABPM as the preferred method for diagnosing hypertension before initiating treatment. This approach ensures more precise and reliable assessments of blood pressure levels and contributes to better patient management and more appropriate treatment decisions. [13]

Ambulatory Blood Pressure Monitoring (ABPM) is also useful in cases of resistant hypertension. The study by M. Brown et.al highlights that approximately one-third of patients with resistant hypertension showed good blood pressure control on ABPM. This finding indicates that ABPM provides valuable insights into blood pressure patterns beyond what clinic or home monitoring can reveal. [14]

When the usual 10–20% decrease in blood pressure during sleep doesn't happen as it should (known as the nondipper pattern), it's linked to a higher risk of harming important organs in the body. This includes the heart (enlarged left ventricle, heart failure, and heart attacks), the brain (strokes), and the kidneys (excessive protein in urine and progression to severe kidney problems). [15] In our study 55.2% of the patient were nondippers who have greater chance of experiencing serious cardiovascular events that could be fatal.

In ACC/AHA 2017 guidelines, nocturnal hypertension is characterized by a blood pressure (BP) exceeding 110/65 mm Hg during nighttime hours. [10] While distinct, both nocturnal hypertension and nocturnal dipping are linked to adverse cardiovascular outcomes, either independently or in conjunction. Notably, isolated nocturnal hypertension, even without concomitant nocturnal dipping, has demonstrated a connection with subclinical damage to target organs, particularly microalbuminuria. Findings from a comprehensive study encompassing over 30,000 untreated individuals and more than 60,000 individuals undergoing antihypertensive treatment (as documented in the Spanish Ambulatory Blood Pressure Monitoring registry) revealed a prevalence exceeding 40% in the untreated group and approaching 50% in those receiving treatment. [16,17]

Most of our hypertensive patient have nocturnal hypertension only eight patient with normal daytime BP had nocturnal hypertension which helps in identification of masked hypertension particularly in Asians especially in the Chinese population. [18]

One of the main limitations of Ambulatory Blood Pressure Monitoring (ABPM) is the interference with sleeping patterns. In a study conducted by Viera et al., it was found that 67% of participants reported that the monitor woke them up after falling asleep, and 8.6% removed the device at some point during the night. This disruption during sleep may be a reason why the majority of studies rely on awake blood pressure measurements instead. Furthermore, the use of ABPM can lead to several adverse effects. Participants reported discomfort in 32% of cases, skin irritation in 37% of cases, and bruising in 7% of cases. These adverse effects can impact the overall acceptability and compliance with ABPM. [19]

## 5. Conclusion

Most of the patient treated with hypertension had inadequate control as seen on ambulatory blood pressure monitoring. ABPM should be utilized in every hypertensive patient to monitor the adequate control of BP. By continuously monitoring blood pressure over a 24-hour period, it provides valuable data on the effectiveness of medications, helping healthcare professionals make informed decisions to ensure that blood pressure is well controlled. Despite the growing evidence supporting its benefits and superiority over office blood pressure measurements, ambulatory blood pressure monitoring remains underutilized. This under-utilization might be attributed to several factors, including limited awareness among healthcare providers and patients about its advantages, lack of access to monitoring equipment, and challenges in incorporating it into routine clinical practice.

## 6. Source of Funding

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## 7. Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this article.

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