



The Role of ABPM and HBPM in Diagnosing Blood Pressure Variability

Bagus A Pramono*

Cardiology Division, Panembahan Senapati District Hospital Bantul

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*Corresponding author
Email:
bagus.yogyes@gmail.com

Address:
Jl. Dr. Wahidin Sudiro Husodo, Trirenggo, Bantul,
Daerah Istimewa Yogyakarta

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ABSTRACT

The following are some of the forms of blood pressure variability that can be encountered in the clinic: white coat hypertension, masked hypertension, and morning surge hypertension. Many guidelines recommend the use of out of office blood pressure measurements to diagnose these conditions. We will discuss the role of out-of-office blood pressure measurement in detecting blood pressure variability.

Introduction

Blood pressure (BP) is a physiologic parameter characterized by continuous dynamic fluctuations that occur over time spans ranging from seconds to years. These fluctuations are the result of a complex interplay between environmental (e.g. seasons, altitude, stress), physical (posture or volemia), and emotional factors inducing BP changes, and cardiovascular regulatory mechanisms aimed at maintaining the so-called BP “homeostasis.” These mechanisms are intended to ensure a constantly adequate organ perfusion, being able to modify BP levels in response to the changing demands of different organs.¹

Blood Pressure Variability

BP increase when facing physical or emotional stress and BP reduction during sleep). The size and patterns characterizing these BP variations define the term BP variability (BPV). BPV represents a dynamic and characteristic physiologic feature of the cardiovascular system function, its size being widely different among individual subjects in response to their daily challenges, and also determined by the characteristic reactivity of their cardiovascular control mechanisms. On the other hand, from a clinical perspective, BPV could be seen as a source of noise that creates difficulties in assessing the individual's “true” BP level. Moreover, evidence is now available to support its role also as an independent predictor of cardiovascular risk.¹ Finally, recent studies have suggested that an increased BPV could be a possible target for pharmacological treatment.

The term BPV encompasses a wide range of BP variations, occurring over seconds or minutes (very short-term BPV),

along 24 hours (short-term BPV, usually assessed by ambulatory BP monitoring), and between days (mid-term or day-to-day BPV, assessed with home BP monitoring). Long-term BPV has also been described, including seasonal BP variations and changes between clinic visits over months or years (visit-to-visit BPV; Figure 1)

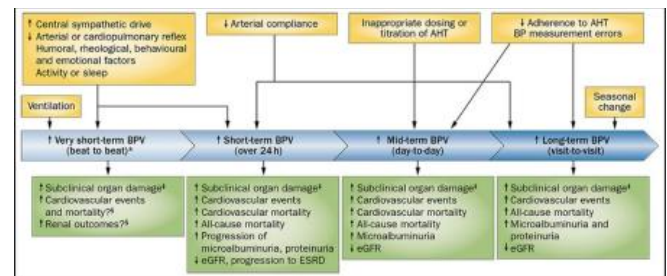


Figure 1. Various types of BPV, their determinants, and prognostic relevance for cardiovascular and renal outcomes. From Parati et al.¹

Blood Pressure Variability Related Conditions

White Coat Hypertension

WCHT is defined as office BP persistently ≥ 140 mmHg systolic, ≥ 90 mmHG diastolic, or both, whereas out-of-office BP is within normal ($< 130/80$ mmHg for 24-h mean BP, or $< 135/85$ mmHG for home BP)²⁻⁴ Medical environment triggers this *alarm reaction*, through the hyperactivation of sympathetic nervous system.⁵ It peaked 2-4 min after the start of the visit and continued throughout the duration of the physician's visit.⁶ For this reason, international

guidelines recommended to record at least two ABPM to confirm the diagnosis of WCHT and to determine the possible development of sustained hypertension.⁷ Further WCHT can be divided into true WCH, when both home BP values and ABPM values are normal, and partial WCHT, when only one of these out-of-office measurements is normal.

Masked Hypertension

In masked hypertension, the blood pressure (BP) in the clinic or office is below 140/90 mmHg, but the BP out of the clinic is above 135/85 mmHg. It may affect 10% of the general population, and it is significant because it is not normally detected, and is important because it is not diagnosed by routine medical examinations, but carries an adverse prognosis, both in terms of increased target organ damage and cardiovascular events. Possible characteristics of individuals with masked hypertension are: relatively young age, male sex, stress or increased physical activity during the daytime, and smoking or drinking habits. Masked hypertension has also been described in treated hypertensive patients (in whom the prognosis is worse than predicted from the clinic pressure) and in children, in whom it may be a precursor of sustained hypertension. It may be suspected in individuals who have a history of occasional high BP readings, but who are apparently normotensive when checked in the office. One practical point is that we should continue to follow such people rather than dismissing them, and encourage out-of-clinic monitoring of BP. This would apply particularly to smokers and those with BP in the prehypertensive range. The potential implications of masked hypertension are huge, but the optimal strategy for detecting the condition in the general population is not yet clear.⁷

Morning Surge Hypertension

Although a normal rise in blood pressure in the morning is a physiological phenomenon, an exaggerated rise in blood pressure represents a cardiovascular risk. Therefore, the association between the degree of morning BP surge and cardiovascular risk is not linear, but rather has a threshold. There have been 6 prospective studies demonstrating that the morning 2 surge in BP is a risk for cardiovascular events.⁸⁻¹¹ These studies have used 3 different definitions of the morning BP surge as follows (Figure 1): (1) a sleep-trough surge defined as the morning BP (2-hour average of four 30-minute BP readings just after wake-up) minus the lowest nocturnal BP (1-hour average of the 3 BP readings centered on the lowest nighttime reading); (2) a prewaking surge defined as the morning BP minus the prewaking BP (2-hour average of 4 BP readings just before wake-up)^{8,10,11} and (3) a rising BP surge defined as the morning BP measured on rising minus the BP in a supine position 30 minutes before rising. All of the different morning BP surges were associated with cardiovascular events.

How to Diagnose BPV

Guidelines recommend measuring out-of-clinic blood pressure (BP) to identify masked hypertension (MHT) defined by out-of-clinic BP in the hypertensive range among individuals with clinic-measured BP not in the hypertensive range. There are 2 primary methods of measuring out-of-

clinic BP to diagnose MHT: ambulatory BP monitoring (ABPM) and home BP monitoring (HBPM).

Ambulatory Blood Pressure monitoring (ABPM)

ABPM is the most frequent mechanism used in measuring the presence of the white coat effect. The standard definition of white coat hypertension is an elevation of clinic pressure with a normal daytime ambulatory profile. However, the initial few measurements on the ambulatory monitor, and the final measurement, which reflect the patient’s attention to attaching and removal of the monitoring device, respectively, are frequently abnormal also. A typical ambulatory monitor recording from such a patient is shown in Figure 2.

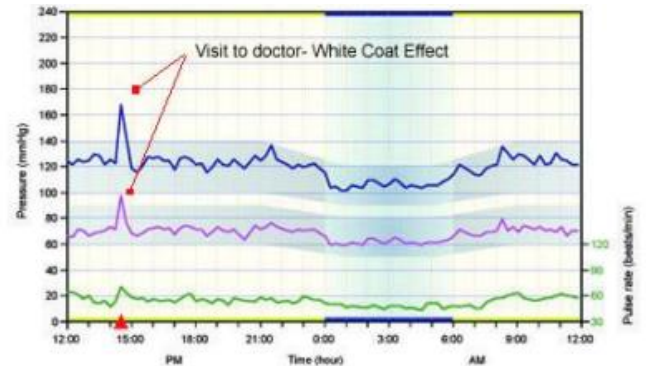


Figure 2. ABPM pattern of WCHT

Suspected white-coat hypertension is defined as a clinic blood pressure of 140/90 mm Hg or higher on at least three occasions, with at least two sets of measurements of less than 140/90 mm Hg in nonclinic settings, plus the absence of target-organ damage. The diagnosis is important because it is generally accepted that patients with white-coat hypertension are at relatively low risk and are unlikely to benefit from antihypertensive-drug treatment. Several studies have shown that drug treatment of white-coat hypertension reduces the clinic blood pressure but has a negligible effect on the ambulatory blood pressure, which by definition is normal. In addition, the only study to investigate the effects of treating white-coat hypertension on morbid events found no significant benefit. Sustained hypertension may develop in some patients with whitecoat hypertension, and the risk of stroke may increase after six years.¹² The Task Force of the Eighth International Consensus Conference on Blood Pressure Monitoring¹⁰ recommends ambulatory monitoring to exclude white-coat hypertension in untreated patients when (1) the office blood pressure is $\geq 140/90$ mm Hg on ≥ 3 separate office visits; (2) ≥ 2 blood pressure measurements taken outside the office are $< 140/90$ mm Hg, frequently using home blood pressure monitoring; and (3) there is no evidence of hypertensive target organ damage. For patients with a confirmed daytime ABPM of $\geq 135/85$ mm Hg, physicians may wish to consider starting antihypertensive drug treatment.

Masked hypertension is the inverse phenomenon: an elevated out-of-clinic BP despite a non-elevated clinic BP. First coined by Pickering in 2002, masked hypertension has gained increasing recognition in research and clinical

practice and is now known to be a high-risk BP phenotype, associated with an increased risk of CVD events and target organ damage.^{7,9,10}

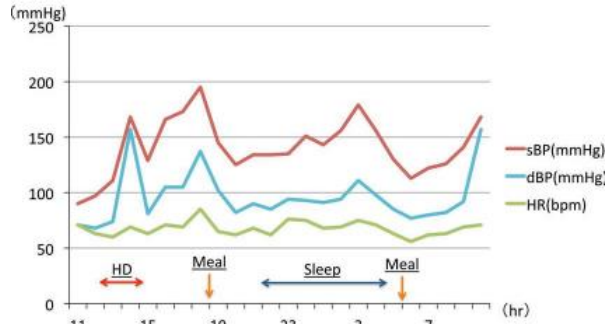


Figure 3. ABPM Pattern of Masked Hypertension

Home Blood Pressure Monitoring

In the past decade, HBPM has emerged as an effective and convenient means of screening for hypertension, as well as being cost-effective. Methods for non-invasive BP measurement include auscultatory, oscillometric, tonometry and pulse wave record and analysis. HBPM uses the same technology as ABPM monitors, but allows patients to monitor BP as often as they wish. While ABPM provides BP information at many timepoints on a particular day during unrestricted routine daily activities, HBPM provides BP information obtained under fixed times and conditions over a long period; thus, HBPM gives stable readings with high reproducibility and has been shown to be as reliable as ABPM.

Currently, there is little evidence to determine whether ABPM, HBPM, or both modalities should be used to detect MHT among individuals not taking antihypertensive medication. Prior population-based studies of individuals without clinic hypertension have shown that the prevalence of MHT differs when defined using ABPM or HBPM: ranging from 14% to 30% when assessed using daytime or 24-hour periods on ABPM and 12% to 18% when assessed using HBPM. There is also evidence to suggest that MHT prevalence differs by the period examined on ABPM.¹³

National Institute for Clinical Excellence (NICE) guidelines for HBPM recommend that when using HBPM to confirm a diagnosis of hypertension it is necessary to ensure that:

- for each BP recording, two consecutive measurements are taken, at least 1 minute apart with the person seated;
- BP is recorded twice daily, ideally in the morning and evening; and
- BP recording continues for at least 4 days, ideally for 7 days.

Measurements taken on the first day should be discarded and the average value of the remaining days after day one is discarded be used. Home BP monitoring has high specificity but low sensitivity in the diagnosis of white-coat and masked hypertension, and may therefore behave as a complementary to, but not a replacement of, ambulatory BP monitoring.¹³

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