

Revisiting ambulatory blood pressure monitoring

Tim Tse, Bosco Wu, Sanjyot Vagholkar, Simon Willcock

HYPERTENSION remains an important modifiable cardiovascular risk factor that can be difficult to reliably diagnose. Using office blood pressure (OBP) alone can result in incorrect diagnoses, while home blood pressure monitoring (HBPM) is time consuming for the patient. Ambulatory blood pressure monitoring (ABPM) is the reference standard for diagnosing blood pressure abnormalities and should be used when possible.¹⁻³ The aim of this article is to remind general practitioners (GPs) of the important utility, diagnostic indications and practical applications of ABPM in the primary care setting.

ABPM is the use of a portable wearable device that takes repeated blood pressure readings every 15–60 minutes over 24 hours as the patient details specific periods of activities – such as sleep, meals or exercise – in a diary. Interpretation includes analysis of the daytime readings, night-time readings and presence or absence of nocturnal dipping. It is the reference standard for the diagnosis of hypertension, with elevated readings associated with cardiovascular disease independent of clinic measurements. Indications for ABPM include the diagnosis of masked, white coat, nocturnal, episodic or treatment-refractory hypertension.¹⁻³

It is important to understand the four combinations of blood pressure readings that can be identified from the incorporation of in-office and out-of-office measurements. Sustained normotension (consistently normal blood pressure) and sustained hypertension (consistently elevated blood pressure) are reliably diagnosed entities and correspond with best and worst outcomes. Masked hypertension, defined as an OBP <140/90 mmHg but ABPM diagnostic for hypertension, has an estimated prevalence of 14–30%. White coat hypertension, with an estimated prevalence of 5–65%, is defined as an OBP >140/90 mmHg with an ABPM not diagnostic for hypertension.⁴ Without using out-of-office blood pressure measurements, it cannot be ascertained from clinic measurements if white coat hypertension is present, which may lead to unnecessary overtreatment.

The rationale for ABPM following screening OBP measurements for the diagnosis of hypertension was addressed in a systematic review by the United States Preventive Services Task Force in 2021. Incorporating 15 studies with 11,309 patients, initial OBP screening had a low sensitivity of 0.54 (95% confidence interval [CI]: 0.37, 0.70) and high specificity of 0.90 (95% CI: 0.84, 0.95) for detecting hypertension when compared with ABPM. Hence, OBP alone underdiagnoses patients with true hypertension and can miss masked

hypertension. Within the same systematic review of eight studies with 53,183 patients, repeated OBP measurements following an initial elevated screening OBP visit had a sensitivity of 0.80 (95% CI: 0.68, 0.88) and low specificity of 0.55 (95% CI: 0.42, 0.66) when compared with ABPM. As such, using serial OBP measurements alone may result in many patients without hypertension being misdiagnosed as having the condition.⁵

International guidelines on when ABPM should be used based on OBP are outlined in Table 1. The most recent Australian guidelines recommend ABPM or HBPM if OBP ≥140/90 mmHg or if hypertension is suspected.⁶ The National Institute for Health and Care Excellence suggests offering ABPM primarily, and HBPM only if ABPM is unsuitable, in patients with OBP between 140/90 mmHg and 180/120 mmHg. While these guidelines can diagnose white coat hypertension, masked hypertension remains undetected given that ABPM would not be routinely offered to patients with normal blood pressure on screening OBP.⁷ The American College of Cardiology and American Heart Association advises out-of-office blood pressure measurements for diagnostic clarification of white coat hypertension in patients with OBP of 130–160/80–100 mmHg. Out-of-office blood pressure measurement is also recommended for OBP between 120/75 mmHg and 129/79 mmHg to exclude underlying masked hypertension.⁸

Similarly, the European Society of Hypertension suggests that out-of-office blood pressure measurements should be performed for OBP between 130/85 mmHg and 159/99 mmHg to capture white coat and masked hypertension.⁹ It is noteworthy that cardiovascular risk calculators have only been validated using OBP measurements. Hence, it is not recommended to use ABPM but rather OBP as these calculators can misestimate absolute cardiovascular risk when used.⁶

Table 2 highlights the diagnostic criteria of the various blood pressure abnormalities detectable using ABPM. It is crucial to note the different cut-offs used between 24-hour ($\geq 130/80$ mmHg), daytime ($\geq 135/85$ mmHg) and night-time readings ($\geq 120/70$ mmHg). Awareness of nocturnal dipping is important. Nocturnal dipping is a physiological phenomenon and considered normal when there is a 10–20% reduction in nocturnal blood pressure when compared with daytime blood pressure. Patients who exhibit reduced dipping (night/day blood pressure ratio [NDBPR]: <1 and >0.9) are shown to have increased cardiovascular and total mortality when compared with the general population. Patients with non-dipping/rising (NDBPR: ≥ 1) have the poorest clinical outcomes, while extreme dipping (NDBPR: <0.8) is a complex phenomenon with heterogeneous consequences.¹⁰ The European Society of Hypertension suggests that obstructive sleep apnoea be considered in patients with refractory hypertension and a non-dipping profile.²

ABPM provides medical practitioners with a much more nuanced clinical picture of hypertension than the unreliable binary diagnosis from OBP measurements. With ongoing changes to access worldwide, it is important for GPs to be aware of the indications for its use and interpretation of its findings to provide best practice care to patients around Australia.

Authors

Tim Tse BMed, MD, MMed, FRACGP, General Practitioner, Department of Primary Care, Macquarie University, NSW

Table 1. Society guidelines on indications for ambulatory blood pressure monitoring based on office blood pressure readings

Guideline	Year	Recommendation
European Society of Hypertension ⁹	2021	If OBP 140–159/90–99 mmHg, perform out-of-office blood pressure measurement* to capture white coat hypertension If OBP 130–139/85–90 mmHg, perform out-of-office blood pressure measurement* to exclude masked hypertension
National Institute for Health and Care Excellence ⁷	2019	If OBP 140–180/90–120 mmHg, offer ABPM Only if ABPM unsuitable, offer HBPM
American College of Cardiology/American Heart Association ⁸	2017	If OBP 130–160/80–100 mmHg, perform out-of-office blood pressure* to capture white coat hypertension If OBP 120–129/75–79 mmHg, perform out-of-office blood pressure measurement* to exclude underlying masked hypertension
Australian Guidelines for the Diagnosis and Management of Hypertension ⁶	2016	If OBP $\geq 140/90$ mmHg or if hypertension is suspected, perform out-of-office blood pressure measurement*

*Out-of-office blood pressure measurement includes ABPM or HBPM.

ABPM, ambulatory blood pressure monitoring; HBPM, home blood pressure monitoring; OBP, office blood pressure

Table 2. Diagnostic criteria for hypertension using ambulatory blood pressure²

Method of measurement	Average reading
ABPM over 24 hours	$\geq 130/80$ mmHg
ABPM daytime (awake)	$\geq 135/85$ mmHg
ABPM night-time (asleep)	$\geq 120/70$ mmHg
Non-dipping and rising*	Night/day blood pressure ratio: ≥ 1
Reduced dipping*	Night/day blood pressure ratio: <1 and >0.9
Dipping*	Night/day blood pressure ratio: <0.9 and >0.8
Extreme dipping*	Night/day blood pressure ratio: <0.8

*Nocturnal dipping is not part of the diagnostic criteria for hypertension but provides further information. ABPM, ambulatory blood pressure monitoring

Bosco Wu MBBS, BMedSci (Hons), FRACGP, General Practitioner, Department of Primary Care, Macquarie University, NSW

Sanjyot Vagholkar MBBS (Hons), MPH, PhD, FRACGP, General Practitioner, Professor, Department of Primary Care, Macquarie University, NSW

Simon Willcock MBBS, PhD, FRACGP, General Practitioner, Professor, Department of Primary Care, Macquarie University, NSW

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Correspondence to: tim.tse@mqhealth.org.au

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