

Ambulatory Blood Pressure Measurement Should Be a Routine Investigation in Patients with Renal Disease

a report by
Eoin O'Brien

Professor of Molecular Pharmacology, Conway Institute of Biomolecular and Biomedical Research, University College Dublin

What criteria must be fulfilled in order to make a technique indispensable to clinical practice and the rule rather than the exception? It seems that ambulatory blood pressure measurement (ABPM) is in much the same historical position at the start of the 21st century as conventional measurement with the mercury sphygmomanometer and stethoscope was at the end of the 19th. At the time, sceptics expressed doubt that the sphygmomanometer would ever be accepted by 'overworked, underpaid general practitioners'.¹

ABPM is not new to medicine; in fact, it has been with us in one form or another for nearly half a century. In 1964, Sir George Pickering demonstrated for the first time the profound fall in blood pressure during sleep and the fluctuations in pressure during the course of a 24-hour period. Pickering's group went on to develop an ambulatory technique whereby pressure could be measured directly from the brachial artery with a small plastic catheter. The first intra-arterial ABPM in unrestricted man was performed in 1966. In 1962, Hinman and colleagues first described the truly portable ambulatory system for non-invasive measurement of blood pressure. This was subsequently developed commercially by the Remler Company in California. So began non-invasive measurement of ambulatory blood pressure.² We first used ABPM in 1979 when we anticipated that "development of a cheap and accurate means of ambulatory recording would have a considerable impact on the diagnosis of borderline hypertension and the assessment of the efficacy of treatment".³ This forecast has been slow to materialise, but the evidence that ABPM is indispensable to clinical practice has been growing steadily. During the last decade the information that can be derived from ABPM has surprised even the most ardent supporters of the technique.^{4,5}

In clinical practice, the most common use of ABPM – and the only one for which reimbursement is approved by the Centers for Medicare & Medicaid Services (CMS) in the US – is to identify patients with suspected white coat hypertension. This is defined as "office blood pressure >140/90mm/hg on at least three separate clinic/office visits with two separate measurements

made at each visit". In addition, "there should be at least two blood pressure measurements taken outside the office, which are <140/90mmHg" and "there should be no evidence of end-organ damage".⁶ Some believe these stipulations for reimbursement are too restrictive and limit the wider use of ABPM. The CMS decision to permit ABPM in suspected white coat hypertension ignores the fact that there are no clinical characteristics that lead the practising physician to suspect the condition. A number of studies suggest that in untreated subjects with essential hypertension, the probability of white coat hypertension increases in non-smoking female subjects with mild hypertension of recent origin who have had a limited number of office blood pressure measurements

During the last decade the information that can be derived from ambulatory blood pressure measurement has surprised even the most ardent supporters of the technique.

and who have small left ventricular masses.⁶ However, these predictive factors are vague and of little help to the physician. Another important stipulation in the CMS directive is that potential ABPM patients should have no evidence of target organ damage. However, the means whereby a practising physician is to determine the target organ status of a patient are not stipulated. Should all patients being considered for ABPM undergo an echocardiograph or some other measure of target-organ involvement? Indeed, four years on from the CMS directive, it is difficult not to reiterate with greater conviction (because of stronger evidence) the conclusion from the European Society of Hypertension (ESH) statement on when to suspect white coat hypertension: "In truth, it must be admitted that it is difficult to escape the conclusion that all patients in whom a diagnosis of hypertension is being contemplated based on office/clinic blood pressure, should have ABPM to exclude white coat hypertension...".⁶

Continuing on the diagnostic front, ABPM can identify patients with masked hypertension (estimated to be present in as many as 10 million people in the US) in whom conventionally measured blood pressure in the clinic setting is normal but using ABPM is increased.⁷ ABPM cannot be performed in everyone and there is a strong case for performing it in patients who have had a cardiovascular event. The consequence of not prescribing antihypertensive medication to a patient with, for example, a history of a previous stroke is to deny that patient the most potent medication to prevent stroke recurring. It is a salutary thought that if white coat hypertension is present in 20% of the population when blood pressure is measured conventionally in primary care, and if



Eoin O'Brien is a Professor of Molecular Pharmacology at the Conway Institute of Biomolecular and Biomedical Research, University College Dublin. He is President of the Irish Heart Foundation (IHF) and Director of Clinical Hypertension Research at the Blood Pressure Unit at St Michael's Hospital, Dublin. Dr O'Brien has published over 600 scientific papers on hypertension research, especially in the areas of blood pressure measurement, ambulatory monitoring and the management of

hypertension in the elderly. He serves in an administrative capacity with a number of national and international bodies concerned with the global management of cardiovascular disease, being Co-Chair of the World Health Organization (WHO) Committee on Blood Pressure Measurement in Low Resource Settings.

E: eobrien@iol.ie

masked hypertension is present in 10% of patients whose blood pressure is measured in similar circumstances, it follows that hypertension is being misdiagnosed in as many as one-third of all patients attending for routine blood pressure measurement.

It is estimated that pre-hypertension occurs in about 28% of American adults (or 59 million people),⁸ but we must question the accuracy of these figures as they are derived from conventional blood pressure measurements. If as many as 20% of these patients have white coat hypertension, it follows that the diagnosis of pre-hypertension will be erroneous in nearly one-quarter of the patients diagnosed with this condition. The financial implications for society are obvious and ABPM provides a cost-effective means of accurately determining the true prevalence of pre-hypertension.

The evidence for ABPM as a methodology for guiding drug treatment in clinical practice is growing. The technique provides evidence for efficacy of blood pressure control over 24 hours, allows resistant hypertension to be differentiated from a white coat reaction that misleadingly suggests resistance to therapy and provides evidence of overtreatment, particularly in the elderly, who are prone to hypotension.⁹ ABPM is the only accurate means of monitoring nocturnal blood pressure, which has been largely ignored in clinical practice. This is despite many studies showing that nocturnal phenomena such as non-dipping, reverse dipping, extreme dipping, nocturnal hypertension and a morning surge are associated with a poor prognosis.⁵ ABPM is also valuable in special populations such as the elderly and patients with diabetes (in whom optimal 24-hour control of blood pressure is mandatory) and in pregnancy.⁹

Ambulatory blood pressure measurement is the only accurate means of monitoring nocturnal blood pressure, which has been largely ignored in clinical practice.

Recently, ABPM has been used to achieve more subtle insights into circadian hypertension. The Ambulatory Arterial Stiffness Index (AASI), which has been shown to predict cardiovascular mortality in a large cohort of hypertensive individuals, particularly stroke even in normotensive subjects, may prove to be a readily applicable index that can be derived from a routine ABPM to predict outcome. The practical importance of such an index is that it may permit early identification of

hypertensive patients at risk of cardiovascular events, and thus indicate those in need of aggressive blood pressure lowering.¹⁰ Therefore, the case for ABPM in general clinical practice is overwhelming.¹¹

There is also considerable evidence supporting the use of ABPM in patients with renal disease. The prevalence of chronic kidney disease (CKD), currently estimated to be 11% in the US, is increasing because of increased longevity and the accompanying rise in diabetes and hypertension, the main causes of CKD.¹² Almost invariably, patients with CKD have a non-dipping nocturnal blood pressure that puts them

Ambulatory blood pressure measurement should be an integral part of good clinical practice. The case is particularly compelling in nephrological practice.

at high risk, and this pattern can be detected only with ABPM.^{13,14} Patients with CKD, who, like diabetic patients, are at high risk from the cardiovascular complications of hypertension, need optimal control of blood pressure, which is best assessed over a 24-hour period with ABPM. Finally, there are aspects of CKD that lend themselves to assessment using ABPM. These include the evaluation of the interdialytic blood pressure in haemodialysis patients and assessing the adequacy of therapy throughout the interdialytic period.¹⁵

Conclusion

First, ABPM should be an integral part of good clinical practice. The case is particularly compelling in nephrological practice. It is the responsibility of healthcare providers to reimburse doctors adequately for the procedure given the assurance of considerable cost savings. Second, practising physicians must agitate for a technique that will provide them with the means of diagnosing hypertensive patients more accurately, guiding drug prescription more efficiently and predicting risk and outcome in individual patients. Third, manufacturers of ABPM devices must improve monitors in keeping with the innovative possibilities that contemporary technology provides, and also ensure that software options allow for standardised presentation of data, statistics and plots, interpretation of recordings and an electronic means of sharing data in order to further patient management and hypertension research. Finally, patients must be aware of the possibilities of ABPM and ask why it is being denied to them so often. ■

- Blake E, Recent British research on arterial tension, *Med Times Gaz*, 1895;23:29–30.
- O'Brien E, Fitzgerald D, The history of indirect blood pressure measurement, In: Birkenhager WH, Reid JL (eds), *Handbook of Hypertension*, 1991;1:1–54.
- O'Brien E, O'Malley K, The ABC of Blood Pressure Measurement: reconciling the controversies: a comment on the 'literature', *Br Med J*, 1979;2:1201–2.
- Pickering TG, Shimbo D, Haas D, Ambulatory Blood-Pressure Monitoring, *N Engl J Med*, 2006;354:2368–74.
- O'Brien E, Ambulatory Blood Pressure Measurement: A Trove of Hidden Gems, *Hypertension*, 2006;48:364–5.
- Verdecchia P, O'Brien E, Pickering T, et al., When to suspect white coat hypertension? Statement from the Working Group on Blood Pressure Monitoring of the European Society of Hypertension, *Am J Hypertens*, 2003;16:87–91.
- O'Brien E, Unmasking Hypertension, *Hypertension*, 2005;45:481–2.
- Thom T, Haase N, Rosamond W, et al., Heart Disease and Stroke Statistics – 2006 Update. A Report From the American Heart Association Statistics Committee and Stroke Statistics Subcommittee, *Circulation*, 2006;113(6):e85–151.
- O'Brien E, Asmar R, Beilin L, et al., European Society of Hypertension recommendations for conventional, ambulatory and home blood pressure measurement, *J Hypertens*, 2003;21:821–48.
- Dolan E, Thijs L, Li Y, et al., Ambulatory Arterial Stiffness Index as a Predictor of Cardiovascular Mortality in The Dublin Outcome Study, *Hypertension*, 2006;47:365–70.
- O'Brien E, Is the Case for ABPM as a Routine Investigation in Clinical Practice Not Overwhelming?, *Hypertension*, 2007;50:284–6.
- Coresh J, Astor BC, Greene T, Levey AS, Prevalence of chronic kidney disease and decreased renal function in the adult US population: Third National Health and Nutrition Examination Survey, *Am J Kidney Dis*, 2003;41:1–12.
- Redon J, Oliver V, Zaragoza MD, Galindo MJ, Ambulatory blood pressure during diseases of the kidney, *Blood Press Monit*, 1999;4:267–74.
- Bianchi S, Bigazzi R, Baldari G, et al., Diurnal variations of blood pressure and microalbuminuria in essential hypertension, *Am J Hypertens*, 1994;7:23–9.
- Santos SFF, Peixoto AJ, Ambulatory Blood Pressure in Patients With Chronic Kidney Disease. Clinical Hypertension and Vascular Disease, In: White WB (ed.), *Blood Pressure Monitoring in Cardiovascular Medicine and Therapeutics*, 389–410.