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REVISIÓN

Ambulatory blood pressure measurement is indispensable to good clinical practice

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Summary
Traditional clinic or office blood pressure measurement (OBPM) is limited in the amount of information it can provide for the adequate management of hypertension; ambulatory blood pressure measurement (ABPM), which can diagnose white coat hypertension in as many as 20% of people who appear to have hypertension with OBPM, and masked hypertension which may affect 10 and 20% of the population, is a vastly superior technique. Furthermore, nighttime BP measured by ABPM is superior to OBPM in predicting cardiovascular events. Perhaps the greatest value for ABPM will be to enable blood pressure control in the aging community, thereby leading to prevention of stroke. There should be an imperative to change contemporary clinical practice if we are to avert the burden of stroke and heart failure in an aged population. We have adequate drugs to achieve effective BP lowering in the vast majority of patients; what we lack is the determination to achieve effective BP control as early as possible.

PALABRAS CLAVE
Monitorización ambulatoria de la presión arterial;
Atención primaria;
Prevención de ictus

La monitorización ambulatoria de la presión arterial es imprescindible para la buena práctica clínica

Resumen
La información que la medida tradicional de la presión arterial (PA) en la consulta (o en el hospital) (MPAC) puede proporcionar para el manejo adecuado de la hipertensión es limitada. Es una técnica muy superior la monitorización ambulatoria de la PA (MAPA), que puede diagnosticar la hipertensión de bata blanca en hasta el 20% de los que parecen tener hipertensión con MPAC, y la hipertensión enmascarada, que puede afectar a un 10-20% de la población. La PA nocturna medida por MAPA también es superior a MPAC en la predicción de acontecimientos cardiovasculares. Quizás el valor más importante de la MAPA es que

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puede monitorizar la PA en la comunidad de ancianos, con prevención de ictus. Es imperativo cambiar la práctica clínica contemporánea si queremos evitar la carga de ictus e insuficiencia cardíaca en los ancianos. Tenemos medicamentos apropiados para bajar la PA con eficacia en la gran mayoría de los pacientes. Lo que nos hace falta es tener la determinación para lograr un control eficaz de la PA tan pronto como sea posible.

Introduction

Since Riva-Rocci and Korotkoff gave us the technique of conventional blood pressure (BP) measurement over a century ago, we have landed men on the moon, encircled Mars, invented the automobile and aeroplane and most importantly revolutionized the technology of science with the microchip. Why, we might ask, has medicine ignored scientific evidence for so long so as to perpetuate a grossly inaccurate measurement technique in both clinical practice and hypertension research?

It is generally accepted that traditional clinic or office blood pressure measurement (OBPM) is limited in the amount of information it can provide for the adequate management of hypertension and that contemporary practice must turn to out-of-office measurement to obtain additional information to guide the diagnosis and management of hypertension. The methods available for out-of-office measurement are ambulatory blood pressure measurement (ABPM) and self blood pressure measurement (SBPM). The information provided by SBPM is limited by virtue of the fact that it must be repeated over 5 days to give measurements that approximate mean daytime ABPM and the technique cannot give nocturnal blood pressure levels. There can be little argument about ABPM being superior to OBPM, if for no other reason than being free of the white coat reaction that gives OBPM levels considerably higher than those measured away from the medical environment in as many as 20 per cent of individuals with suspected hypertension and in most patients with hypertension.[1] It is my firm belief that ABPM should be available to all primary care physicians where the responsibility for the management of the majority of patients with hypertension lies. It is important for physicians using ABPM to ensure that the device being used has been recommended for clinical use by checking the website (www.dableducational.org) which provides the latest accuracy data on all BP measuring devices.

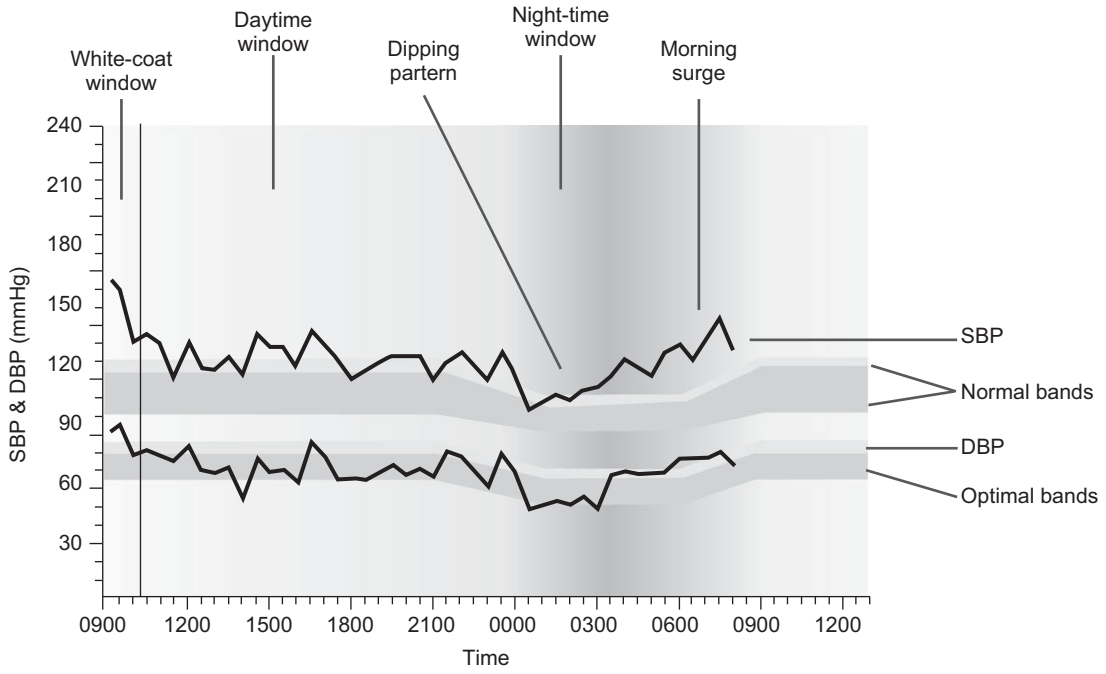
Developments in software and electronic transmission of data have been used to make the technique of ABPM more accessible to clinical practice. The dabl® ABPM program generates a graphic presentation of ABPM data in a standardized format, demarcates the bands of normality and provides a computer generated interpretative report[1,2] (Fig. 1). Because ABPM has been shown to significantly improve BP control in primary care[1,3] advances have been made in central hosting and analysis of ABPM data. For example, the Spanish Society of Hypertension has developed a nationwide project to promote the use of ABPM in primary care settings based on central analysis of ABPM data transmitted electronically.[3]

Experience with ABPM in primary care

One of the first studies of ABPM in primary care showed that BP measurements made by doctors were much higher than those using ABPM, leading the authors to conclude that it was "time to stop using high BP readings documented by general practitioners to make treatment decisions.[4]" Another study using ABPM in primary care showed that office BP incorrectly labeled nearly a third of patients with a white coat effect as having poor BP control, and that these patients were likely to be recalled for unnecessary follow-up and intervention.[5] An Irish study in primary care showed that only 12% of patients achieved target BP with OBPM compared to over one third of patients with ABPM. Furthermore 38% of patients had a change in their medication as a result of ABPM; 32% had a new medication started and 14% of untreated patients with elevated OBPM, who were candidates for drug treatment, were not commenced on medication because ABPM was normal.[6]

The largest study to-date on ABPM in primary care comes from Spain where a nationwide project to promote the use of ABPM in primary care settings is being established.[3] In the initial analysis of some 20,000 patients, clinic BPs were approximately 16/9 mmHg higher than ABPM in patients categorized as being at low to moderate added risk with a greater difference (23/23 mmHg) in those categorized as being at high risk in spite of receiving much more antihypertensive treatment. Moreover, high-risk hypertensive patients showed a high prevalence of circadian rhythm abnormalities on ABPM with the prevalence of a non-dipping pattern being almost 60%, and in patients with the lowest ABPM levels, high-risk patients showed a higher prevalence of non-dipping nocturnal BP than lower-risk cases. An editorial commentary on this study urged the wider use of ABPM to gain more accurate risk categorization of patients in the community as well as being able to obtain a more accurate estimate of the community control of BP.[7] As in the Irish study, BP control was better when assessed by ABPM than by OBPM indicating that the white coat effect with OBPM is leading to an underestimation of BP control in the community. BP control was underestimated in over a third of patients and overestimated in some 5% by OBPM as compared to ABPM. Notably BP was uncontrolled by both methods of measurement in 43% of patients. High-risk patients showed poorer ABPM control then low-to-moderate risk patients in spite of receiving much more antihypertensive treatment.[1]

The superiority of ABPM over OBPM in managing antihypertensive medication has been demonstrated in a number of clinical studies. Adjustment of antihypertensive therapy according to ABPM rather than OBPM has been shown to result in less antihypertensive medication being



The ABPM suggests bordeline 24-hour systolic hypertension (133 mmHg daytime, 118 mmHg night-time) and normal 24-hour DBP (71 mmHg daytime, 59 mmHg nigh-time) white a white-coat effect (175 mmHg/95 mmHg).

Automatic interpretation

	SBP	DBP	BPM	HR
White-coat window				
Readings	3	3	3	3
First hr max	175	95	124	50
Daytime (09:00-21:00)				
Readings	21	21	21	21
Mean	**133**	**71**	90	44
SD	8	7	8	3
Night-time (01:00-06:00)				
Readings	10	10	10	10
Mean	**118**	**59**	81	40
SD	9	8	10	2
24-hour				
Readings	43	43	43	43
Mean	129	68	88	42
SD	11	9	10	3
Dip %	11	17	10	8

Statistical analysis

Figure 1 Example of a standardized interpretative ABPM report [The levels of normality are based on latest outcome-based thresholds which give daytime ABPM values 130/85 mmHg and nighttime values 110/70 mmHg. ABPM: ambulatory blood pressure measurement; BPM: blood pressure measurement; DBP: diastolic blood pressure; SBP: systolic blood pressure; SD: standard deviation. Kikuya K, Hansen TW, Thijs L, Björklund-Bodegård K, Kuznetsova T, Ohkubo T, et al, on behalf of the International Database on Ambulatory blood pressure monitoring in relation to Cardiovascular Outcomes (IDACO) Investigators. Diagnostic Thresholds for Ambulatory Blood Pressure Monitoring Based on 10-Year Cardiovascular Risk. *Circulation*. 2007;115:2145–2152.]

prescribed without compromising target organ involvement.[8] It has also been shown that in patients on treatment with BP lowering drugs the long-term cost of care for hypertension is dominated by costs for drug treatment, rather than for visits and investigations.[9]

Identification of white coat hypertension

ABPM is the most effective technique for identifying white coat hypertension, which may be present in as many as 20% of people who appear to have hypertension with OBPM,[10] and these patients may be spared years of unnecessary and expensive drug treatment, as well as avoiding being penalized unnecessarily for insurance or employment by having the diagnosis of 'hypertension' misapplied. The use of ABPM is recommended by several national and international guidelines for the management of hypertension in Europe and the US.[1] The most recent and thorough cost benefit analysis by Krakoff showed that potential savings of 3% to 14% for cost of care for hypertension and 10% to 23% reduction in treatment days when ABPM was incorporated into the diagnostic process at an annual cost that would be less than 10% of treatment costs.[9]

Identification of masked hypertension

Masked hypertension is the reverse of white coat hypertension in that patients have normal OBPM but elevated daytime ABPM. The prevalence of masked hypertension seems to vary between 10 and 20%, but even if the prevalence was only 5%, this number applies to the whole adult population, not just the proportion of the population with hypertension, which translates into about 10 million people in the US.[11] Indeed it is a salutary thought that if white coat hypertension is present in 20% and masked hypertension in 10% of the population when BP is measured conventionally in primary care, it follows that the diagnosis of hypertension is being misdiagnosed in as many as a third of all patients attending for routine BP measurement.[12]

The importance of masked hypertension as a clinical entity rests on the fact that those with the condition are not only at increased risk of developing sustained hypertension, but they also have increased target organ involvement as denoted by left ventricular mass and carotid atherosclerosis and, as might be expected when target organ involvement is increased, they also have increased cardiovascular morbidity. The logical extension of this line of reasoning is that future studies will also show cardiovascular mortality to be increased.[13] Masked hypertension presents clinicians with the serious problem of identifying subjects with the condition. Clearly, it is not practical to perform ABPM in all subjects with normotension in the office or clinic to unmask those with ambulatory hypertension. Yet the consequences of not identifying masked hypertension carry serious implications for patients who may already have overt coronary and cerebrovascular disease in whom BP lowering medication would be the single most important therapy in preventing recurrent stroke or heart attack. The best policy for the moment would seem to be to perform ABPM in patients with high normal OBPM who are at high risk of developing cardiovascular disease due the presence of multiple risk factors, and in patients with associated morbidity, such as diabetes mellitus, a previous history of a cardiovascular event or those with evidence of target organ damage.[1]

Identification of nocturnal hypertension

Nighttime BP measured by ABPM is superior to OBPM in predicting cardiovascular events,[14] In the Spanish study in primary care, the prevalence of a non-dipping BP pattern was almost 60% and this was more likely in high-risk patients.[3] The importance of measuring BP over the 24-hour period has been stressed in the recent International Database on Ambulatory blood pressure monitoring in relation to Cardiovascular Outcomes (IDACO) analysis in 7458 people which showed that both day and nighttime BP contribute differing information on outcome, which may be influenced by antihypertensive medication.[15] Recent studies have drawn attention to the importance of controlling not only daytime but also nighttime BP.[16] In this regard control of the early morning surge may prove to be particularly important in preventing stroke.[17] It follows, therefore, that if nocturnal BP control, which can only be assessed with ABPM, is important in preventing cardiovascular events, ABPM should be available to ensure that 24-hour BP control is achieved in hypertensive patients.

ABPM in stroke prevention

Individuals over age 60 represent the most rapidly growing segment of the population with the average life expectancy of people born in the United States in 2003 being 77.6 years.[18] Projections for the European region suggest that the proportion of the population aged 65 and over will increase from 20% in 2000 to 35% in 2050, and the median age will rise from 37.7 years in 2000 to 47.7 years in 2050.[19] The prevalence of hypertension increases with advancing age to the point where more than half of people aged 60 to 69 years old and approximately three-fourths of those aged 70 years and older are hypertensive.[20] As the predominant determinants of stroke are hypertension and age, it is hardly surprising that increased age carries an increased risk of stroke, and that with increasing longevity the incidence of stroke is rising; for example in Europe, stroke rates increased from approximately 5000 per 100,000 in subjects aged less than 75 years to 10,000 or more per 100,000 in those aged more than 80 years.[21]

Improved BP control could have a major impact on these daunting statistics. For example, a meta-analysis of 8 placebo controlled trials in 15,693 elderly patients followed for 4 years showed that active antihypertensive treatment reduced coronary events (23%), strokes (30%), cardiovascular deaths (18%), and total deaths (13%), with the benefit being greatest in patients older than 70 years.[22] Hypertensive patients in whom BP is uncontrolled by treatment have a cardiovascular risk only modestly less than that of untreated individuals,[23] which leads to the conclusion that in practice BP lowering drugs are prescribed inappropriately without achieving optimal control, or put another way "patients are frequently not barely but badly controlled.[24]" This therapeutic inertia whereby the *prescribing* of medication is seen as constituting an end in itself in that some good will be achieved, must now be replaced by a clinical *modus operandi* recognising that the *efficacy* of medication will ultimately determine the fate of the patient with hypertension.[25] Efficacy, however, can only be gauged by the achievement of evidence-based target levels of BP, which in turn demands accurate BP measurement that should also be capable of indicating BP control over the 24-hour period.

Given these facts it seems that there should be an imperative to change contemporary clinical practice if we are to avert the burden of stroke and heart failure in an aged population. We have adequate drugs to achieve effective BP lowering in the vast majority of patients; what we lack is the determination to achieve effective BP control as early as possible. In the light of the evidence available on these societal and financial consequences of uncontrolled hypertension we must no longer quibble over the cost of technology to measure BP. Every patient suspected of having hypertension should have ABPM to confirm or refute the diagnosis, and every patient with uncontrolled hypertension should have ABPM repeated as necessary until 24-hour control of BP is achieved.

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