Blood pressure

The value of patterns of 24-hour ambulatory BP

Prof Eoin O'Brien writes that patterns of 24-hour ambulatory blood-pressure are very valuable in clinical practice

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, revolutionised 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.

There can be little argument about ambulatory blood pressure management (ABPM) being superior to OBPM. The 'white coat' effect 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. 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 hypertensive patients lies.

It is important for physicians using ABPM to ensure that the device being used has been recommended for clinical use by checking with 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 standardised format, demarcates the bands of normality and provides a one-page computer-generated interpretative report *(Fig 1, above)*. Because ABPM has been shown to significantly improve BP control in primary care, advances have been made in central hosting and analysis of ABPM data.

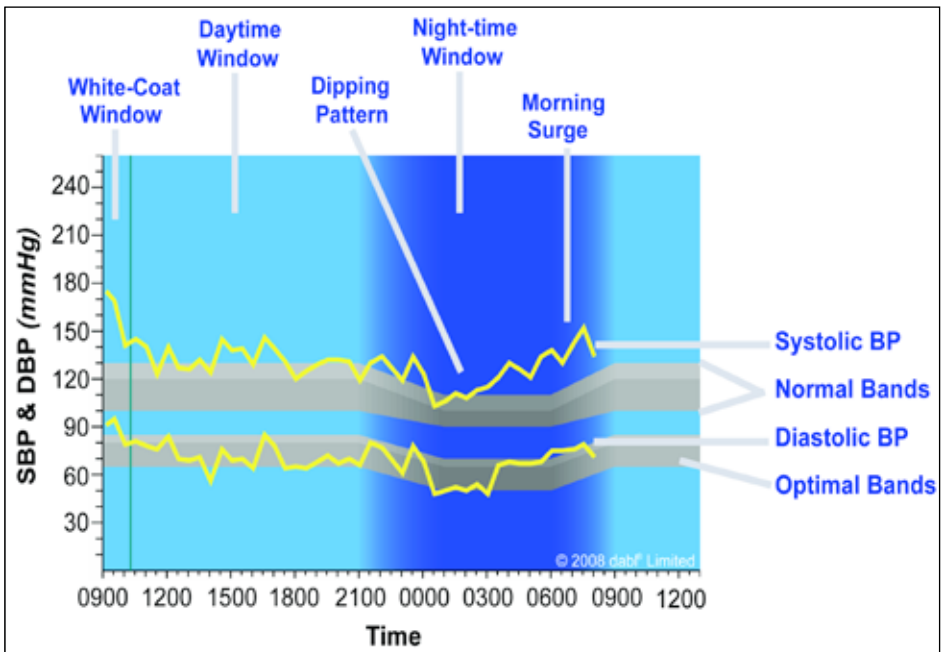

Figure 1: Schema for dabl one-page interpretative report

Experience with ABPM in primary care

One of the first studies of ABPM in primary care was the RAMBLER I study, which showed that only 12 per cent of patients achieved target BP with OBPM, compared to over one third of patients with ABPM.

Furthermore, 38 per cent of patients had a change in their medication as a result of ABPM; 32 per cent had a new medication started and 14 per cent of untreated patients with elevated OBPM, who were candidates for drug treatment, were not commenced on medication because ABPM was normal. Now the Rambler II Study is under way in Ireland, with the purpose of linking primary care with a central repository for the analysis of ABPM data *[see box, next page]*.

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. In this study clinic, BPs were approximately 16/9 mmHg higher than ABPM in patients categorised as being at low-to-moderate added risk with a greater difference (23/23 mmHg) in those categorised as being at high risk. Moreover, 60 per cent of high-risk patients had a non-dipping nocturnal pattern. As in the Irish RAMBLER 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. However, BP was uncontrolled by both methods of measurement in 43 per cent of patients.

Windows of the 24-hour circadian profile

In contemporary clinical practice, the mean daytime and nighttime BPs are generally taken as being the most valuable parameters of ABPM, but ongoing research indicates that there is much more information to be gleaned from the 24-hour BP cycle.

The 24-hour period can be divided into a number of windows – the 'white coat' window, which is the first hour after the monitor has been fitted when the pressor effect of the medical environment may be present; the daytime window; the vesperal window, when pressures begin to decline on retiring; the nocturnal window, when pressure should reduce and be at the lowest or basal level during the 24-hour period; and the matinal window, the pressure rise prior to awakening when a morning surge in BP may be evident *[Fig 1]*.

Patterns of ABPM

The following patterns can be identified from the 24-hour ABPM profile:

'White coat' hypertension: The risk associated with 'white coat' hypertension remains controversial, but there is general agreement that the condition should not be regarded as benign, with the risk of developing sustained hypertension at some time being almost inevitable *[Fig 2, next page]*.

'White-coat' effect: 'White coat' hypertension must be distinguished from the 'white-coat effect', which is the term used to describe the increase in pressure that occurs in the medical environment regardless of the daytime ABPM.

In other words, the term indicates the phenomenon, found in most hypertensive patients, whereby OBPM is usually greater than the average daytime ABPM, which is nonetheless increased above normal *[Fig 1]*.

Masked hypertension: This phenomenon denotes subjects classified as normotensive by conventional office or clinic measurement, who are hypertensive with ABPM or self-measurement. The prevalence of masked hypertension in adults seems to be at least 10 per cent and may indeed be higher with a tendency to decrease with age.

Adult subjects with masked hypertension have increased target organ involvement as denoted by left ventricular mass and carotid atherosclerosis. The problem for clinical practice is how to identify and manage these patients. It is estimated that these may number as many as 10 million people in the USA.

Ambulatory hypotension: Hypotension is particularly common in the elderly, who may have autonomic or baroreceptor failure and who may also experience post-prandial and postural hypotension – conditions that may lead to risk from falls and accidents.

ABPM may also be useful in identifying hypotensive episodes in young patients in whom hypotension is suspected of causing symptoms.

In treated hypertensive patients, ABPM may also demonstrate drug-induced decreases in BP that may have untoward effects in those with a compromised arterial circulation, such as individuals with coronary and cerebrovascular disease *[Fig 3, next page]*.

Daytime systo-diastolic hypertension: Many patterns of BP behaviour can be discerned from ABPM. By far the most common pattern is systo-diastolic hypertension. Usually, daytime BP levels are lower than clinic readings – the 'white coat' effect. Mean daytime levels of BP are superior to OBPM in predicting outcome but inferior to nocturnal BP.

Isolated systolic hypertension: Isolated systolic hypertension can, of course, be apparent on OBPM but it can be overestimated and ABPM allows for confirmation of the diagnosis as well as predicting outcome more accurately *[Fig 4, next page]*.

Nocturnal patterns: The 'dipper/non-dipper' classification was first introduced in 1988 when a retrospective analysis suggested that non-dipping hypertensive patients had a higher risk of stroke than the majority of patients with a dipping pattern.

Large-scale prospective studies currently support the concept that a diminished nocturnal BP fall is associated with a worse prognosis.

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Moreover, nocturnal hypertension is now known to be an independent risk for cardiovascular outcome over and above all other measures of BP. For example in the Dublin Outcome Study, for each 10-mm Hg increase in mean nighttime systolic BP, the mortality risk increased by 21 per cent *[see Figs 5 and 6, right]*.

In some patients, BP rises above the daytime pressures rather than falling during the night. These patients (also referred to as extreme non-dippers) have the worst cardiovascular prognosis, both for stroke and cardiac events.

Patients with a marked nocturnal fall in BP, known as extreme-dippers, are at risk for non-fatal ischaemic stroke and silent myocardial ischaemia, probably because of the presence of atherosclerotic arterial disease that leaves them prone to cardiac or cerebrovascular events if excessive BP reduction results from injudicious antihypertensive medication. Extreme dipping is closely associated with an excessive morning surge in BP, which is associated with cerebral infarction and a high risk of future stroke.

Cardiovascular events, such as myocardial infarction, ischaemia and stroke are more frequent in the morning hours, soon after waking, than at other times of day. It has been shown that in older hypertensive subjects, a morning surge in BP carries a risk of stoke almost three times that seen in patients without a morning surge.

Conclusion

There is a wealth of information to be obtained from ABPM in identifying forms and patterns of hypertension, which then allows for the more rational use of BP-lowering drugs.

We must remind ourselves that the prevention of the cardiovascular consequences of hypertension is dependent on not merely prescribing antihypertensive drugs, but ensuring that drugs are prescribed in sufficient dosage or combinations to bring BPs within the normal bands throughout the day and nighttime periods.

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Interested in participating in a 24-hour BP study? RAMBLER II study (Role of Ambulatory Blood Pressure Monitoring in General Practice)

Background

The clinical use of 24-hour blood pressure recordings has been rapidly increasing all over the world. However, its role and impact on daily clinical practice in Ireland, and indeed internationally, is not clear.

What is being asked of my practice?

RAMBLER II simply involves connecting your 24-hour monitor to the internationally recognised dabl ABPM program for one year and this will allow you to receive real-time on-line interpretation of 24-hour blood pressure measurements. Further information on the dabl ABPM program is available at www.dabl.ie. Broadband internet access is required.

Your patient data, over the year, will then be made anonymous allowing the researchers at NUI, Galway to describe the role and impact of ABPM on daily clinical Irish practice.

Why on earth should I do that?

There are a number of unique advantages to being part of the dabl ABPM program:

- Your data is securely saved off site, should you ever require a copy or should your computer fail;
- Any internationally agreed developments in 24-hour blood pressure interpretation are immediately applied by the dabl ABPM program to your data;
- You will receive confidential six-monthly audit data of your own practice compared to the average of the dabl ABPM program network. This includes percentages of patients who are controlled and uncontrolled and mean daytime, nighttime and 24-hour blood pressure according to whether they are on medication or not;
- You will receive six-monthly newsletters, edited by **Prof Eoin O'Brien**, of the latest international developments in hypertension management.

How much will all this cost?

It will cost you nothing. Menarini Pharmaceuticals will fund the costs of joining the dabl group and then connecting to, and participating in, the dabl ABPM program network for one year.

Data security and handling

The Principle Investigators and other designated research personnel have access only to a pseudoanonymised database, i.e. the data is coded to remove all patients and practice identifying features rendering the database anonymous.

The key to the code is held only by dabl and is not available to the research team.

We would be delighted if you would consider participating; just email akke.vellinga@nuigalway.ie or ring Akke at (091) 495192.

References

This article is based on the following papers in which full references may be obtained:

1. O'Brien E. The circadian nuances of hypertension: a reappraisal of 24-h ambulatory blood pressure measurement in clinical practice. *Ir J Med Sci* 2007;176:55-63

2. O'Brien E. Ambulatory Blood Pressure Measurement. The Case for Implementation in Primary Care. Hypertension 2008;51;1435-1441

Legends for figures

Figure 1: Schema for dabl one-page interpretative report.

Figure 2: White coat hypertension: The ABPM suggests white coat hypertension (175/95 mm Hg) with otherwise normal 24-hour systolic and diastolic blood pressure (133/71 mm Hg daytime, 119/59 mm Hg nighttime).

Figure 3: Ambulatory hypotension: The ABPM suggests low daytime systolic blood pressure (100 mm Hg) and normal daytime diastolic blood pressure (61 mm Hg) and moderate night-time systolic and diastolic hypertension (146/89 mm Hg) with white coat effect (200/102 mmHg).

Figure 4: Isolated systolic hypertension: The ABPM suggests severe 24-hour isolated systolic hypertension (176/68 mm Hg daytime, 169/70 mm Hg night-time).

Figure 5: Hypertensive dipper: The ABPM suggests mild daytime systolic and diastolic hypertension (147/93 mm Hg) and normal night-time systolic and diastolic blood pressure (111/66 mm Hg) with white coat effect (158/90 mm Hg)

Figure 6: Hypertensive non-dipper: The ABPM suggests severe systolic and diastolic hypertension over 24 hours (209/135 mm Hg daytime and 205/130 mm Hg at night).

[All plots and reports generated by dabl ABPM—© dabl 2008 (www.dabl.ie)]

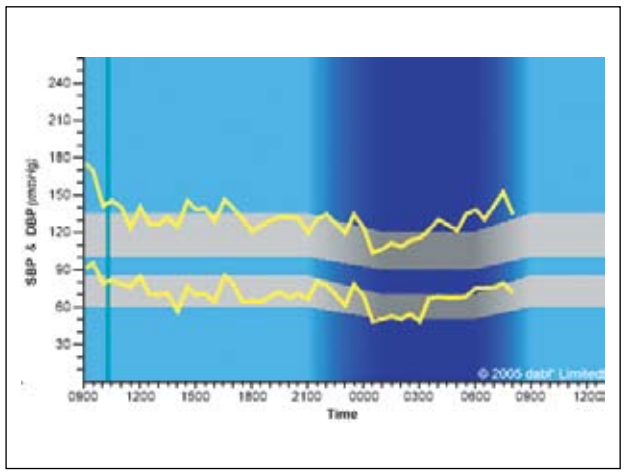

Figure 2: 'White coat' hypertension *(see 'Legend' in box, lower left)*

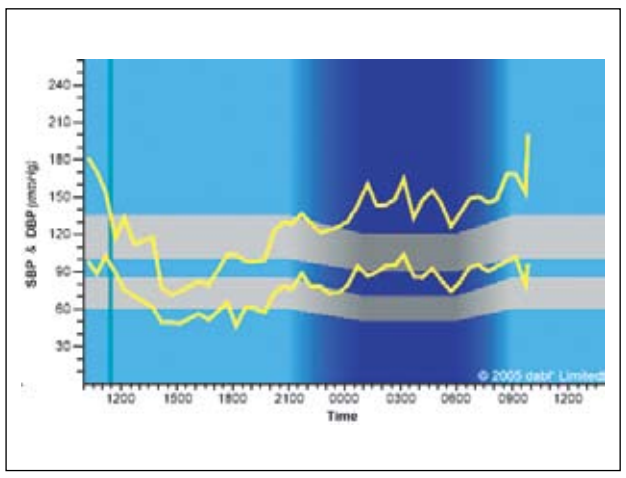

Figure 3: Ambulatory hypotension *(see 'Legends for figures' box, lower left)*

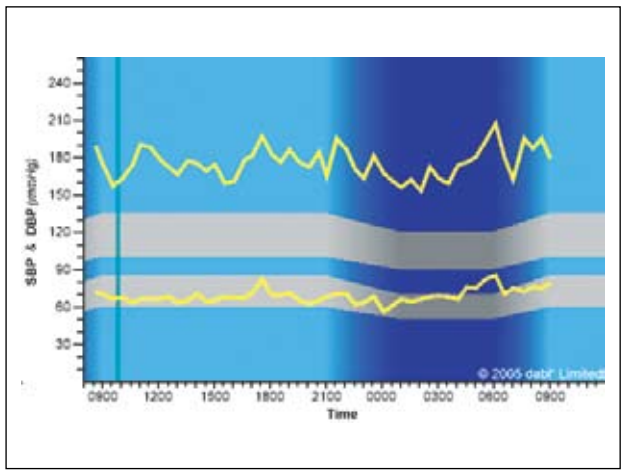

Figure 4: Isolated systolic hypertension *(see 'Legends for figures' box, lower left)*

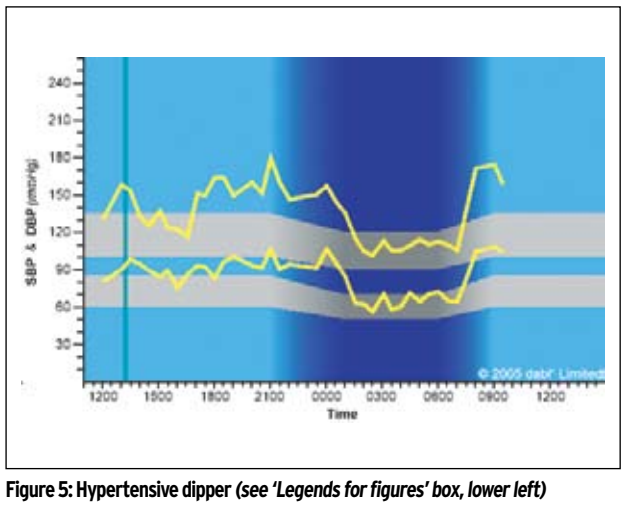

Figure 5: Hypertensive dipper *(see 'Legends for figures' box, lower left)*

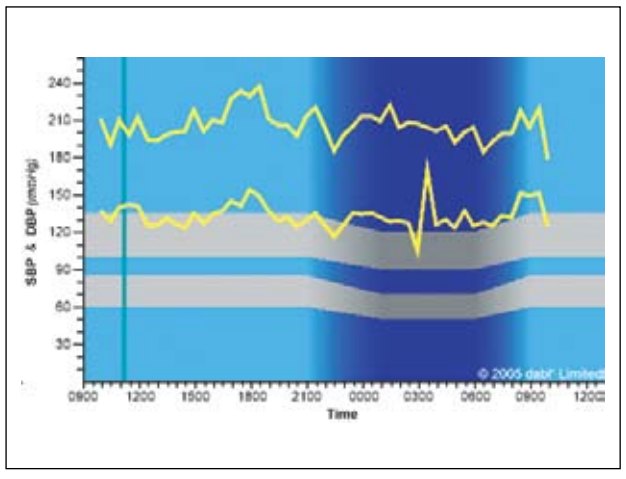

Figure 6: Hypertensive non-dipper *(see 'Legends for figures' box, lower left)*