Editorial

Blood pressure measurement is changing!

As we move into the new millennium, the century old Riva-Rocci/Korotkoff technique of measuring blood pressure is changing. There are a number of reasons for this. First, mercury is a toxic substance, the use of which can no longer be countenanced in clinical medicine, and the traditional technique, despite a history of reputable service, is likely to disappear from clinical practice.[1 2] Second, it is now recognised that though the old technique has given good service, it is fraught with inaccuracies,[3] and accurate automated devices are becoming available to replace the mercury sphygmomanometer. Third, 24 hour ambulatory blood pressure measurement (ABPM) has highlighted the phenomenon of white coat hypertension, and more reliance is being placed on blood pressure behaviour than on casual measurement of blood pressure levels.[4]

Banning mercury

Mercury is a toxic, persistent, and bioaccumable substance, many tons of which are distributed throughout the world to hospitals and countless individual doctors and little of which is returned for disposal. Admittedly the contribution of mercury from sphygmomanometers to environmental pollution is small, but none the less, mercury from whatever source finds its way back into the environment through evaporation, in sewage or in solid waste, most seriously damaging the marine environment, and it accumulates in soil and in sediments thereby entering the food chain.[1] The mercury thermometer has been replaced in many countries, and in Sweden and the Netherlands the use of mercury is no longer permitted in hospitals. In other European countries, however, including the UK and Ireland, the move to ban mercury from hospital use has not been received with enthusiasm because we do not have an accurate alternative to the mercury sphygmomanometer.[1 2] This ambivalence often results in hospitals and doctors replacing mercury sphygmomanometers with unreliable and inaccurate devices, such as aneroid sphygmomanometers, which become inaccurate with use and should not, therefore, be substituted for the mercury instrument.[2] Many automated devices have had a poor record for accuracy, but automated devices are now beginning to satisfy the stringent criteria of the validation protocols of the British Hypertension Society (BHS) and the Association for the Advancement of Medical Instrumentation (AAMI).[5]

The passing of mercury sphygmomanometers should not in itself be a cause for concern. In fact, it might be argued that the sooner we rid ourselves of an inaccurate technique, on which we base so many important decisions of management, the better.[1 3] Automated devices can remove observer error and provide in addition a printout of the measurement with the date and time of the measurement, or the measurement can be stored for display in a computer program.

Banning mercury from clinical use raises another issue of importance for clinical medicine. The Systeme International (SI) unit for pressure is the kilopascal. However, replacing the millimetre of mercury by the kilopascal has been postponed until such time as there is a suitable alternative to the mercury sphygmomanometer.[6] If the millimetre of mercury is no longer the unit of measurement for blood pressure, the mainstay of the medical argument for retaining it as a unit of measurement—namely, that we measure what we see—will also disappear.

White coat hypertension

The importance of white coat hypertension rests on a curious haemodynamic phenomenon, which has quite profound clinical relevance: patients—let us call them people, because they may not be ill—who appear to have hypertension when their blood pressure is measured by the traditional Riva-Rocci/Korotkoff method, have normal blood pressures when ambulatory techniques are used to record their blood pressures away from the medical environment. Put another way, conventional blood pressure measurement is misleading in people with white coat hypertension (and most of us have some degree of white coat reaction), and if decisions are based on these measurements inappropriate diagnosis and treatment may result.

The best way to diagnose white coat hypertension is with ambulatory blood pressure measurement.[7] The evidence from self measurement of blood pressure is not as conclusive, but the phenomenon can be demonstrated if home recorded blood pressures are normal with elevated clinic blood pressures. Unfortunately, there is no means of identifying people with white coat hypertension except by demonstrating the presence of normal blood pressures away from the medical environment.

The most popular definition is that blood pressure measured by conventional techniques in the office, clinic or surgery is above 140/90 mm Hg, but when ambulatory measurement is performed the blood pressures are normal throughout the 24 hour period, except perhaps during the first hour of the 24 hour recording when the patient is under the pressor influence of the medical environment while having the monitor fitted (fig 1).[7] White coat hypertension is common, being present in about a quarter of people who appear to have hypertension with conventional measurement.[8]

The consequences of failing to identify white coat hypertension are considerable. Young (and indeed the not so young) people may be penalised for insurance and pension policies, and for employment. Life long treatment may be prescribed unnecessarily, and if antihypertensive medication is given to people whose 24 hour pressures are normal they may be made unwell by the adverse effects of medication. In the elderly, in whom white coat hypertension is common, the inappropriate use of drugs may have serious debilitating consequences.

Are people with white coat hypertension at risk? This is an important question because future management will be dependent on it. The evidence from a growing literature on the subject strongly supports the view that though white coat hypertension may not be altogether benign (some 10% of subjects show echocardiographic evidence of increased left ventricular hypertrophy), the risk of

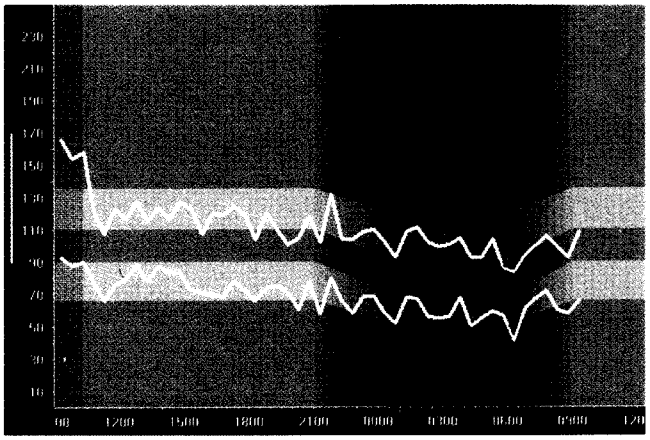

Figure 1 DABL cardiovascular plot.[5] Vertical axis: blood pressure level; horizontal axis: time of day; hatched area: first hour of recording or "white coat window"; darkened area: night-time period; grey bands: limits of normality for systolic and diastolic blood pressures. ABPM plot shows white coat hypertension: office blood pressure 170/90 mm Hg (vertical bar); first hour blood pressure reaches 166/94 mm Hg, but then settles to give daytime pressures averaging 122/78 mm Hg and night-time pressures averaging 112/68 mm Hg.

cardiovascular complications is very much less than for patients with sustained hypertension.[9] Therefore, most people with white coat hypertension are not in need of antihypertensive medication, but because some may be at risk, albeit it considerably less so than patients with sustained hypertension, follow up is required. Of course, concomitant risk factors, such as smoking, obesity, and hypercholesterolaemia, should be addressed.

Ambulatory blood pressure measurement

It is recommended that people with white coat hypertension should be followed at yearly intervals with ambulatory measurement.[10] In advocating the use of ambulatory measurement annually to follow people with white coat hypertension, the fiscal argument is often invoked, namely that the technique is too expensive to justify such a recommendation, and that indiscriminate use of ABPM would place an intolerable burden on health care services. Studies on the economics of ABPM are few, and the fear of inappropriate use, especially in private practice, has had a negative influence.[4] However, the main riposte to the financial argument must be that if drug treatment is postponed or averted, the savings in pharmacological costs far outweigh the technologic costs of using ABPM. Until recently the evidence that ABPM might beneficially influence drug prescribing was lacking. However, in a study in which treatment was prescribed on the basis of either conventional blood pressure or mean daytime ABPM, significantly less antihypertensive medication was prescribed when ABPM was used, multiple drugs were used less frequently, and importantly there was no difference in left ventricular size between the two groups, showing that the patients for whom less medication was prescribed were not disadvantaged in terms of target organ status.[11]

The issue of equipment accuracy is very much better for ABPM devices than for other automated devices, with a large number of devices fulfilling the criteria of the BHS and AAMI protocols (for a list of devices see O'Brien and colleagues[10]).

Another argument put forward against the use of ABPM is that there are not sufficient data from longitudinal studies showing its superiority over conventional measurement to justify its use in clinical practice. In fact this line of reasoning is no longer valid as the evidence is now available to show that ABPM is superior to conventional measurement in predicting prognosis.[12] However, when ABPM is used to find those people with elevated conventional blood pressure in whom blood pressure elevation is not sustained when they are removed from the pressor effect of the medical environment, the technique is merely a facet of good clinical practice in which the issue of outcome is secondary.

Who should have ABPM? This interesting question is addressed—but not answered satisfactorily—in three prestigious international guidelines on hypertension: the Joint National Committee on prevention, detection, detection, evaluation, and treatment on high blood pressure (JNC VI)[13] recommends that ABPM should be performed in "suspected white coat hypertension", whereas the BHS,[14] and the World Health Organization/International Society of Hypertension (WHO/ISH)[15] guidelines both recommend that ABPM should be performed when blood pressure shows "unusual variability". However, the guidelines do not say when white coat hypertension should be suspected, or what exactly constitutes unusual variability of blood pressure, simply because there are no identifying characteristics for white coat hypertension other than by demonstrating that elevation of blood pressure using conventional measurement is absent on ABPM.[16] The BHS recommendations on the use and interpretation of ambulatory blood pressure measurement recommends the technique for the exclusion of white coat hypertension.[10] But as every patient with apparent elevation of blood pressure in our clinics and surgeries could have white coat hypertension, does this mean that all such people should have ABPM? The answer has to be "yes" in patients with mild, borderline and moderate elevation of blood pressure on conventional measurement. I would not permit a doctor to prescribe life long treatment for me on the basis of conventional measurement, and this is also my recommendation for my patients. The benefits of identifying white coat hypertension are such that ABPM should be available to patients wherever and whenever the diagnosis of "hypertension" is contemplated.

Self blood pressure measurement

Self blood pressure measurement is re-establishing a place for itself in the management of hypertension. The First International Consensus Conference on Blood Pressure Self-Measurement was held in Versailles in June 1999.[17] A large number of issues were examined and it was agreed that self measurement had a role in the management of hypertension, but that data were needed from longitudinal studies before its place could be firmly established. The technique should be seen as complementary to ABPM rather than a substitute for it, as both techniques allow blood pressure behaviour outside the medical environment to be assessed in different ways.

EOIN O'BRIEN

Blood Pressure Unit,
Beaumont Hospital,
Dublin 9, Ireland
eobrien@iol.ie

1 O'Brien E. Replacing the mercury sphygmomanometer. *BMJ* 2000;**320**:815–16.
2 O'Brien E. Will mercury manometers soon be obsolete? *J Hum Hypertens* 1995; **9**:933–4.
3 Markandu ND, Whitcher F, Arnold A, *et al.* The mercury sphygmomanometer should be abandoned before it is proscribed. *J Human Hypertens* 2000; **14**:31–6.
4 O'Brien E. White coat hypertension: how should it be diagnosed? *J Human Hyperten* 1999;**13**:801–2.
5 O'Brien E, Mee F, Atkins N, *et al.* Evaluation of three devices for self-measurement of blood pressure: according to the revised British Hypertension Society protocol: the Omron HEM-705CP, Phillips HP5332, and Nissei DS-175. *Blood Pressure Monitoring* 1996; 1:55–61.
6 O'Brien E. Will the millimetre of mercury be replaced by the kilopascal. *J Hypertens* 1998;**16**:259–61.

7 Owens P, Atkins N, O'Brien E. The diagnosis of white coat hypertension by ambulatory blood pressure measurement. *Hypertension* 1998;**34**:267–72.
8 Pickering TG, James GD, Boddie C, *et al.* How common is white coat hypertension? *JAMA* 1988;**259**:225–8.
9 Owens P, Lyons S, Rodriquez S, *et al.* Is elevation of clinic blood pressure in patients with white coat hypertension who have normal ambulatory blood pressure associated with target organ damage? *J Hum Hypertens* 1998;**12**:743–8.
10 O'Brien E, Coats A, Owens P, *et al.* Use and interpretation of ambulatory blood pressure monitoring: British Hypertension Society recommendations. *BMJ* 2000;**320**:1128–34.
11 Staessen JA, Byttebier G, Buntinx F, *et al*, for the Ambulatory Blood Pressure Monitoring and Treatment of Hypertension Investigators. Antihypertensive treatment based on conventional or ambulatory blood pressure measurement. A randomized controlled trial. *JAMA* 1997;**278**: 1065–72.
12 Verdecchia P. Prognostic value of ambulatory blood pressure current evidence and clinical implications. *Hypertension* 2000;**35**:844–51.
13 The Joint National Committee of Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. The sixth report of the Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure. *Arch Intern Med* 1997;**157**:2443–6.
14 Ramsay LE, Williams B, Johnston GD, *et al.* Guidelines for management of hypertension: report of the third working party of the British Hypertension Society. *J Human Hypertens* 1999;**13**:569–92.
15 Guidelines Subcommittee of the World Health Organisation-International Society of Hypertension (WHO-ISH). 1999 World Health Organisation-International Society of Hypertension guidelines for the management of hypertension. *J Hypertens* 1999;**17**:151–83.
16 O'Brien E, Staessen J. Critical appraisal of the JNC VI, WHO/ISH and BHS guidelines for essential hypertension. *Expert Opinion on Pharmacotherapy and Emerging Drugs* 2000;**1**:675–82.
17 Asmar R, Zanchetti A on behalf of the Organizing Committee and participants. Guidelines for the use of self-blood pressure monitoring: a summary report of the first international consensus international conference. *J Hypertension* 2000;**18**:493–508.

IMAGES IN CARDIOLOGY

Aortic valve sparing operations

A new aortic Dacron prosthesis (Sulzer Vascutek, Renfrewshire, UK) that replaces the aortic root and at the same time recreates the sinuses of Valsalva has been designed (top; LV, left ventricle). It has been employed in the two types of surgical techniques more commonly used to spare the aortic valve: the reimplantation (or David I) technique where the natural valve is sutured inside the Dacron conduit, and the remodelling (or Yacoub) technique where the Dacron conduit is tailored to fit the crescent shape of the aortic root.

A transoesophageal echocardiographic long axis view of the aortic root during diastole in a patient after a Yacoub type of valve sparing procedure (middle; Ao, prosthetic ascending aorta) and during systole in a patient after a David I type of valve sparing procedure using the new Dacron conduit (bottom) shows the normal shape and dimension of the sinuses, the natural narrowing of the sinotubular junction, and the perfect alignment of the open leaflet with the prosthetic ascending aortic wall.

Upon implantation of the new aortic root conduit and without technical modification of the techniques as originally described by their authors, it is possible to restore a perfect anatomy of the aortic root.

RUGGERO DE PAULIS
GIOVANNI MARIA DE MATTEIS
LUIGI CHIARIELLO