The Role of Home and Ambulatory Blood Pressure Recording in the Management of Hypertension

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A review of the literature shows that doctor-recorded measurement (DRM) of blood pressure is higher than patient-recorded measurement (PRM) by either home-recording or ambulatory measurement. The role of home-recording and ambulatory measurement as a means of supplementing doctor-recorded measurement is discussed. The results of two studies comparing home-recording with clinic and ambulatory blood pressure showed that home-recording of blood pressure did not lower blood pressure.

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Introduction

Hypertension can only be diagnosed by blood pressure measurement, and its management is dependent on measurement with a sphygmomanometer. It is hardly surprising, therefore, that in recent years considerable attention has been focused on the accuracy of this important technique [1-3]. Although it has been recognized for many years that blood pressure measurements made away from the hospital environment may be considerably lower than those obtained by a doctor [4], the relevance of this observation has only been given due attention recently [5-7]. Blood pressure levels are lower with patient-recorded measurement (PRM) than with doctor-recorded measurement (DRM). The most widely used form of PRM is home-recording of blood pressure [8-11], but non-invasive techniques of ambulatory blood pressure measurement are now playing an increasingly important role in the assessment of hypertension [12-15]. It has been suggested that home-recording of blood pressure has a blood pressure lowering effect [16-18]. In this paper, home-recording is compared with conventional clinic measurement, and non-invasive ambulatory blood pressure measurement, and the effect of home-recording on blood pressure is examined.

Differences between DRM and PRM

The first study to assess the difference between blood pressure measurement by a doctor and a patient was that of Ayman and Goldshine in 1940 [8], who demonstrated that PRM using home-recording was lower than DRM by as much as 40/20 mmHg in nearly a quarter of their patients. Subsequent studies have confirmed that DRM is higher than PRM with both home-recording [9-11,19,20] and ambulatory methods of blood pressure measurement [14,21-26]. This difference, which is highly variable, is greater for systolic than for diastolic pressure, with higher blood pressures for both home-recording [7,9] and ambulatory measurement [27], and in younger subjects for home-recording [7]. Both home-recording [5] and ambulatory measurements are reproducible [23,27], but neither home [7] nor ambulatory blood pressure can be predicted from clinic measurements [22,23,27].

The reasons for the difference between DRM and PRM is not clear. The pressor effect of doctors [13] may be a contributory factor but is not the whole explanation [28]. Familiarization with the technique of measurement is

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another possibility which has not been confirmed for either home-recording [29] or ambulatory measurement [27].

Accuracy of techniques

Doctor-recorded measurements (DRM)

A variety of factors may influence the accuracy of blood pressure measurement [1-3]. Casual blood pressure measurement, once the accepted measurement on which diagnostic and prognostic decisions were made, is now considered to be of limited value and may in fact be misleading [30]. Indeed the value of DRM alone in the assessment of hypertension has been questioned, and it has been suggested that home-recording [7], ambulatory measurement [14], or both [31] should supplement DRM.

Patient-recorded measurments (PRM)

Home-recording

The accuracy of home-recording can be tested readily using a double stethoscope [8]. Assessed against clinic measurements, home measurement of blood pressure is accurate when performed by patients [5,7,9-11,20,32] or their relatives and friends [8,11], and the technique is capable of detecting small average changes in blood pressure [5]. Home-measurements also compare well with continuous intra-arterial measurments [25]. The technique can be learned accurately by the majority of patients [5,6,19,20] and by adolescents [33]. Patients have been shown to retain the ability to record blood pressure accurately for as long as two years [20], and relatives or friends for up to three months [11].

Ambulatory techniques

Ambulatory blood pressure may be measured continuously by direct intra-arterial measurement [34], or intermittently by non-invasive techniques utilizing semi-automated portable recorders that detect Korotkoff sounds with a microphone during cuff deflation. As direct intra-arterial measurement of ambulatory blood pressure is not without risk, and cannot be repeated readily, the procedure is restricted to a few research centres. Two non-invasive systems have been shown to be accurate – the Remler M2000 [12,14,35] and the Avionics Pressurometer [36] – and have been widely used in a variety of studies.

Of the proven advantages of PRM over DRM, the most important are the ability of PRM to improve the accuracy of diagnosis and to predict the cardiovascular complications of hypertension. In borderline hypertension diagnosed at the clinic, as many as one-third may have normal blood pressures recorded by home-measurement [9,28]. Using ambulatory blood pressure measurement, as many as 43% of borderline hypertensive patients were shown by Fitzgerald *et al.* [27] to have normal ambulatory pressure, and Waeber *et al.* [23] demonstrated that only 39% of borderline hypertensives had elevated systolic blood pressure and 44% had elevated diastolic pressure with ambulatory measurements.

It has been shown that left ventricular hypertrophy correlates better with home [37] and ambulatory blood pressure measurement [38,39] (PRM) than with office measurement (DRM), and the incidence of the fatal and non-fatal consequences of hypertension is predicted more accurately by ambulatory (PRM) than office-recorded blood pressure (DRM) [14].

By providing more measurements, PRM assists the physician in initiating and modifying drug therapy, and it has been suggested that patients might be able to modify their own therapy according to self-recorded levels [32]. PRM provides an assessment of blood pressure behaviour throughout the day which can be helpful in adjusting drug treatment, as well as being a method for assessing drug effect in pharmacological studies in hypertension [8,36]. Decreases in home blood pressure measurements have been observed in drug trials that would not have been detected at the clinic [40], and similar changes have been observed with ambulatory measurement [2]. Recent studies have demonstrated that PRM, both home-recording [20] and ambulatory measurement [14], are superior to DRM in epidemiological research.

Which method of PRM is best home-recording or indirect ambulatory blood pressure measurement?

The accuracy and reproducibility of home and ambulatory measurement assessed against other indirect methods of measurement are about equal, though the usefulness of either technique depends on the frequency of measurement made in a 24-h period, the number of times that these measurements are repeated and the duration of the study period.

The high cost of non-invasive ambulatory equipment and of its maintenance must restrict the application of this technique, but when balanced against the problems of diagnosis in borderline hypertension, and the potential cost of an incorrect diagnosis, ambulatory techniques may be good value for money. By comparison, home-recording is very much cheaper in terms of the initial outlay for equipment, but the cost of training patients, and the problem of compliance with the technique must be taken into consideration. In some studies of home-recording, as many as one-third of patients refused to participate [5], and in other studies there has been a large drop-out rate [7,32]. Moreover, there may be reluctance among doctors to adopt the technique [42].

Patients undertaking home-recording need to be trained in the technique, whereas only a brief period of instruction in the use and care of the equipment is required with ambulatory techniques. Training techniques for home-measurement vary greatly from the elaborate use of videos and film [11,33] to the provision of brief written instructions [43,44] and reinforcement of the technique when the trainee attends for assessment of accuracy.

Home-recording of blood pressure may prove valuable in managing hypertensive patients who live long distances from a doctor, and the availability of a sphygmomanometer in the home may serve as a means of detecting hypertension in families [45].

Some studies have shown that compliance to drug therapy is improved by home-recording of blood pressure [6,32] and it has been suggested that home-recording may in itself have a blood pressure lowering effect [16-18].

Blood pressure lowering effect of home-recording

Brown [4] first suggested in 1930 that home-recording might alert patients to stress-mediated elevation of blood pressure that might be modified by 'emotional control'. Ayman and Goldshine [8] suggested that such elevation could be avoided by relaxation, and patients have confirmed this effect of home-recording [6]. Home--recording might therefore lower blood pressure through biofeedback, relaxation or avoidance of activities known to be associated with elevation of blood pressure.

Carnahan and Nugent [16] demonstrated a blood pressure lowering effect with home-recording, but as treatment was altered during the study no firm conclusion can be drawn from their results. However, the authors suggest that improved compliance might confer a blood pressure lowering effect on home-recording, and Johnson *et al.* [17] noted a beneficial effect of home-recording only in patients who admitted to difficulty in taking medication. Similarly, Laughlin *et al.* [18] found a significant decrease with home-recording in nearly half their patients. They attributed the initial decrease to familiarization with the technique, and the smaller but persistent decrease to either biofeedback or improved compliance with treatment and lifestyle recommendations. The results of these studies are inconclusive either because of changing treatment, or failure to use a cross-over design.

We have examined the effect of home-recording on blood pressure in two studies. In the first [45], 83 patients with diastolic pressures on treatment less than or equal to 110 mmHg were randomized to either a 9-week period of home-recording with clinic visits every 3 weeks, or to a 9-week period of clinic visits only. Patients were then crossed-over to alternative regimens for a further 9 weeks. Treatment was unchanged throughout the study. There was no significant mean difference between home and clinic blood pressures, and there was no change in clinic blood pressure during the home-recording periods. The relationship between clinic and home pressures was highly variable, and consecutive clinic systolic pressures showed a significant fall with time.

In the second study we assessed home-recording against ambulatory blood pressure recorded with the Remler M2000, and examined the effect of home-recording on both clinic and ambulatory blood pressure behaviour [46]. Twenty untreated patients with blood pressures between 90 and 110 mmHg on two successive clinic visits entered the study. Blood pressure was assessed firstly over a 6-week period by clinic and ambulatory measurement, then over a 2-month period by home, clinic and ambulatory measurement and, finally, over a further 4-week period by clinic and ambulatory measurement alone.

Blood pressures recorded at home and by ambulatory measurement (PRM) were lower than clinic measurements (DRM), this being significant for systolic pressure. Of the three methods of measurement, ambulatory measurement gave the lowest pressures. The relationship between the three measurements was highly variable especially for systolic pressures. Differences between home and clinic recordings and between ambulatory and clinic measurements were correlated significantly for both systolic and diastolic pressure. The home-clinic difference tended to decrease with age and increase with the level of clinic blood pressure. There was no change in clinic systolic or diastolic pressure nor in ambulatory measurement during the period of home-recording.

Conclusions

If we accept the concept of DRM to denote blood pressure levels recorded in a medical environment such as a clinic, office or surgery, and PRM to denote those blood pressures obtained by the patient or by an ambulatory technique, a review of the literature shows that DRM gives higher blood pressures than PRM, which is usually significant for systolic pressure. Furthermore, PRM seems to be better than DRM in predicting end-organ damage. It is unfortunate that PRM cannot be predicted from DRM.

The practical consequences of the discrepancy between PRM and DRM is that many people classified as hypertensive by DRM will be normotensive with PRM, and that DRM may be failing to detect the hypertensives at risk from cardiovascular complications.

It would seem, therefore, that conventional means of blood pressure assessment, namely DRM, may on its own be misleading in the diagnosis, management and prognosis of hypertension. PRM can be achieved readily by increased use of home-recording, a technique that is simple, accurate and economical, whereas the increasing use of non-invasive ambulatory measurement techniques is proving valuable not only in patient management but also in research.

Home-recording of blood pressure does not in itself have a blood pressure lowering effect.

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