Home blood pressure monitoring: its effect on the management of hypertension in general practice

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SUMMARY

Background. *Ambulatory and home blood pressure monitoring have been shown to improve the management of hypertension. Either can be used to diagnose 'white coat hypertension' (WCH), which affects 10% to 20% of hypertensives and usually does not require drug treatment. Home monitoring has been used little in primary care.*

Aim. *To investigate the use and acceptability of home monitoring, and to establish the incidence of WCH as diagnosed in a primary care setting.*

Method. *Twenty practices were asked to monitor hypertensive patients, in particular those about to start drug treatment and those who were poorly controlled.*

Results. *A total of 660 patients were monitored. Sixty-four (27%) of the 236 untreated patients had WCH and no medication was started in 60 (94%) of this group. Forty-five (17%) of the 258 poorly-controlled patients had WCH and, of these, 34 (76%) continued with the same medication and 11 (24%) either reduced or stopped it. Compliance with recording was high. Questionnaires and focus groups with doctors and nurses showed that home monitoring represented a valuable enhancement of their management of hypertensive patients. Patients reported a high degree of interest and satisfaction with monitoring.*

Conclusions. *Patients, doctors, and nurses found monitoring valuable, and found the instruments easy to use with few problems. The feasibility of screening for WCH with home blood pressure monitoring was demonstrated, and, for this specific purpose, it is recommended as the preferred alternative to ambulatory monitoring in primary care.*

Keywords: hypertension; home monitoring; blood pressure.

Introduction

THE diagnosis and management of hypertension is based on blood pressure (BP) measurements taken by doctors or nurses with conventional sphygmomanometers. Asking the patient to take their own BP at home has been sporadically reported for many years,[1-4] but the potential value of patient home measurement has been overshadowed by the development of continuous ambulatory BP monitoring.[5]

Home BP monitoring is recommended in some national[6] and local guidelines (Burns-Cox, personal communication, 1998) as an adjunct to the diagnosis and management of hypertension because it has been shown to diagnose sustained 'white coat hypertension' (WCH),[7,8] improve patient compliance with follow-up and medication,[9] help in the management of poor BP control[10] and drug side-effects,[5] and reduce prescribing costs.[10] It has not been widely used in the United Kingdom because it has required patient training in the use of mercury or aneroid sphygmomanometers and because of doubts about the accuracy of patient measurements. Now that accurate, reliable, and inexpensive semi-automatic monitors are available and have been validated,[11] home monitoring has become feasible.

We saw the need to establish the feasibility of home BP monitoring in the diagnosis of sustained WCH and assess its acceptability to doctors, nurses, and patients. This study therefore investigated the use and acceptability of home monitoring and estimated the incidence of WCH as diagnosed in a primary care setting.

Method

Local practices were offered participation in the study and the 20 who agreed were offered a monitor in exchange for data on its use. Each practice was provided with an Omron 705CP monitor, which enabled the storage of up to 14 measurements within its mechanism and a printout of these with mean values. They were asked to monitor new hypertensive patients before starting drug treatment (the 'untreated' group), those who were poorly controlled before increasing or changing their medication (the 'uncontrolled' group), and others whom they thought might benefit. Details of prior BP measurements, medication, and cardiovascular risk were requested, and nurses were asked to brief patients to take the patients' BP 14 times over five days, recording the figures automatically in the device and on a written chart. Patients completed a simple questionnaire on acceptability. Doctors and nurses detailed their experiences and opinions during the study. Focus groups with patients and with doctors and nurses were held.

Guidelines on monitoring and using the results were provided for practices. We used the British Hypertension Society Guidelines on the criteria for the diagnosis (≥160/100) and control (<160/90) of hypertension[12] using clinic readings. Home BP levels are known to be similar to those of daytime ambulatory monitoring,[13] and we defined the normal as a mean home BP of <150/95 for untreated cases and <150/85 for those poorly controlled. Mean home levels could be compared with clinic readings by adding the correction factors of 10 mmHg to the mean home systolic and five to the mean home diastolic as discussed below.

Sustained WCH was diagnosed if clinic levels were hypertensive but corrected mean home levels were normal.[14] We advised that patients with WCH, mild to moderate clinic levels, and no evidence of cardiovascular damage or major risk factors could be treated by non-drug strategies and observation with further home monitoring.

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Results

The practices' age–sex distributions, their setting, their teaching status, and their socioeconomic profiles varied considerably, but these were not associated with any differences in monitor use. There were 81 full-time equivalent doctors, a total list size of 142 000, a mean of 7200 patients per practice, and 1760 per doctor. Most practices quickly developed a waiting list for monitoring and five were lent second monitors by the project. Others purchased one so that, within a few months of the beginning of the investigation, 12 practices had more than one monitor.

The patients

A total of 672 patients were offered monitoring. One refused and a further 11 were excluded from the analyses; three because they provided no monitor readings, two where the practices did not provide records of clinic BP measurements, and a further six because of unacceptable readings. Of the 660 remaining, 236 (36%) were new patients, 258 (39%) were poorly controlled, and 166 (25%) were monitored for other reasons (Table 1). This latter group were mainly borderline cases not fulfilling the study criteria for hypertension or poor control, while three were pregnant and several others were monitored for undocumented reasons. Twenty-nine (4.4%) of the total had diabetes and 45 (7%) had a history of cardiovascular disease.

Monitor use

The 37 monitors in use for a period between six and 12 months had only minor technical problems. Two reported faulty printers; one of which was resolved by correcting the paper feed and the other was replaced by the supplier. The standard cuff containing a bladder measuring 23.5 cm by 12 cm was supplied, and this was found to be too short for a few patients with very fat arms.

A feature of modern semi-automatic sphygmomanometers is that mechanical problems, rather than causing inaccurate readings, produce an 'error' reading, and patients were asked to record these on their chart. The commonest, 'cuff over-inflation', is often a result of the cuff being too loosely applied. The total of 58 error readings recorded represented less than 1% of the 9240 BP measurements taken, and no patients had more than two. Occasional unexpectedly high readings occurred for no obvious reason, but a second attempt usually gave a reading in the expected range. However, six patients produced records with consistently exceptionally high values, which we were unable to explain and which were excluded from our analysis. In these cases, practices used office values for management decisions.

Outcome of monitoring

Where WCH was diagnosed, no change in drug status was made for 60 (94%) out of 64 untreated patients and 34 (76%) out of 45 of the uncontrolled patients (Figure 1).

Patient acceptability

Practices asked patients to record BP measurements using the 'memory' button on the machine and on a chart. Twenty-three patients (3.5%) had problems with the memory button and a further two (0.3%) had difficulty in reading the figures on the monitor. Nine (1.4%) had difficulty in entering figures on the chart. A total of 14 entries (the maximum number that the memory will store) were requested, and we found that chart records were more complete than those in the memory. Of chart entries, 533 (81%) patients made all 14 entries and only 11 (1.7%) made less than 10, whereas, of memory entries, 501 (76%) made 14 and 75 (11%) made less than 10. Using both machine and chart entries, 98% of patients produced 10 or more recordings.

A focus group highlighted the interest and enthusiasm that patients had for monitor use, their views on anxiety and BP variability, difficulties making recordings at work, and the importance of help from the practice nurses. Two hundred and one (30%) patients said that cuff inflation was comfortable, 349 (53%) said it was uncomfortable, and 90 (14%) said that it was very uncomfortable or painful. Forty-one (6%) patients said that monitoring interfered with normal living; most of these having found that it was inconvenient to take a BP reading while at work.

Doctor and nurse questionnaires

Seventy-one questionnaires were returned from 15 practices: 49 from doctors and 22 from nurses. Seventy responders said that monitoring had improved patient management, and other replies expressed satisfaction and interest. The median reported number of monitors needed per practice was 2.6.

Monitor validation

Periodic checks are advised in recent American guidelines,[6] and the European Union is expected to introduce regulations concerning annual checks on medical instruments. Checks by practice nurses were made in this study using 'Y-tubes' to connect a mercury sphygmomanometer in parallel with their monitor and take 10 random readings. Of the 40 mean systolic and diastolic figures received, 32 were within less than 2 mmHg, four within 3 mmHg and four between 3 and 5 mmHg.

Discussion

Home BP monitoring is feasible, acceptable, and effective in the diagnosis of WCH in routine primary health care. Compliance with recording was high. Patients, doctors, and nurses expressed a high degree of interest and satisfaction with monitoring. Only one previous study of home monitoring has been based in primary care[15] and that compared office, home, and ambulatory measurement in a group selected on the basis of an initially elevated office BP.

The practices collaborating in the study were self-selected but

Table 1. Numbers of patients monitored by age and sex.

	Age group (years)						
	<40	40–49	50–59	60–69	70–79	>80	Total
Male	27	65	80	70	28	5	275
Female	39	67	110	106	60	6	385
Total	66	132	190	176	88	8	660
Percentage of those monitored	10%	20%	29%	27%	13%	1	100%
Per 1000 of total population	3	6	10	12	8	1	5

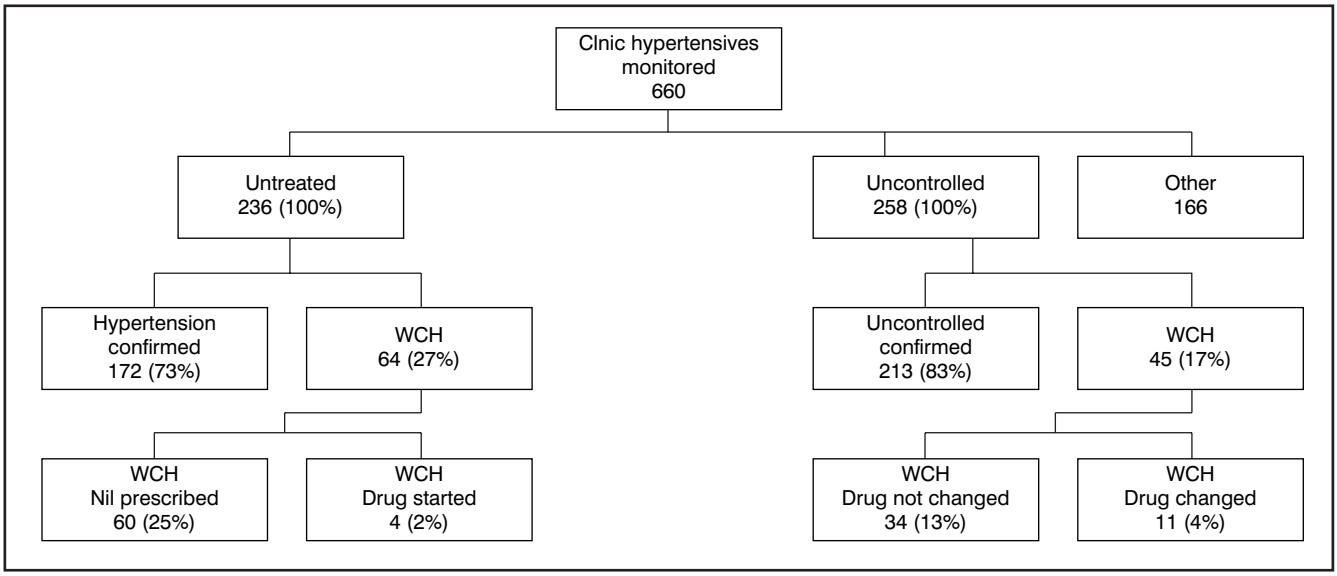

Figure 1. Outcome of monitoring.

appeared to be representative of primary care in general. They were likely to have monitored only a third of their untreated hypertensive patients since we know that the average practitioner starts roughly nine new patients on medication annually,[16] and they actually monitored a mean of 2.9 in this study. Up to one-half of hypertensive patients on medication are uncontrolled,[17-19] and these were also under-represented by the mean of 3.2 per doctor monitored in the study. Practices therefore demonstrated that, in the normal working environment, they are likely to use the home monitoring in less than half of those patients who could benefit from it. However, most practices had waiting lists and many would have monitored more patients had they been able.

As with the use of continuous ambulatory monitoring, it is necessary to establish arbitrary levels of the normal BP, and this we did on the best available evidence.[5,20] Having done so, we then adopted the use of correction factors as a practical guide to diagnosis.[21,22] Since clinicians use different 'normal' BP measurements depending on coexisting cardiovascular risk factors, employing correction factors is the best way of applying the results of monitoring outside the clinic to the individual patient's risk profile. This then enables simple criteria to be applied in diagnosing WCH. Because home readings are, in general, lower than office ones, using uncorrected home figures would risk seriously underestimating BP and leaving some patients untreated who, on present evidence, should receive it.

The management of WCH has been the subject of much discussion since it was recognized as a common entity about 10 years ago.[8] Though there are no major prospective trials with morbidity and mortality as endpoints, it is generally accepted that WCH has a cardiovascular risk intermediate between that of sustained hypertension and normotension.[23,24] Most authorities now agree that, where clinic levels are in the mild to moderate range and in the absence of other major risk factors, these patients require non-drug antihypertensive treatment and careful observation, but medication should not be prescribed.[23-25]

Previous studies of home monitoring have differed in the number of readings and the number of days. The more readings patients take the less the variability problem, but the shorter the period, the greater the patients' willingness and compliance. Most investigators have taken readings twice or three times a day for up to a week,[21,22,26-29] but a study in older patients showed that more than 15 readings over five days did not give significant changes in mean values.[30]

Patients recorded readings more reliably on charts than in the memory, and we recommend that a chart is likely to make more readings available as well as making the patient more aware of their blood pressure. Use of the memory has the advantage of automatically calculating the mean BP, which is an essential part of monitoring. We had to accept patients' honesty in recording readings, and it is possible that some chose to select only the values they saw as favourable.[5] We did not ask patients to avoid recording on working days, and some commented that this was a problem.

Cuff size was a matter for concern in that the bladder of the Omron 'standard cuff' measures only 22.5 cm in length. A larger cuff is marketed but, since only the standard one has been validated[11] and arm measurement is not part of normal clinical practice,[31] we decided not to employ it in this study. Though this could have resulted in inaccurately high home readings of some patients with obese arms and therefore some underdiagnosis of WCH, we took this option rather than risk overdiagnosis using the larger cuff.[5,31]

The monitors used in the study functioned well, and the nurses and patients quickly learned how to avoid multiple 'error' readings. Two suggestions concerning the design of the Omron HEM705CP were made by users. First, only 14 readings can be stored, and routine use would be more flexible by being able to store and printout a greater number. Secondly, in order to clear the memory for each patient, it is necessary to remove the batteries for at least a minute. This was seen as a waste of time in busy clinics where a monitor was often passed on to a new patient in the same clinic session, and we recommend that a memory clearing switch, suitably concealed, should be incorporated into the design. We also think that suppliers should recommend that a large cuff should be purchased with each instrument.

The accuracy of the instrument, the validity of readings, and therefore their variability, have been established as acceptable.[11] We are concerned, however, that six of the 660 patients monitored had unacceptable readings; in all cases the mean systolic being more than 40 mmHg above their mean clinic value. These patients reported no cuff problems and did not have multiple 'errors'; therefore, we have no explanation for these anomalous readings. They may represent extreme cases of what has recently been described as 'inverse white coat hypertension',[32] but further

investigation of this phenomenon is required. In practical terms, these readings are so obviously idiosyncratic that the practices ignored them in management decisions and they were treated as monitoring failures. Again, as with ambulatory monitoring, failures do occur and, where there is doubt about the results of monitoring, decision-making must be based on clinic readings.

The questionnaire responses and comments made by the doctors, nurses, and patients were generally favourable and criticisms were constructive. What they do not account for is the enthusiasm expressed by many who considered that home monitoring enhanced the quality of care given by the practices and was a powerful educational and empowerment tool for patients.

Semi-automatic instruments suitable for home monitoring cost between £100 and £160, whereas the equipment for ambulatory monitoring is at least 20 times this amount and needs more training and technical backup. This, we believe, is the main reason why ambulatory monitoring will not become part of the routine assessment of most hypertensive patients in most clinical settings. The feasibility and acceptability of home BP monitoring was demonstrated in this study and, for the specific purpose of screening all hypertensive patients in primary care for WCH, it is recommended as the preferred alternative to ambulatory monitoring.

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