

Is ambulatory blood pressure monitoring cost-effective in the routine surveillance of treated hypertensive patients in primary care?

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SUMMARY

Achieving target levels of office and/or ambulatory blood pressure readings among treated hypertensive patients is an important aspect of cardiovascular disease prevention. Although office blood pressure measurement is simple and convenient, ambulatory blood pressure monitoring is especially useful for identifying patients with 'white coat' hypertension, in whom falsely raised office blood pressure recordings often lead to unnecessary return visits and additional treatment. Office and ambulatory blood pressure control was compared in 374 treated hypertensive patients in a single general practice, and the costs of performing annual ambulatory blood pressure measurements were compared with potential clinical savings. Ambulatory blood pressure monitoring detected 115 (31%) patients who fulfilled the British Hypertension Society target for ambulatory but not office blood pressure, i.e. white coat hypertension, and 21 patients apparently controlled by office but not ambulatory blood pressure criteria. In economic modelling, the capital, maintenance and user costs of ambulatory blood pressure monitoring (£13 790 per year) were partly offset by fewer follow-up visits and second-line treatments in the group with white coat hypertension (there were modelled savings of £10 178). Thus, ambulatory blood pressure monitoring identified a much larger number of treated hypertensive patients with adequate blood pressure control at an extra net cost of £3612 per year.

Keywords: blood pressure monitoring, ambulatory; hypertension; cost-effectiveness

Introduction

HYPERTENSION is a common, reversible risk factor associated with a higher incidence of cerebrovascular accident, coronary heart disease, heart failure, and progressive renal impairment. British and other international guidelines set ambitious target levels for office and/or ambulatory blood pressure readings for those receiving antihypertensive treatment,¹ but isolated measurements in the general practice are often misleading, not least because of the 'white coat' effect, where blood pressure is raised when taken in the practice, but not when an ambulatory reading is taken. This has significant clinical and cost implications both for health services; for example, with regard to practice audit, and for the individual patient, in whom an incorrect diagnosis of poor blood pressure control may result in more frequent follow-up visits and unnecessary titration of second- or third-line antihypertensive drugs. The quality-of-life implications of unnecessary antihypertensive drug use are considerable in terms of drug-related side effects and patient perceptions of wellbeing.

Although the advantages and indications for 24-hour ambulatory blood pressure monitoring are highlighted in clinical practice guidelines,¹ the procedure has only recently become more widely used in primary care for the routine surveillance of treated hypertensive patients. The extra time, inconvenience, and costs of measuring and analysing ambulatory blood pressure profiles may seem discouraging, but the extent to which they are useful for assessing blood pressure control in a primary care population is still unclear, and there has been little attempt to define the costs and potential savings in a primary care setting. Thus, the purpose of the present study was to evaluate the use of annual ambulatory blood pressure monitoring in the assessment of blood pressure control among treated hypertensive patients in a single general practice, and to define the associated costs and potential savings of this approach.

Method

All treated hypertensive patients aged 50–75 years attending a nurse-led hypertension and cardiovascular risk reduction clinic in primary care over a 2-year period were invited to have an annual ambulatory blood pressure recording as part of their routine surveillance. In the practice population, 5% of patients are from social class I, 14% from social class II, and 26% from social classes IV and V. Clinical information was obtained from the database, including all office blood pressure measurements (recorded as the mean of three measurements on each visit using a mercury sphygmomanometer).

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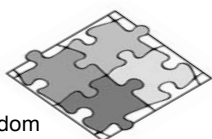
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HOW THIS FITS IN*What do we know?*

Blood pressure control of treated hypertensive patients in the United Kingdom is poor, leaving patients at unacceptably high risk of cardiovascular complications. However, blood pressure is often higher in the surgery than at home, so reliance on office blood pressure measurement to define control may result in unnecessary treatment in some patients.

*What does this paper add?*

This paper shows that nearly one-third of treated hypertensive patients in primary care exhibit a rise in blood pressure in the surgery — the 'white coat effect' — which may result in unnecessary additional treatment and have quality-of-life implications. The cost of ambulatory monitoring was £31 per additional patient identified as adequately controlled.

Ambulatory monitoring was performed using the Medilog or Meditech ABPM-04 recorder, with the blood pressure being recorded every 30 minutes for 24 hours. Twenty-four-hour blood pressure profiles were analysed to derive the average awake ambulatory blood pressure for each patient.

Adequate blood pressure control is defined in the British Hypertension Society (BHS) guidelines as an office blood pressure of <150/90 mmHg, and/or an average awake ambulatory blood pressure of <140/85 mmHg.¹ Patients were therefore put into specific groups according to whether they fulfilled the BHS standards for office and/or ambulatory blood pressure control, in particular identifying those with white coat hypertension, i.e. with an adequate ambulatory blood pressure control but raised office blood pressure. The average office blood pressure reading over the previous year was used to identify patients above or below the threshold blood pressure of <150/90 mmHg.

Economic modelling

The assumptions and costs relating to different clinical management outcomes are summarised in Table 1. Patients with adequate blood pressure control require only two visits annually, whereas those not adequately controlled require a minimum of 3-monthly follow-ups to assess treatment response and tolerability. The financial details; for example, the costs of the ambulatory blood pressure monitoring device with regards to purchase, annual maintenance and life expectancy, or of extra consultations or second-line drug use, were based on published information.^{2,3} This economic analysis, however, only provides a limited health service perspective and does not address patient-related perspectives; for example, the impact on time, travel and quality of life of added attendance and healthcare interventions.

Results

A total of 374 patients participated in the study, and their mean age was 65 years, with 60% of them being female. The average office blood pressure recording was 154/89 ± 16/8 mmHg, and the average awake ambulatory blood pressure recording was 137/77 ± 17/9 mmHg. The proportion of patients in each blood pressure control group

Table 1. Care pathways and associated costs according to blood pressure control, and the fixed costs of undertaking ambulatory blood pressure monitoring.

Care and treatment	Cost per patient (£)
Adequate control	
GPC at 6 months	18
GPC at 12 months	18
Total care cost per adequately controlled patient	36
Sub-optimal control	
GPC at 3 months;	18
with additional 2nd-line agent ^a	15.60
GPC at 6 months;	18
with an increase in 2nd-line agent ^b	36.90
GPC at 9 months	18
GPC at 12 months	18
Total care cost per sub-optimally controlled patient	124.50
Ambulatory blood pressure assessment	
GPC for fitting	36
(extended consultation)	
GPC for removal	18
Total ambulatory blood pressure assessment cost per patient	54
Ambulatory monitoring equipment	
Capital cost ^c	176
Annual maintenance	150
Total fixed costs ^d	326

^aFor example, enalapril 10 mg for next 3 months. ^bFor example, enalapril 20 mg for next 6 months. ^cWith a life expectancy of 9 years and a 6% discount rate. ^dTotal fixed costs, irrespective of the number of patients who are monitored. The assumption is that patients with adequate control require only 2 visits annually, whereas those who are not adequately controlled require a minimum of 3-monthly follow-ups to assess treatment response and tolerability. GPC = general practice consultation.

is shown in Table 2. Ambulatory blood pressure monitoring identified 115 patients who had adequate blood pressure control as assessed by ambulatory monitoring, but in whom office blood pressure measurements were above target levels. Thus, 31% of the patients showed a white coat effect, and if assessed only by office blood pressure measurements would be incorrectly labelled as having poor blood pressure control, and potentially recalled for unnecessary follow-ups and intervention. Similarly, there were 21 patients (6%) in whom office but not ambulatory blood pressure measurements were below the BHS targets (Table 2).

The costs of performing annual ambulatory blood pressure profiles in treated hypertensives, including the capital cost of the monitoring device and its maintenance, and general practice consultations to fit, remove and analyse the recordings, was approximately £13 790. However, the discovery of 115 patients with adequately controlled blood pressure would result in fewer follow-up visits and the avoidance of increased medication. The modelled cost savings of this outcome amounted to £10 178. Thus, while ambulatory blood pressure monitoring identified a larger proportion of patients with adequate blood pressure control, it did so at an extra cost of £3612 compared to office blood

Table 2. Proportion of patients achieving target blood pressure readings according to office and ambulatory blood pressure measurements.

	Controlled on ambulatory readings	Not controlled on ambulatory readings
Controlled using office readings	78	21
Not controlled on office readings	115	160

pressure measurement, or £31 per additional patient found to be adequately controlled.

Discussion

Summary of main findings

Ambulatory blood pressure monitoring of 374 treated hypertensive patients attending a nurse-led hypertension surveillance clinic in primary care identified 115 (31%) patients in whom average awake ambulatory blood pressure, but not the office blood pressure, fulfilled the BHS target for optimum blood pressure control, i.e. the white coat effect is common in this patient group. The annual costs of providing ambulatory monitoring were high at £13 790, but office blood pressure measurements alone would have triggered unnecessary follow-up visits and add-on treatments in 31% of treated patients, with potential savings of £10 178. There are ongoing uncertainties about whether or not to treat patients with white coat hypertension,¹ but the adverse impact of over-treatment or unnecessary visits on quality of life is an important consideration for this patient group. Ambulatory blood pressure monitoring also identified 21 patients in whom average office blood pressure measurements may have incorrectly suggested that blood pressure was well controlled. Thus, there are cogent clinical grounds for undertaking annual ambulatory blood pressure monitoring to improve the reliability of assessments of blood pressure control, while the net costs of providing this service may previously have been overestimated.

Strengths and limitations of the study

This study was performed on 374 treated hypertensive patients attending a single general practice. The results provide new information on how common the white coat effect is among unselected hypertensive patients in primary care. The economic modelling was based on various assumptions and previously published figures; for example, relating to consultation costs and approximate costs of dose increases of typical second-line antihypertensive agents. We have sought to include all the 'hidden' costs of ambulatory blood pressure monitoring, especially personnel costs for the time taken to attach, remove, download and analyse recordings, and the capital cost of the equipment. The same equipment, of course, may give added value to the service via other applications; for example, in the diagnosis of newly presenting patients. Whether the proposed cost savings could be realised in practice is unclear, but with the increasing use of protocols to drive clinical management, it is likely that

patients discovered to have adequate blood pressure control as a result of annual ambulatory blood pressure measurements would indeed avoid unnecessary follow-up visits and add-on treatments.

Relationship of these findings to existing literature

Most previous studies of ambulatory blood pressure monitoring have focused on its use in the diagnosis of hypertension and in decision making about whether to initiate treatment, mostly in secondary care. This study provides new information about the use of ambulatory blood pressure monitoring in assessing blood pressure control among treated hypertensive patients in a general practice setting, and explores the costs and savings in a United Kingdom context. Relevant previous work from the United States of America⁴ and elsewhere in Europe^{5,6} has also quantified the impact of ambulatory blood pressure monitoring on treatment avoidance and fewer clinic visits, but not in a primary care setting.

Implications for future research or clinical practice

Assessing blood pressure control based solely on isolated or averaged office blood pressure recordings is potentially misleading, since over half of such patients in primary care will show a white coat effect, i.e. their average awake ambulatory blood pressure fulfils the BHS target, even though their office blood pressure reading does not. Putting in place systems to perform annual ambulatory blood pressure monitoring has various equipment and personnel costs, but improved detection of adequate blood pressure control has many clinical and cost advantages. There are also major quality of life implications for avoidance of unnecessary drug use and healthcare monitoring. Clearly, this hypothesis might be tested in a prospective randomised trial.

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