



ORIGINAL ARTICLE

The impact of physician vs automated blood pressure readings on office-induced hypertension

MG Myers, G Meglis and G Polemidiotis

Division of Cardiology, Sunnybrook Health Science Centre, Toronto; Department of Medicine, University of Toronto, Ontario, Canada

Blood pressure (BP) readings in the doctor's office are frequently higher than home or ambulatory values. This study examines the role of the physician in the aetiology of the 'white coat' effect, by comparing standard readings taken by the family physician of 27 treated hypertensive patients with readings taken by an automated BP recording device, with the patient alone in the examining room during the same office visit. The physician and automated readings were each compared to the

mean awake ambulatory BP. Mean (\pm s.e.m.) routine office BP (mm Hg) recorded by the patient's physician ($155 \pm 4/80 \pm 2$) was similar to the mean value obtained using the automated BP recording device ($157 \pm 3/83 \pm 2$). The mean awake ambulatory BP was $145 \pm 3/78 \pm 2$ with the systolic value lower ($P < 0.05$) than either the physician or automated reading. Self-measurement of BP by the patient in the office setting does not reduce the magnitude of the white coat effect.

Keywords: blood pressure; self measurement; white coat effect

Introduction

Patients frequently exhibit an increase in blood pressure (BP) when visiting their physician's office, a phenomenon which has been called the 'white coat' effect. A variety of factors have been shown to increase office BP compared to ambulatory readings during usual daily activities. BP increases upon the arrival of the patient in the doctor's office and tends to diminish during the subsequent 10 min.¹ Conversation with the patient also tends to accentuate the white coat effect.² Office BP and the consequent white coat effect may be reduced by having a nurse record the office BP.^{1,3} Digit preference, the use of aneuroid sphygmomanometers and unfamiliar surroundings for new patients may also contribute to higher office readings and the misdiagnosis of hypertension.⁴

The white coat effect has usually been considered as part of the diagnosis of patients with possible hypertension. In previous studies^{5,6} we have also noted a persistent difference between office and ambulatory readings in patients receiving long-term antihypertensive therapy from their own family physicians. Thus, office-induced hypertension is important in both the diagnosis of untreated hypertensive patients and in the management of those

individuals already receiving antihypertensive therapy.

One factor in the measurement of office BP has not yet been examined in the clinical setting – does the presence of a physician in the examining room affect the level of a patient's BP? The present study addresses this question by comparing routine BP readings taken by the patient's family physician using a mercury sphygmomanometer with readings taken by an automated BP recording device with the patient resting alone in the examination room. Both the automated and physician readings were also compared to the ambulatory BP to see if the use of an automated device could reduce any white coat effect which might be present.

Patients and methods

Patient population

Patients were recruited from the computerised records of a family practice unit in a university teaching hospital (Sunnybrook Health Science Center). A random sample of 45 treated hypertensive patients were identified. Initial contact was made by telephone with 13 patients failing to respond and five patients declining to participate in the study. The remaining 27 patients were entered after giving written informed consent in accordance with the guidelines of the institution's research ethics board.

The study population included 16 females and 11 males with a mean age of 73 ± 1 (range 59–84) years. Antihypertensive therapy consisted of diuretics ($n = 16$), beta-blockers ($n = 5$), angiotensin-converting enzyme inhibitors ($n = 9$), and calcium

Correspondence: Dr Martin G Myers, Sunnybrook Health Science Centre, A-222, 2075 Bayview Avenue, Toronto, Ontario, M4N 3M5, Canada

Received 11 November 1996; revised 17 March 1997; accepted 19 May 1997

antagonists ($n = 11$). Single, dual and triple therapy were taken by 14, 12 and one patient respectively. The mean duration of hypertension was 15 ± 2 years and the mean period on antihypertensive therapy was 14 ± 2 years. Fifteen patients were free of target organ damage. All patients were regular attendees at the family practice unit and had been receiving antihypertensive therapy for at least 6 months.

Procedures

Office BP was recorded during two separate visits approximately 2 weeks apart, with the ambulatory BP being recorded in the interval between the visits. On each office visit, patients remained quiet for about 5 min after which their BP was taken in duplicate by their family physician using a mercury sphygmomanometer. A total of nine family physicians participated in the study. The patient was also seen by the study nurse who attached the cuff of an Omron HEM-705CP (AMG Medical Inc, Montreal, Quebec, Canada), an automated BP recording device which meets British Hypertension Society criteria for accuracy of measurement with validation of accuracy having been reported by independent investigators.⁷ The nurse instructed the patient on the use of the automated device and then left the patient alone in a room for a further 5 min after which BP was again measured in duplicate with readings stored in the recorder's computer memory. The order of the physician and automated measurements was decided by randomisation with the reverse order used on the second visit. The automated BP measurements were not visible to the patient. Both the manual and automated readings were taken under the same conditions including support for the arm at heart level.

In between the two office visits, each patient underwent an ambulatory BP recording using a Spacelabs 90202 (Redmond, WA, USA) recording device to obtain the mean awake ambulatory BP value. Ambulatory readings were taken every 15 min and all valid readings were included in the analysis except for clearly artifactual numbers such as a difference of less than 20 mm Hg between systolic and diastolic values. Generally, fewer than 5% of readings were excluded.

A white coat effect was present if the office BP exceeded the mean ambulatory BP by at least 20 mm Hg systolic and/or 10 mm Hg diastolic. Differences between office and ambulatory BP recordings were evaluated statistically by analysis of variance. Data are presented as mean \pm standard error of the mean (s.e.m.). The level of minimum statistical significance was set at $P < 0.05$.

Results

There were no significant differences between the mean office BP (mm Hg) recorded by the family physician ($155 \pm 4/80 \pm 2$) and the reading obtained using the automated recording device ($157 \pm 3/83 \pm 2$; Figure 1). The mean awake ambulatory BP during 12.2 ± 1.3 daytime hours was $145 \pm 3/78 \pm 2$ with the systolic value significantly

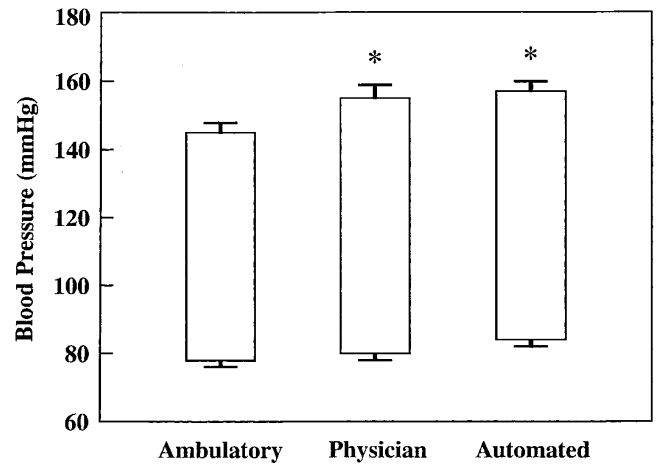


Figure 1 Mean (\pm s.e.m.) systolic and diastolic BPs are shown for the physician, automated and ambulatory recordings. The asterisk denotes a significant difference of $P < 0.05$ between the ambulatory vs physician or automated systolic BP.

($P < 0.05$) lower than either the corresponding physician or automated BP readings. A white coat effect defined as office BP greater than ambulatory BP by at least 20 mm Hg systolic and/or 10 mm Hg diastolic was present in 12 of 27 physician readings (44%) compared to nine of 27 automated readings (33%), with the difference being non-significant. Mean heart rates (beats per minute) were similar for the physician (75 ± 3), automated device (76 ± 3), and ambulatory BP recording (72 ± 2).

Familiarity with the automated device did not appear to influence BP measurements. Mean values for the automated device were similar for the first ($157 \pm 3/80 \pm 2$) and second ($159 \pm 4/83 \pm 2$) visits. Similarly, the manual readings taken by the physicians were similar for the first ($157 \pm 3/80 \pm 2$) and second ($156 \pm 3/81 \pm 3$) day's readings.

Discussion

A visit to the doctor's office in itself appears to be a major contributing factor to the white coat phenomenon. In replacing the physician with an automated BP recording device, we were unable to demonstrate any reduction in the white coat effect, even though the BP was recorded in the absence of the physician or other health care professional. This result is somewhat surprising if we consider previous studies on the white coat response.

Mancia *et al*¹ have used intra-arterial BP recordings to demonstrate that readings increase during a visit to the doctor's office compared to the preceding period. These authors also reported that readings obtained by a physician decreased during the first 5–10 min that the patient was in the office setting but still remained higher than ambulatory values. Readings taken by the physician also tended to be higher than those obtained by a nurse under the same conditions, but the nurse's measurements followed a similar pattern, with the BP being higher initially and then decreasing during the period of the visit, albeit to a level which was still above that of the ambulatory recorder.

Other factors may contribute to the physician-

induced white coat effect. Le Pailleur *et al*² have reported that conversation between the physician and patient augments the office BP compared to ambulatory values. Digit preference may also play a role. In a previous series of 110 patients with mild or borderline office hypertension, Reeves and Myers (unpublished data) found 67% of patients to be hypertensive if hypertension was defined as a diastolic BP ≥ 90 mm Hg. However, if the definition of hypertension was changed to include only those values which exceeded 90 mm Hg, then the portion with hypertension fell to 30%. Finally, if one considers only the patient's role, self-measurement of BP in the home is usually comparable to the ambulatory BP and significantly lower than in the office.⁸

The white coat effect confounds the diagnosis of hypertension in about 20% of patients with untreated mild to moderate hypertension.⁹ Office-induced increases in BP also have an impact on the management of treated hypertensive patients. In the absence of target organ damage, about one-third of patients may have a clinically important difference between office and ambulatory BP values.^{5,6} Although it would seem logical to expect a diminished white coat effect if the office BP was taken by an automated device in the absence of the physician, the findings of the present study do not support this hypothesis, leading to the conclusion that a visit to the doctor's office is the predominant stimulus for the white coat effect, regardless of how the BP is measured. Moreover, replacing the physician with an automated device does not reduce the magnitude of the patient's white coat response. The ambulatory BP recording continues to be the most reliable method for eliminating the pressor response patients experience when they visit their own physicians.

Acknowledgements

The authors would like to acknowledge the participation of Ms Pauline Parsons RN (Study Nurse) and Mr Tyler Crawford BPHE (Research Assistant) in this study and to thank them for their valuable contribution.

References

- 1 Mancia G *et al*. Alerting reaction and rise in blood pressure during measurement by physician and nurse. *Hypertension* 1987; **9**: 209–215.
- 2 Le Pailleur C *et al*. Quantification of the "white coat" effect: evaluation of the role of dialogue and silence during the consultation in 35 consecutive hypertensive patients. *Am J Hypertens* 1994; **7**: 106A.
- 3 Veerman DP, Van Montfrans GA. Nurse-measured or ambulatory blood pressure in routine hypertension care. *J Hypertens* 1993; **11**: 287–292.
- 4 Reeves RA. Does this patient have hypertension? How to measure blood pressure. *JAMA* 1995; **273**: 1211–1218.
- 5 Myers MG, Oh PI, Reeves RA, Joyner CD. Prevalence of white coat effect in treated hypertensive patients in the community. *Am J Hypertens* 1995; **8**: 591–597.
- 6 Myers MG, Reeves RA. White coat effect in treated hypertensive patients: sex differences. *J Hum Hypertens* 1995; **9**: 729–733.
- 7 O'Brien E, Mee F, Atkins N, Thomas M. Evaluation of three devices for self-measurement of blood pressure according to the revised British Hypertension Society protocol: the Omron HEM-705CP, Philips HP5332 and Nesei DS-175. *Blood Pressure Monitoring* 1996; **1**: 55–61.
- 8 Campbell NRC *et al*, for the Canadian Coalition for High Blood Pressure and Control. Self-measurement of blood pressure: benefits, risks and interpretation of readings. *Can J Cardiol* 1995; **11** (Suppl H): 18H–22H.
- 9 Pickering TG *et al*. How common is white coat hypertension? *JAMA* 1988; **259**: 225–228.