Ambulatory blood pressure monitoring — comparison with office blood pressure in patients on antihypertensive therapy in private practice

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Introduction. Available data on the use of 24-hour ambulatory blood pressure recordings in private practice are limited. For this purpose we studied 39 consecutive hypertensive patients on treatment in a private practice.

Method. Office blood pressure, 24-hour ambulatory blood pressure, daytime ambulatory blood pressure and M-mode echocardiography were undertaken in 39 consecutive hypertensive patients (21 men, 18 women) on treatment.

Results. Mean 24-hour ambulatory blood pressure and mean daytime ambulatory blood pressure were lower than office blood pressure, similar to findings seen in academic settings. A blood pressure load of more than 50% was seen in 12 out of 39 patients (31%). Left ventricular hypertrophy, assessed by means of Framingham criteria, was seen in 33% of patients. A white-coat effect was seen in 15.4% of patients.

Conclusions. A large proportion (33%) of patients on treatment for hypertension had left ventricular hypertrophy, despite normal electrocardiograms. Ambulatory blood pressure measurements identified a blood pressure load of more than 50% in 31% of patients on treatment for hypertension.

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Excess risk of mortality and morbidity is incurred by patients who have blood pressures above a certain critical level derived from epidemiological and intervention studies. A diagnosis of hypertension is generally based upon persistently elevated office blood pressure readings at several visits. The decision to treat, as well as the course of therapy, are written into guidelines and recommendations.[1,2] A single blood pressure measurement at the physician's office is not a good predictor of the risk of end-organ damage.[3-5] The presence and severity of cardiovascular morbidity and mortality are associated more closely with ambulatory blood pressure than with office blood pressure measurements.[6,7] Most ambulatory blood pressure studies have been undertaken in academic settings where patients were recruited into specific studies. Data on the use of ambulatory blood pressure in private practice are limited.[8,9] The aim of this study was to compare office blood pressure measurements with total 24-hour ambulatory blood pressure measurements and daytime ambulatory blood pressure measurements in a group of hypertensive patients on treatment in a private practice.

A secondary aim was to measure left ventricular mass in these patients and to compare standard electrocardiography with echocardiography.

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Methods

Patient population

Eligible subjects included men and women who were receiving antihypertensive medication under the supervision of their primary care family physician. None of these patients had congestive heart failure, cerebrovascular disease, renal impairment or peripheral vascular disease. No patient had cardiac arrhythmias that could interfere with the ambulatory blood pressure recording. These patients were all referred for evaluation of their hypertension. There were no other selection criteria and patients were examined consecutively in a convenience sample.

Study design and procedure

All blood pressures were measured with a mercury sphygmomanometer after at least 10 minutes in the sitting position according to established guidelines.[1] The 1st and 5th Korotkoff sounds were used to identify systolic and diastolic values, respectively. Each patient underwent a 24-hour ambulatory blood pressure recording with a Spacelabs model 90239A. Ambulatory readings were taken at 15-minute intervals and mean and SD values for systolic and diastolic blood pressure measurements were computed. A white-coat effect was defined as a difference of at least 20 mmHg systolic or 10 mmHg diastolic between the office and ambulatory blood pressure values.[10] The mean office blood pressure (systolic and diastolic) was compared with the mean 24-hour ambulatory blood pressure (systolic and diastolic) and the mean daytime ambulatory blood pressure (systolic and diastolic) reading in each patient.

Echocardiographic methods

All studies were performed with a Panasonic Hewlett Packard Model 77030A Ultrasound system (USA). Standard M-mode echocardiography measurements were obtained at the tip of the mitral valve and M-mode examinations were guided by two-dimensional scan. Measurements were made according to the Penn conventions.[11]

Left ventricular mass (LVM) was calculated by means of the modified cubed formula:[11]

$$LVM = 1.04\,[LVID + VST + PWT]^3 - [LVID]^3 - 13.6\ g,$$

where LVID = left ventricular diameter in diastole, VST = ventricular septal thickness and PWT = posterior wall thickness. LVM was divided by patient height, yielding a

corrected LVM (g/m). Echocardiographic left ventricular hypertrophy was defined for this study as a height-indexed LVM that was above the upper limits derived from the Framingham Heart Study subjects: 143 g/m in men and 102 g/m in women.[12,13] Each patient underwent standard 12-lead electrocardiography at rest. Left ventricular hypertrophy was measured by the method of Sokolow and Lyon[14] and by Casale *et al.*'s criteria.[15]

Statistical analysis

Statistica was used for the analysis. Descriptive statistics are given as mean (SD). Systolic blood pressure values and LVM (g/m) were log-transformed because of unequal variances. Comparisons were by means of analysis of variance (ANOVA) for repeated measurements and *t*-tests for dependent samples. *P*-values were corrected for multiple testing by means of the Bonferroni method. For evaluating diastolic blood pressure measurements, non-parametric Friedman's two-way ANOVA and Wilcoxon's matched pair tests were used. *P*-values were Bonferroni adjusted again. LV mass of men and women were compared, with a *t*-test for independent samples. *P*-values < 0.05 were regarded as statistically significant.

Results

Demographic data on patient characteristics are shown in Table I. Office and ambulatory systolic and diastolic blood pressure values and data on LVM are shown in Table II. In Table III the data on the statistical analysis are shown. Mean 24-hour ambulatory systolic and diastolic blood pressures were lower than corresponding office values. Mean ambulatory daytime systolic and diastolic blood pressures were also lower than office values. Blood pressure load was calculated as the percentage of 24 hours that the blood pressure exceeded 140/90 mmHg. A blood pressure load of more than 50% was seen in 12 patients while in 24 patients the load was less than 50%. Only 3 patients had no blood pressure load. Thirteen patients (8 men, 5 women) had left ventricular hypertrophy on the basis of the Framingham criteria (33%).

In 4 patients insufficient echocardiographic data were obtained to calculate LVM accurately. The mean corrected LVM in the men was 142.95 (43.14) g/m, and in the women 96.30 (21.32) g/m. In 15 patients (39%) there was a less than 10% fall in blood pressure during night time, and these patients were classified as 'non-dippers'. None of the patients had left ventricular hypertrophy on ECG, on the basis of two different criteria.[14,15] White-coat hypertension was seen in 6 patients (15.4%), 4 men, 2 women.

Table I. Demographic data on patients

	Total patients (*N* = 39)	Men (*N* = 21)	Women (*N* = 18)
Mean age (yrs) (SD)	52.5 (14.3)	49.5 (14.2)	56.0 (14.4)
Mean body mass index (kg/m^2) (SD)	28.3 (5.5)	29.44 (3.95)	27.01 (6.78)
Median duration of hypertension (yrs) (range 1 - 30 yrs)	6.7	7.2	6.6

Table II. Blood pressure data and corrected left ventricular mass

	Total patients (*N* = 39)	Men (*N* = 21)	Women (*N* = 18)
Mean systolic blood pressure (mmHg) (SD)			
Ambulatory 24-hour	132.6 (14.2)	133.3 (10.1)	131.8 (18.1)
Ambulatory daytime	138.6 (13.8)	138.5 (12.8)	138.7 (15.3)
Office	152.6 (22.2)	150.0 (16.1)	157.2 (29.3)
Mean diastolic blood pressure (mmHg) (SD)			
Ambulatory 24-hour	79.6 (10.7)	83.3 (8.8)	75.1 (11.4)
Ambulatory daytime	84.1 (11.3)	87.5 (10.5)	80.2 (11.2)
Office	89.1 (9.0)	88.8 (8.0)	89.4 (9.7)

Table III. Data on the statistical analysis

		Men and women (*N* = 39)	Men (*N* = 21)	Women (*N* = 18)
Systolic blood pressure (log-transformed)				
ANOVA	All 3 tests	$P < 0.001$	$P < 0.001$	$P < 0.001$
t-test dependent samples	Office blood pressure v. 24-hour ambulatory blood pressure	$P < 0.001$	$P < 0.001$	$P < 0.001$
t-test dependent samples	Office blood pressure v. daytime ambulatory blood pressure	$P < 0.001$	$P = 0.054$	$P < 0.01$
Diastolic blood pressure				
ANOVA	All 3 tests	$P < 0.001$	$P < 0.05$	$P < 0.001$
Wilcoxon matched pairs	Office blood pressure v. 24 hour ambulatory blood pressure	$P < 0.001$	$P = 0.124$	$P < 0.01$
Wilcoxon matched pairs	Office blood pressure v. daytime ambulatory blood pressure	$P < 0.05$	$P = 1.65$	$P < 0.01$
LVM (g/m)		121.63 (41.74)	142.95 (43.14)	96.30 (21.32) (*t*-test independent samples on log-transformed LVM $P < 0.001$)

Discussion

This study describes the information obtained in a private practice from a group of hypertensive patients on treatment whose blood pressure patterns were investigated by two different methods. As reported by others, we found mean 24-hour ambulatory blood pressures to be significantly lower than mean office blood pressures ($P < 0.001$ for men and women). The average difference between office and ambulatory systolic pressure is 20 mmHg, while the diastolic difference is 10 mmHg. Krakoff *et al.*[16] found a systolic difference of 24 mmHg and a diastolic difference of 18 mmHg, while Harshfield *et al.*[17] found a 10 mmHg difference for both systolic and diastolic blood pressures. This suggests that ambulatory blood pressure assessment in a private practice setting, such as this study, gives results similar to those obtained in academic settings and that the differences between ambulatory and office blood pressure readings observed in either setting are of equal magnitude. The occurrence of white-coat hypertension in our study (15.4%) is less than the 21% quoted for untreated patients.[18]

Various estimates suggest that the true prevalence of white-coat hypertension may be around 20%.[19] Blood pressure load has been suggested as a better determinant of hypertension.[20] In this series of treated hypertensives, 12 patients had a blood pressure load of more than 50%. This was an unexpected finding because it could not be predicted by the office blood pressure measurement. Only 3 patients in this study had no blood pressure load. Other studies have indicated that blood pressure load is superior to office blood pressure measurement in predicting end-organ disease.[21]

Failure to decrease blood pressure by more than 10% during sleep (the so-called 'non-dippers') has been associated with left ventricular hypertrophy.[22] We identified 15 non-dippers in our study. Of these 15 patients, complete echocardiographic data are available for 12 patients. Left ventricular hypertrophy with an increase in LVM was seen in 6 patients (4 men, 2 women). A recent meta-analysis suggests that ambulatory night-time blood pressure might not be a better predictor of LVM than ambulatory daytime blood pressure and that the relationship of an increased LVM to day-night blood pressure differences may not be a unanimous one.[23] We used Framingham criteria for the calculation and evaluation of LVM, which might not be appropriate in a South African population. In a recent study the prevalence of left ventricular hypertrophy ranged from 17% to 39% according to the threshold value applied.[24] No normal left ventricular mass values exist for the South African population and the Framingham criteria may therefore not be valid threshold values. Using the Framingham criteria, we documented a 33% prevalence of left ventricular hypertrophy in this sample of hypertensive patients on treatment in private practice. We have shown that 24-hour ambulatory and daytime ambulatory blood pressure values were lower than office blood pressure values in hypertensive patients in a private practice.

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