Assessment of Resistant Hypertension with Home Blood Pressure Monitoring

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Abstract

Background: Ambulatory blood pressure monitoring (ABPM) is considered the gold standard for the diagnostic confirmation of resistant hypertension (RH). However, home blood pressure monitoring (HBPM) has been considered an option, because of its lower cost and greater comfort.

Objective: To compare the values obtained by HBPM with those obtained by ABPM in the identification of patients with resistant hypertension.

Methods: A total of 51 consecutive patients with resistant hypertension were selected. All were adults of both genders and were undergoing treatment in an outpatient referral clinic from January 2007 to September 2009. Casual office blood pressure (BP), 24-hour ABPM, and HBPM were performed according to current guidelines, with a maximum two-week interval between the methods.

Results: The comparison of ABPM (mean daytime) with HBPM showed a good correlation between them, both for systolic blood pressure (SBP) and for diastolic blood pressure (DBP): SBP r = 0.70, CI = 0.51-0.82, DBP r = 0.69, CI = 0.52-0.81. RH was confirmed by ABPM in 33 patients and by HBPM in 37, with no significant difference between the methods.

Conclusion: According to the results obtained, we conclude that HBPM is a method that can be used as an alternative to ABPM for the diagnostic confirmation of RH. (Arq Bras Cardiol 2010; 95(4): 536-540)

Key words: Hypertension; blood pressure monitoring, ambulatory; blood pressure/drug effects.

Introduction

Hypertension has a high prevalence in Brazil with a very high medical and socioeconomic burden given its resulting complications. BP reduction decreases the risk of development of these complications; however, BP control is only achieved in a minority of the hypertensive patients[1]. In Brazil, only 10.0% of the hypertensive population is estimated to have a controlled BP, whether because of a missing diagnosis, lack of treatment, or difficulties to control the disease[2]. Resistant hypertension may be present in as much as 20.0% to 40.0% of the hypertensive individuals[3].

RH is defined by the finding of casual office BP levels that remain above goal in patients taking at least three antihypertensive agents of different classes, including a diuretic whenever possible, at optimal doses[4].

Several factors influence the identification of RH, such as a poor technique for BP measurement, poor adherence to treatment, and BP elevation only in a medical environment (white coat effect)[4]. These factors may lead to pseudoresistance, which is an apparent lack of BP control when measured in a medical office. If the technique and adherence are adequate, but the white coat effect changes the diagnosis, the white coat RH syndrome is characterized[5]. The only means to correctly identify this condition is by using BP monitoring[6].

ABPM, considered the gold standard for the diagnostic confirmation of RH, is still an expensive procedure unfeasible for the majority of the population. However, HBPM has been widely studied because it is easy to apply and has good patient acceptability[7]. Thus, the objective of this study was to compare the values obtained by HBPM with those obtained by ABPM, thus analyzing the validity of the method in the identification of resistant hypertensive patients.

Methods

Patients

A total of 51 consecutive hypertensive patients were selected. They were using at least three classes of antihypertensive

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Manuscript received November 18, 2009; revised manuscript received February 03, 2010; accepted March 15, 2010.

medications at optimal doses, including a diuretic, and were being treated in the Department of Hypertensive Heart Disease of *Universidade Federal de São Paulo* - UNIFESP, from January 2007 to September 2009.

The Research Ethics Committee approved the research protocol and all patients gave written informed consent, according to the principles of the Declaration of Helsinki.

Patients presenting with office SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg (or ≥ 130 x 80 mmHg for diabetic patients and patients with renal injury) were included. The mean of two out of three measurements taken in both upper limbs (using the measurement of the limb where the highest values were obtained) was considered. Secondary hypertension was systematically investigated in the patients by means of a standard screening according to the protocol used in the Department, which is based on the first American Heart Association guideline on RH[6].

Full clinical assessment of all patients was performed, including information on medications used and factors related to the lifestyle, such as cigarette smoking and alcohol consumption, as well as the regular practice of physical activity. Anthropometric measurements were taken including height, weight, and waist and hip circumferences. Routine laboratory tests were used to investigate diabetes or renal injury.

For casual office BP measurement, the auscultatory method with a mercury-column sphygmomanometer was used. Three measurements were taken in each arm, at 1-minute intervals between measurements, with the patient in the sitting position and resting for 5 minutes. The mean of the last two measurements in the limb showing the highest values was considered[2].

Next, ABPM and HBPM were scheduled. The ABPM monitors (Spacelabs 90207™) were programmed to take BP every 15 minutes (daytime) and every 30 minutes (nightime) for 24 hours, with a proper cuff positioned in the non-dominant arm. Nightime and daytime were set individually and checked according to the daily recordings.

As regards HBPM, three BP measurements were taken in the morning and at night for five consecutive days, with the first day reserved for instructions, according to the IV Guideline for the Use of Ambulatory Blood Pressure Monitoring and the II Guideline for the Use of Home Blood Pressure Monitoring of the Brazilian Society of Cardiology[8]. In addition to verbal instructions, the participants also received a handout describing the methods. A validated semi-automated device (Microlife BP 3AC1-1™) was used. The time elapsed between the casual office measurement and ABPM and HBPM installation was not longer than two weeks.

Diagnostic criteria

For casual BP measurement, SBP values ≥ 140 mmHg and/or DBP ≥ 90 mmHg (or ≥ 130 mmHg and/or 80 mmHg for patients with diabetes and patients with renal injury) were considered RH. For ABPM, mean daytime values ≥ 135 mmHg (SBP) or ≥ 85 mmHg (DBP) were considered for the diagnosis of RH; the same values applied to HBPM in properly medicated patients.

The diagnosis of diabetes mellitus was made for patients with fasting plasma glucose levels ≥ 126 mg/dl or for those receiving treatment for this disease. The diagnosis of renal injury was based on a glomerular filtration rate < 60 ml/min/1.73 m^2, as estimated by the Cockcroft-Gault formula.

Statistical analysis

The results were expressed as means and standard deviation. The chi square test and Pearson's linear correlation were used for result analysis. The level of statistical significance was set at 95% confidence intervals and $p < 0.05$.

Results

A total of 28 men (55.0%) and 23 women (45.0%) with ages between 34 and 74 years (mean of 56.4 ± 10 years) participated in the study. The characteristics of the study population as regards the anthropometric data and the presence of cardiovascular risk factors are summarized in Table 1. A significant incidence of overweight and obesity (84% of the sample) was observed, with six patients presenting with body mass index (BMI) ≥ 40 (morbid obesity). Only five men and one woman had an adequate waist-hip ratio (≤ 0.90 and 0.85, respectively). As regards the patients reporting the presence of snoring during sleep (61.0% of the sample), all had a BMI ≥ 25.

The antihypertensive medications most frequently prescribed were: thiazides (hydrochlorothiazide, with 34 prescriptions; and chlorthalidone, with 17 prescriptions), captopril (24 prescriptions), amlodipine (36 prescriptions), and propranolol (22 prescriptions). In addition to these medications, 22 patients were receiving antiplatelet agents.

The mean blood pressure levels obtained by the three methods used with discrimination of the periods of ABPM recordings are shown in Table 2. The correlation between the different means, with emphasis on the comparison between mean daytime ABPM and mean HBPM are shown in Table 3.

The comparison of the diagnosis of RH as made by the two methods analyzed is shown in Table 4. Although the mean systolic BP, as determined by HBPM, was significantly higher than the mean daytime systolic BP by ABPM (Table 2), the impact of this difference on classification was small.

Casual office BP was less elevated than those obtained by ABPM and HBPM in 19 patients (37.0%).

Discussion

Distinction between uncontrolled hypertension due to different factors and true resistant hypertension is very important, because patients belonging to the first group are frequently subjected to unnecessary tests and inconvenient changes in their treatment regimens[9].

Although the concept of RH is arbitrary, it is necessary to identify patients who are at high risk of having reversible causes of hypertension, and separate them from those who, because of persistently high BP levels, may benefit from more specific diagnostic and therapeutic measures that promote a better control of their disease[10].

Table 1 - Clinical and demographic characteristics of the study population

Variable	Values
BMI (kg/m²)	30.2 ± 6.3
Abdominal circumference - mean	101.3 ± 12.8
Waist/hip ratio - mean	0.96 ± 0.03
Black/white	19 (37.0%) / 29 (63.0%)
Family history of hypertension	32 (63.0%)
Coronary insufficiency	15 (29.0%)
Overweight (BMI from 25.0 to 29.9)	23 (45.0%)
Obesity (BMI ≥ 30)	20 (39.0%)
Report of snoring	31 (61.0%)
Dyslipidemia	13 (25.0%)
Sedentary lifestyle	25 (49.0%)
Smoking/former smoking	1 (2.0%) / 21 (41.0%)
Alcohol use	0
Diabetes and/or renal injury	11 (22.0%)

BMI - body mass index.

Table 2 - Mean systolic and diastolic blood pressures according to the method used and period assessed

Blood pressure	Means
Casual office	169.3 ± 32.7 / 100.8 ± 16.0
24-hour ABPM	141.7 ± 22.4 / 86.4 ± 16.7
ABPM (daytime)	143.7 ± 21.9 / 88.7 ± 20.5
ABPM (nighttime)	135.9 ± 20.1 / 80.9 ± 20.9
HBPM	150.4 ± 24.5 / 86.0 ± 16.4

ABPM - ambulatory blood pressure monitoring; HBPM - home blood pressure monitoring.

Table 3 - Comparison of casual office BP with BP measured by ABPM and HBPM

Comparison	Pearson's r	CI
Casual SBP versus ABPM (daytime) SBP	0.73*	0.57 - 0.84
Casual SBP versus HBPM SBP	0.63*	0.43 - 0.77
Casual DBP versus ABPM (daytime) DBP	0.63*	0.44 - 0.77
Casual DBP versus HBPM DBP	0.57*	0.35 - 0.73
ABPM (daytime) SBP versus HBPM SBP	0.70*	0.51 - 0.82
ABPM (daytime) DBP versus HBPM DBP	0.69*	0.52 - 0.81

** p < 0.05; BP - blood pressure; ABPM - ambulatory blood pressure monitoring; HBPM - home blood pressure monitoring; SBP - systolic blood pressure; DBP - diastolic blood pressure, CI - confidence interval*

Table 4 - Comparison between mean BP in daytime ABPM and in HBPM in the diagnosis of RH and white-coat RH

Method	RH	White-coat RH
ABPM (daytime)	33	18
HBPM	37	14

Chi square test = 0.410; p = 0.522; RH - resistant hypertension; ABPM - ambulatory blood pressure monitoring; HBPM - home blood pressure monitoring.

ABPM is considered the gold standard for the confirmation of RH[11]. In this study, ABPM detected 33 patients with RH and 18 with pseudoresistant hypertension. However, using HBPM, 37 cases were diagnosed with RH. There was no statistically significant difference between the two methods. As a matter of fact, a difference of four cases (8.0%) was observed, perhaps pointing to a tendency of a more favorable performance of HBPM as regards diagnostic sensitivity.

In comparison to ABPM, HBPM has some advantages, especially in relation to costs and to a better patient adherence to treatment, although it does not evaluate pressures during sleep[12].

The Pearson correlation showed an excellent association when SBP and DBP as measured by ABPM and HBPM were analyzed, and almost the same values and confidence intervals were observed, which shows the similarity between the two methods. In relation to the differences between the two methods, it was verified that HBPM diagnosed more cases of RH (4 patients), as was previously stressed. This number of possibly false-positive cases evidenced by HBPM is not expressive and has no statistical significance when ABPM is taken as the gold standard. However, we should point out that several studies have shown better correlations between blood pressure measurements taken using HBPM and target-organ lesions in comparison to casual office measurements and those taken using ABPM[13,14].

To date, ABPM values have been the reference for the confirmation and classification of hypertension. However, HBPM has gained ground because it provides some of ABPM advantages, such as an expressive number of measurements, and detection of white-coat hypertension and white-coat effect[15]. Furthermore, HBPM may increase the adherence to antihypertensive therapy and reduce the number of medical visits required for the diagnosis, thus abbreviating the treatment of hypertension, with the subsequent reduction in costs and complications of this process.

The HOMERUS study was designed to determine the impact of treatments based on HBPM on the reduction of unnecessary prescriptions of antihypertensive drugs and on the detection of target-organ lesions in comparison to those based on casual office BP measurement. The study demonstrated a better adjustment of the antihypertensive therapy based on HBPM, as well as a better control of patients with refractory hypertension in comparison to treatment based on casual BP measurement[16].

The analysis of the differences between casual office measurements, daytime ABPM and HBPM showed that the performance of the three methods was similar. These differences are important in the detection of the white-coat effect, when office BP measurement is higher than that obtained with ABPM and/or HBPM.

As regards the fact that 37.0% of the individuals (19

patients) had casual office BP measurements lower than in ABPM and HBPM, the J-MORE study named this phenomenon as negative white-coat effect, and concluded that it could be related to aging, male gender, and ischemic heart disease[17]. In the present study, this phenomenon was observed in 11 men, 31.0% of whom had associated coronary artery disease.

In relation to the presence or absence of obesity and its relation to RH or pseudoresistant hypertension, no statistically significant difference was found.

Several studies describe the advantages of HBPM. However, Van der Hoeven et al[18] studied 106 patients undergoing HBPM and concluded that they need proper instruction and a close watch. The authors verified that even using memory-equipped devices to ensure the accuracy of date, time and number of measurements, the participants had difficulties with the method[18].

In the present study, in addition to verbal instructions, the patients received a handout and a mobile phone number which they could call at any time to solve problems or questions. We observed that this procedure aroused the participants' interest and commitment, thus facilitating their understanding, adherence and relationship with the health professional.

Some studies associated HBPM with BP telemonitoring, which consists of home BP measurement with remote monitoring and management using data transmission by telephone or over the Internet.

Few studies in this area are available. However, some preliminary results have been encouraging[19-21].

Based on the results obtained, we can anticipate HBPM as a very useful tool in the diagnosis of true RH with highly positive reflexes on hypertensive patients' adherence to the treatment established.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Sources of Funding

There were no external funding sources for this study.

Study Association

This article is part of the thesis of master submitted by Fabiane Rosa R. H. Marui, from UNIFESP.

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