

Improving hypertension control by ambulatory blood pressure monitoring

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Abstract

Objective: To compare the proportion of patients with uncontrolled hypertension when using 24 hours ambulatory blood pressure monitoring (ABPM) or office blood pressure.

Methodology: This is a cross sectional study conducted among 105 hypertensive patients attending Primary Care Clinic, HUSM. Schiller BR-102 plus was used to get 24 hours blood pressure (BP) reading. Mean of two office BP were taken. McNemar's test was applied to compare between the proportion of uncontrolled hypertension measured by an ABPM and office blood pressure.

Results: The mean (SD) age was 51.8 (9.34) years. The mean (SD) 24 hours systolic and diastolic BP were 128.4 (12.7) mmHg and 79.7 (8.74) mmHg respectively. Mean (SD) systolic and diastolic office BP was 144.2(15.16) mmHg and 90.2(9.71) mmHg. The proportion of uncontrolled systolic and diastolic based on 24 hours ABPM were 26.7% and 23.8%, respectively. The proportion of uncontrolled office blood pressure (57.1% systolic and 61.0% diastolic) was significantly higher.

Conclusion: The office blood pressure measurement overestimated uncontrolled hypertension compared to 24 hours ABPM. Therefore using ambulatory blood pressure was clinically important to get a better understanding of blood pressure control.

Key words: ambulatory blood pressure, office blood pressure

Introduction

Hypertension is an important worldwide public health challenge because of its high frequency and concomitant risks of cardiovascular, cerebrovascular and kidney diseases.^{1,2} In Malaysia, it is now estimated that there are 4.8 million individuals with hypertension. The third National Health and Morbidity Survey of 2006 showed a prevalence of hypertension among adults 30 years old and above of 43%, a relative increase of 30% compared to the previous 10 years.³

Ambulatory blood pressure monitoring devices more accurately reflect a patient's blood pressure and correlate more closely with end-organ complications than blood pressure levels measured in the physician's office.^{4,5}

Blood pressure control and, hence, decisions about medication dosages might be improved with 24 hour ABPM rather than relying on measurements in a physician's offices⁴. Accurate in-office blood pressure readings, obtained in compliance with the American Heart Association guidelines, remain the gold standard for decision-making in the diagnosis and treatment of hypertension. Recent studies, however, indicate that ABPM data may more accurately reflect a patient's actual blood pressure than casual or in-office blood pressure measurements and may improve the physician's ability to predict cardiovascular risk.⁶

The present study was conducted in order to compare the proportion of uncontrolled hypertensive patients detected by ABPM or office blood pressure.

Methods

A cross sectional study was conducted from 1st January 2008 to 30th June 2008 at Primary Care Clinic, Hospital Universiti Sains Malaysia (HUSM), Kelantan. The inclusion criteria were diagnosed hypertension and aged more than 18 years old. Respondents with end organ damage or pregnant women were excluded. The eligible respondents were selected by systematic random sampling. The study protocol was approved by Research Ethics Committee, Universiti Sains Malaysia on 22 November 2006 (USM/PPSP/Ethics Com./2006 (183.3(2)

Research tool

Initially the office BP was measured after patients were adequately rested and seated with their arms supported at heart level. After 30 minutes of rest, two blood pressure recordings were obtained from the right arm of patients at 5 minute intervals. The mean

of two readings were recorded at 5 minutes intervals as per World Health Organization guidelines, using an automatic device (Omron model HEM 757A-C1).

Subsequently, 24-hour ABPM measurements were taken automatically in the non-dominant arm by a oscillometric portable monitor (Schiller BR-102 model). The devices had been validated by British Hypertension Society and the US Association for the Advancement of Medical Instrumentation.

All the patients were advised to maintain their daily activities and avoid vigorous exercise during the ABPM. The tools were programmed for reading every 60 minutes from 0600 to 2200 and every 120 minutes from 2201 to 2359 because of sleeping time then every 30 minutes from 2400 to 0600 hr. The recordings from the monitor were downloaded to a PC-compatible computer using the MT-300 program and it displayed all the readings values throughout the 24-hour BP both for systolic and diastolic BP.

In this study for uncontrolled office blood pressure was defined as systolic ≥ 140 mmHg and diastolic ≥ 90 mm Hg or ≥ 130 mm Hg systolic and ≥ 80 mm Hg diastolic for diabetic patients.⁷ However for ABPM, abnormal blood pressure was defined based on British Hypertension Society blood pressure of more than 135 mm Hg of systolic and more than 85 mm Hg of diastolic for 24 hour blood pressure, more than 125/75 mm Hg for night time blood pressure and more than 140/90 mm Hg for daytime blood pressure.⁸

Statistical Analysis

Data entry and analysis were conducted using SPSS for Windows, version 12.0. Data exploration was done including descriptive statistics and appropriate graphs for each variable. Quantitative variables are expressed as mean values and standard deviation (SD) and qualitative variables are expressed as frequency and percentage (%).

From this analysis, the mean of daytime blood pressure, nighttime blood pressure and mean 24hours systolic blood pressure (24 SBP) were obtained. The percentage of controlled and uncontrolled hypertension based on 24 hour ABPM and office blood pressure were also documented. The difference in the percentage of uncontrolled hypertension based on 24 hours ABPM and office blood pressure was compared by using Mc Nemar's test.

Results

A total of 114 hypertensive patients were eligible and consented for this study. However, only 105 patients have adequate reading giving the response rate of 92%. Nine patients were excluded because the total ABPM readings a day were less than 80%.

The study population consist of 59 men and 46 women with mean age of 51.8 (9.3) years.

63.8% were not smoker or already quitted for more than 6 months. The hypertension duration range from a month to 8 years and they were on either one to four anti-hypertensive medication. Table 1 shows the details of demographic and clinical characteristic of respondents.

The mean (SD) of 24 hours systolic blood pressure (SBP) and diastolic blood pressure (DBP) was 128.5 (11.52) mm Hg and 79.8 (8.74) mm Hg respectively. Mean (SD) of systolic and diastolic office blood pressure was 144.2 (15.16) mm Hg and 90.2 (9.71) mm Hg (Table 2).

The proportion of uncontrolled BP based on ABPM for systolic and diastolic BP pressure was 26.7% and 23.8% respectively. Office blood pressure shows percentage uncontrolled blood pressure systolic and diastolic was 57.1% and 61.0% as shown in table 3.

There were significant differences in proportion of uncontrolled systolic and diastolic blood pressure based on office blood pressure reading from those based on 24 hour blood pressure monitoring ($p < 0.001$) (Table 4 and Table 5). Office blood pressure reading had 7.40 times odds of uncontrolled systolic and 14.00 times odds of uncontrolled diastolic blood pressure compared to 24 hour blood pressure monitoring.

Discussion

This study showed the proportion of uncontrolled office SBP reading was 57.1% and those with uncontrolled office DBP was 61.0%. However, the percentage of uncontrolled blood pressure based on ABPM was lower with 26.7% and 23.8% of the systolic and diastolic BP respectively. Similar findings were observed in a study performed by Godwin *et al.* The study concluded that there may be mislabeling patients as uncontrolled if we use only the physician office measurements of blood pressure when the patients are actually having a controlled blood pressure.⁴

The higher office blood pressure measurement could represent a white coat effect and might be due to different timing of blood pressure measurement. The present study recommends the use of ambulatory blood pressure monitoring in order to define therapy success rates in hypertensive patients.

The higher mean office blood pressures compared to ambulatory blood pressures in the present study could be explained by isolated clinic hypertension or white coat hypertension among the hypertensive patients attending the family medicine clinic HUSM. That's why patients with high office blood pressure need to be further confirmed with other methods such as home blood pressure or ambulatory blood pressure monitoring.

Traditionally, sporadic office measurements of blood pressure have been used to stratify risk and therapeutic targets, and have proven effective on a population basis. The relationship between office blood pressure and cardiovascular risk is continuous and consistent.⁹ Few prospective studies suggest that the risk of hypertensive target organ damage including left ventricular hypertrophy correlates more closely with ambulatory blood pressure than with office measured blood pressure.^{10, 11} This difference however may be lessened by increasing the number of readings during one office visit.¹² However, although multiple and carefully performed clinical blood pressure measurements may indeed reach a diagnostic power similar to that 24 hour, this is rarely performed in practice, due to the time constraint.¹³

Large studies in normal adult populations have provided suitable normative data for ambulatory blood pressure. This demonstrated that home and 24-hr or daytime average blood pressure was much lower than clinic blood pressure.¹⁴ Preliminary evidence suggest that the average 24 hours blood pressure obtained by ambulatory monitoring may be superior to casual blood pressure readings in treatment evaluation, because ABPM is largely unaffected by any placebo effect and that 24 hour blood pressure rate have more reproducibility than office blood pressure.¹⁵

However there are some limitations in this study, as we all know, the 24 hours blood pressure is patient dependence, patients was instructed to be on ambulatory blood pressure monitoring for 24 hours to get accurate reading but most of the patient are unable to do so as majority of the patients are Malay and Muslim in which they have to remove the machine each for prayer time or when they want to take a bath. Some problems with the tools such as a loose or improperly positioned cuff, a pinched air hose, or excessive patient movement, will cause error and failure of blood pressure reading. This limited reproducibility is presumably related to the fact that the quality and depth of sleep as well the mental and physical activity during daytime can easily vary from one recording session to another.

Another limitation is ABPM done only for 24 hour may be too short to characterize accurately the features of the day/night variation in BP, including the precise period of that variation. In order to get more accurate 24 hours reading of ambulatory blood pressure each patient should undergo ABPM for 48 hours or twice. However the 24-hour mean, still the most common approach for diagnosing hypertension on the basis of ambulatory monitoring, with sensitivities of 40% and 31% for systolic and diastolic blood pressure, respectively. Compared to 48 hours ABPM, sensitivity of this tolerance-hyperbaric test was 98.6%, with a negative predictive value of 99.7% (Ramon, 2000).

Conclusion

A significant percentage of patients with uncontrolled office BP had normal 24 hours ambulatory BP. The present clinical study found that ABPM is more useful in evaluating blood pressure control compared to office blood pressure measurement in hypertensive patients. Therefore, it can actually reduce the chances of adding a new antihypertensive or increase the dose of antihypertensive therapy unnecessarily. This will avoid poly-pharmacy in managing the hypertensive patient especially in primary care.

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References

1. Verdecchia P, Fabio A, Roberto G. Clinical usefulness of ambulatory blood pressure monitoring. *J Am Soc Nephrol*. 2004; 15:30-33.
2. Zweiker R, Eber B, Schumacher M, Toplak H, Klein W. Non-dipping related to cardiovascular events in essential hypertensive patients. *Acta Med Austriaca*. 1994; 21(3):86-9.
3. Institute for Public health (IPH) 2008, The Third National Health and Morbidity Survey (NHMS III) 2006, Vol 2. Ministry of Health, Malaysia
4. Godwin M, Dianne D, Rachele S, et al. Relationship Between Blood Pressure Measurements Recorded On Patients’ Charts In Family Physicians’ Offices And Subsequent 24 hrs Ambulatory Blood Pressure Monitoring. *BMC Cardiovascular Disorder*. 2004; 4:2.
5. Kandiah N, Rampal L, Paranjothy G. A Community Based Study On The Epidemiology Of Hypertension In Selangor. *Med J Malaysia*. 1980; 34:211-220.
6. Pickering TG. Ambulatory blood pressure monitoring in clinical practice. *Clin Cardiol*. 1991; 14:557-62.
7. Malaysian Society of Hypertension and Ministry of health, Malaysia 2008. Clinical Practice Guideline management of hypertension.

8. Pickering T, Pieper C. Methods of analysis of ambulatory blood pressure data. In: Pickering TG, ed. *Ambulatory monitoring and blood pressure variability*. London: Science Press. 1991; 16.1-16.15.
9. O'Brien E, Gareth B, Gregory YL. ABC Hypertension – Blood Pressure Measurement. *BMJ*. 2001;322:1110-1114
10. Verdecchia P, Porcellati C, Schillaci G, et al. Ambulatory blood pressure: an independent predictor of prognosis in essential hypertension. *Hypertension*; 1994; 24:793–801.
11. Appel LJ, Stason WB. Ambulatory blood pressure monitoring and blood pressure self-measurement in the diagnosis and management of hypertension. *Ann Intern Med*. 1993 ; 118:867-82.
12. Fagard R, Staessen J, Thijs L. Optimal definition of daytime and night-time blood pressure. *Blood Press Monitoring*.1997; 2:315-321.
13. Parati G. and Mancia G. Ambulatory blood pressure monitoring in clinical practice. *J Hypertens*. 2002; 20:1925-1927.
14. Staessen JA, Thijs L, Fagard R, et al. Systolic Hypertension in Europe (Syst-Eur) Trial Investigators. Predicting cardiovascular risk using conventional vs ambulatory blood pressure in older patients with systolic hypertension. *J Am Med Assoc*.1999; 282:539–546.
15. Trazzi E, Mutti E, Frattola A, Imhoce B, Parati G, Mancia G. Reproducibility of non-invasive and intra-arterial blood pressure monitoring. Implications for studies on antihypertensive treatment. *J Hypertens*. 1991; 9:115-119.

APPENDIX

Table 1: Demographic and clinical profiles of patients (n=105)

<i>Characteristic</i>	<i>Mean(SD)</i>	<i>n(%)</i>
Age (year)	51.8 (9.34)	
Gender		
Male		59 (56.2)
Female		46 (43.8)
Duration of hypertension (year)	4.2 (3.94)	
Number of antihypertensive	1.6 (0.65)	
Smoking		
No		67(63.8)
Yes		38(36.2)
Diabetes Mellitus		
No		86 (81.9)
Yes		19 (18.1)
Body Mass Index (kg/m ²)		
Normal BMI		13 (12.4)
Overweight		92 (87.6)
Waist Circumference (cm)		
Normal WC		29(27.6)
Abnormal WC		76(72.4)
Total Cholesterol (mmol/L)		
Normal TC		12(11.4)
Abnormal TC		93(88.6)
HDL (mmol/L)	1.4(0.37)	
LDL (mmol/L)	3.5(1.03)	
TG (mmol/L)	1.7(0.85)	

Table 2: Blood Pressure Profile Based on Ambulatory Blood Pressure Monitoring

	Systolic	Diastolic
	Mean (SD)	Mean (SD)
ABPM		
Daytime	132.2 (11.72)	82.4 (9.41)
Nighttime	123.4 (12.78)	76.2 (9.01)
24 Hour	128.5 (11.52)	79.8 (8.74)

Table 3: Proportion of controlled and uncontrolled ambulatory blood pressure and office blood pressure

	Controlled		Uncontrolled	
	Systolic n(%)	Diastolic n(%)	Systolic n(%)	Diastolic n(%)
ABPM	77(73.3)	80(76.2)	28(26.7)	25(23.8)
Office Blood Pressure (OBP)	45(42.9)	41(39.0)	60(57.1)	64(61.0)

Table 4: McNemar's test comparing the difference in proportion of controlled and uncontrolled systolic blood pressure between office and ambulatory blood pressure

<i>24 hours systolic BP</i>	<i>Office Systolic Blood Pressure</i>	
	Controlled	Uncontrolled
Controlled	40	37
Uncontrolled	5	23

Chi-square with continuity correction = 22.88

Odds ratio = 7.40 (95% CI = 2.89, 18.92)

p-value < 0.001

Table 5: McNemar's Test comparing the difference in proportion of controlled and uncontrolled diastolic blood pressure between office and ambulatory blood pressure

<i>24 hours diastolic BP</i>	<i>Office Diastolic Blood Pressure</i>	
	Controlled	Uncontrolled
Controlled	38	42
Uncontrolled	3	22

Chi-square with continuity correction = 32.09

Odds ratio = 14.00 (95% CI = 4.35, 45.15)

p-value < 0.001