Role of Ambulatory Blood Pressure Measurement in Diagnosis and Control of Hypertension

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Abstract

Office blood pressure (BP) measurements by sphygmomanometer are not necessarily representative of patient's usual blood pressure. In contrast, ambulatory blood pressure measurements (ABPM) represent a large number of readings and may reflect the actual BP status of an individual. In this study, 150 individuals were studied in 2 groups. 110 patients (group A) had stage I & II, hypertension based on casual BP readings. 26 (23.6%) of them were found to be normotensive as per existing ABPM standard. There were 40 patients with poorly controlled hypertension on multiple drugs (group B). The trough/peak ratio of >50% was seen in 12.5% of these patients at start of study. This increased to 84.8% after modification of drugs as per the profile on ABPM, thus indicating usefulness in achieving a smoother control.

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Key Words : Ambulatory blood pressure; White coat hypertension

Introduction

The importance of hypertension as a predictor of cardiovascular morbidity and mortality is well established and measurement of BP has become an integral part of physical examination [1]. In several trials of antihypertensive treatment, it was observed that over 30% of placebo treated patients had normal BP at the end of the study despite the high BP recorded at the start of the study [2]. It was suggested that a 24 hour ABPM would be a more accurate guide to the presence of hypertension. We undertook this study to assess BP profiles for diagnosis of hypertension on ABPM and to eliminate 'white coat effect' viz transient elevation of BP induced by medical environment. We also undertook to evaluate the role of ABPM in ensuring a more uniform control of BP in patients with severe hypertension on multiple antihypertensive drugs.

Material and Methods

150 patients with hypertension were evaluated. Hypertension was diagnosed when BP was 140/90 mm Hg by office BP measurements on 3 occasions at 2 weeks interval. Each value was recorded as the average of 3 readings taken 2 minutes apart. Hypertension was graded from stage 1-3 as per the sixth report of the Joint National Committee on prevention, evaluation and treatment of high BP [3]. All patients were divided into two groups - A & B. Group A included 110 patients with stage 1 & 2 hypertension. Group B included 40 patients with stage 3 hypertension constituting both primary and secondary hypertension. They were on at least two antihypertensive drugs but had uncontrolled hypertension as per casual BP recordings. Target organ damage (eyes, kidney and heart) was evaluated clinically and assessed with fundi examination of eyes, X-ray chest, ECG, blood urea, serum creatinine and urinalysis. Each

patient was subjected to 24 hours ABPM using an oscillometric monitor (model 9232) manufactured by GH medical Inc. USA. BP was recorded automatically every 30 minutes from 0800 hours to 2200 hours and then every 2 hours till next day 0800 hours. On completion of 24 hours, the monitor was connected to the computer and results analyzed using software designed by the company.

This initial test was designated as 'test 1'. The test was repeated after 6 months in Group A patients. In Group B patients, the ABPM was repeated one month after modification of drug dosage and on a change of antihypertensive drugs. The second test was designated as 'test 2'.

The parameters analyzed on ABPM in group A patients were average night time BP, 'night dipping' of BP, average daytime BP, 24 hours average BP, systolic and diastolic BP loads and the percentage of systolic BP (SBP) and diastolic BP (DBP) readings greater than 140 and 90 mm of Hg respectively out of the readings recorded. Dippers were defined as those patients who had a decline $\geq 10/5$ mm Hg of BP between mean day and night time BP and nondippers were those who didn't have the difference of 10/5 mm Hg between mean day and night time BP.

In group B patients, we analyzed 24 hours average BP, duration and adequacy of control of BP, systolic and diastolic BP load and the trough / peak ratio (T/P ratio) - the ratio between maximum SBP and DBP to minimum SBP and DBP during 24 hour period. For each parameter mean $\pm$ SD was calculated. For significance, the Chi square test and Student's 't' test were used.

Results

In group A, the mean age of patients was 46 ± 4.3 years (range 23-64 years); male to female ratio was 4:1. The mean office SBP was 146.9 ± 4.2 mm Hg & DBP was 90 ± 3 mmHg respectively. The mean daytime systolic and diastolic ABP was 142 ± 6 mmHg and 83 ± 5 mmHg respectively. The mean night time systolic and diastolic BP was

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significantly less (131 ± 7 and 76 ± 6 mm Hg). 26 out of 110 individuals (23.6%) were found to be normotensive during the initial test (test 1) itself ($p < 0.05$).

According to the reference ABPM standards [5], on calculation of the systolic and diastolic pressure load, 7.3% of total cases were definitely hypertensive basing on both day and night time recordings. In contrast, probable hypertensives were 12.7% when only the day readings were taken into account and 56.4% were hypertensive when only night time readings were recorded. Of the 84 patients with hypertension on test 1, 23.8% were nondippers and remained so after 6 months.

In group B, there were 40 patients. Their mean age was 44.83 years (range 20-58 years); male to female ratio 8:1. Twenty patients had primary hypertension and the remaining had renal parenchymal hypertension. 11 (27.5%) patients had ischaemic heart disease and 8 (20%) patients had NIDDM.

All patients in group B had uncontrolled office BP readings using mercury sphygmomanometer and were on two or more antihypertensive drugs. However, on ABPM and as per reference ABPM standards, 5 (12.5%) of these patients had an acceptable BP control. In the remaining 35 patients modification of drug and their dosage was done. At the end of 1 month, a repeat test was done in these 35 patients. 5 out of 33 (15.2%) patients had uncontrolled hypertension while 28 (84.8%) had well controlled hypertension by ABPM standards.

The trough to peak ratio of $>50\%$ is an indicator of uniform control of BP over 24 hours and was present in 5 (12.5%) of patients of group B in test 1. After modification of drug schedule the T/P ratio was $>50\%$ in 35 (84.8%) patients. Even the mean SBP and DBP that were 163 ± 14 and 93 ± 6 mm of Hg at the baseline study decreased to 138 ± 9 and 82 ± 6 mm of Hg during test 2 after one month (Table-1).

Table 1
Profile of blood pressure in the cases - Group B (Mean $\pm$ SD)

Period	SBP	DBP	MAP
Maximum OBP	177 ± 11	103 ± 13	—
M ABP at			
Baseline (Test 1)	163 ± 14	93 ± 6	116 ± 9
M ABP after			
1 month (Test 2)	* 138 ± 9	* 82 ± 6	* 99 ± 7

$p < 0.05$; OBP - Office blood pressure; MABP - Mean ambulatory blood pressure

Discussion

Office BP measurements by sphygmomanometer are not necessarily representative of patient's usual BP and may reflect transient elevation induced by the medical environment (white coat effect) [4]. ABPM represents a large number of measurements and may

labelled as hypertensive, were found to be normotensive as per existing ABPM standards during the initial test (test 1) itself. BP load (both systolic and diastolic) during awake and asleep is important in differentiating patient with true hypertension and white coat hypertension.

According to the reference ABPM [5], 7.3% of total cases were definitely hypertensive as per both day readings and night readings. However, on day readings alone, 12.7% were grouped as probable hypertensive, which increases to 56.4% as per night time readings alone. The significance of these values is unclear at the moment and will require longitudinal studies for reaching any meaningful conclusion. The 'non dipping' of BP at night compared to daytime is one of the specific indicators of detecting hypertension and may have an impact on target organ involvement [6]. In this study, 23.6% of those detected to have hypertension after test 1 were found to be 'non dippers'. This particular group required therapy and periodic monitoring with ABPM for evaluation of control.

ABPM helps in monitoring actual BP control in patients already diagnosed to have hypertension; particularly when they are on multiple antihypertensive drugs with varying peak and duration of action. 5 out of 40 patients (12.5%) who were thought to be uncontrolled on casual office visits and who would have had their drugs modified basing on these casual readings, were found to have adequate control on ABPM.

Optimal treatment of hypertension involves smooth, usually gradual reduction in both systolic and diastolic BP, which is sustained through out the day and night. Conventionally, a single measurement of BP usually obtained at approximately the same time of the day is employed to assess the efficacy of treatment, duration of drug action, optimal dose and dosing schedules. The mean antihypertensive effect of a drug measured just before the next dose is generally used as criterion for control of BP [7]. However, for many short acting drugs very high doses may be required to maintain anti-hypertensive activity at the end of dosing interval. This may lead to excessive reduction in BP at the time of peak drug effect.

A trough to peak ratio of $>50\%$ indicates a uniform control of BP over 24 hours [8]. In our hypertensive patients at test 1, only 12.5% patients had T/P ratio of $>50\%$. This increased to 84.8% at the end of month with drug dosage modification and timing of administration, which was done with the help of ABPM.

ABPM allows evaluation of a series of BP levels at various times and during varieties of activities and

pertension. However, the standards for ABPM are still evolving and the equipment is available only in few centres. We recommend that ABPM be used more widely to eliminate 'white coat hypertension' and to evaluate adequacy and uniformity of BP control in patients with hypertension requiring multiple drugs.

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