

# The Effective Diagnosis And Treatment Of Hypertension By The Primary Care Physician: Impact Of Ambulatory Blood Pressure Monitoring

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**Abstract: Background:** Ambulatory blood pressure monitoring (ABPM) has been described as an effective method for the diagnosis and formulation of the treatment of hypertension by the primary care physician.

**Methods:** Sixty patients selected from a suburban private primary care practice participated in a study that compared measurements of office blood pressures using a mercury sphygmomanometer with the same pressures recorded by ABPM.

**Results:** Blood pressures and blood pressure loads measured by ABPM were significantly lower than blood pressures and pressure loads recorded in the office setting.

**Conclusions:** Blood pressure recorded by ABPM differed from the same measurements made by office or casual sphygmomanometry. Use of ABPM changed diagnosis or treatment of hypertension in borderline and antihypertensive drug-treated patients. Ambulatory blood pressure monitoring is a useful tool for the diagnosis and treatment of hypertension by the primary care physician. It can be used to identify white-coat hypertension in various patient populations. (J Am Board Fam Pract 1992; 5:457-65.)

The cause of primary (essential) hypertension is unknown, and it seems improbable that a single cause will explain the diverse hemodynamic and pathophysiologic derangements described under the rubric of essential hypertension. Hereditary factors undoubtedly predispose individuals to hypertension, but the exact mechanism is unclear. Environmental factors (e.g., dietary sodium, obesity, diet, and stress) seem to act mostly in genetically susceptible persons.

The diagnosis and treatment of hypertension as they relate to the practicing primary care physician have been the focus of three reports compiled by the Joint National Committee on Detection, Evaluation and Treatment of High Blood Pressure. The latest of the Joint National Committee reports<sup>1</sup> provides guidelines designed to help primary care physicians define and treat hypertension. The Joint National Committee has recommended that hypertension be diagnosed at a

conventional diastolic blood pressure greater than 90 mmHg or systolic blood pressure greater than 140 mmHg. These guidelines have helped reduce the overall morbidity and mortality rates for cardiovascular and cerebrovascular disease.

As early as 1940 it was established that blood pressure measured in the office (office-measured blood pressure, or casual blood pressure measurement) was higher than that recorded at home.<sup>2</sup> Subsequent studies have further documented decreased blood pressure values taken over two or three recordings<sup>3,4</sup> and the phenomenon of so-called white-coat hypertension.<sup>5,6</sup> The inherent variability of blood pressure, the limitations of office measurements, and the occurrence of white-coat hypertension have made diagnosis of essential hypertension a difficult task.<sup>7-10</sup>

Recent advances in medical technology have provided the development of automatic portable noninvasive blood pressure recording devices and a technique known as ambulatory blood pressure monitoring (ABPM). ABPM allows blood pressure to be monitored with minimal intrusion into the daily activities of the patient and can be used to monitor blood pressure for 24 hours or more. Evaluation of the following clinical problems are better elucidated by ABPM than by casual blood pressure readings: borderline hypertension with

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or without target organ involvement, vascular resistance hypertension, episodic hypertension, office or white-coat hypertension, and episodic hypertensive and hypotensive events.<sup>11-15</sup>

The purposes of this prospective study were (1) to determine whether blood pressure measurements recorded by ABPM differed from those made by office or casual sphygmomanometry, (2) to determine whether the use of ABPM would change the diagnosis or treatment of hypertension in borderline hypertensive or antihypertension-drug-treated patients, and (3) to demonstrate the utility of ABPM as a useful tool for the diagnosis and treatment of hypertension by the primary care physician. The study was undertaken in the outpatient setting while patients were under the care and supervision of a family physician. In this study we compared office-recorded blood pressures with 24-hour mean ambulatory and blood pressure loads (the percentages of systolic and diastolic blood pressures exceeding 140 mmHg and 90 mmHg, respectively, in all patients).<sup>16</sup>

## Methods

### *Patient Population*

Sixty patients were selected from a suburban private primary care practice: 17 patients who had no history of hypertension, and 43 patients who had a history of hypertension and were taking medication at the time they entered into the study. Patients were of both sexes and ranged in age from 20 to 65 years. All study patients were normally seen in a private family practice office, and all exhibited three or more consecutive blood pressure readings on different days of greater than 90 mmHg diastolic blood pressure or greater than 140 mmHg systolic blood pressure as measured by office sphygmomanometry. Patients taking no medication upon entry would have been prescribed medication had attempts at eliminating obesity, excessive sodium intake, high caffeine use, or sedentary activity not resulted in a normalization of blood pressure. Patients already taking medication had no changes in dosage in the 2 months before inclusion in the study.

### *Office (Casual) Blood Pressure Recording*

Regardless of their study group assignment, all patients had their casual blood pressures recorded in the same manner: (1) patients were seated with

their arms bared, supported, and positioned at heart level; (2) patients were not to have smoked or ingested caffeine within 30 minutes before measurement; (3) blood pressures were measured following a 5-minute quiet rest period; (4) a cuff of sufficient size was used to ensure that the rubber bladder encircled at least two-thirds of the arm; (5) blood pressure was measured with a mercury sphygmomanometer (placed at the level of the patient's heart); (6) both systolic and diastolic blood pressures were recorded (pressure taken with sphygmomanometer using the first Korotkoff sound as systolic blood pressure and the disappearance of sound as the diastolic blood pressure); (7) three (or more) readings were averaged (when two readings differed by more than 5 mmHg, additional readings were obtained); and (8) all office blood pressures were recorded between 0900 and 1200 hours. Office blood pressures were measured at the beginning and end of each 24-hour recording session for a total of at least six readings.

### *ABPM Blood Pressure Measurement*

Following the office blood pressure measurements, each patient started the ambulatory phase of the study. Ambulatory blood pressure monitoring was carried out using an Accutacker II ABPM device (Suntech Medical Instruments, Raleigh, NC). This device, about the size of a small Holter recorder, is worn about the waist and is connected to a regular blood pressure cuff, which is insufflated by a miniaturized air pump. The ambulatory monitor uses a small microphone to pick up the Korotkoff sounds over the brachial artery and is timed according to the R waves of the electrocardiogram to turn on and off (R wave gating) to eliminate extraneous sounds. A display on the monitor, if activated by the setup protocol, enables the patient to see the results of each blood pressure taken, which the monitor saves electronically. The monitor was applied to each patient in the morning.

At the start of the recording period, the monitors were applied to the patients while they were in the office setting. The patients were asked to rest quietly for 5 minutes before any blood pressure measurements were made. Following the 5-minute rest, a trained registered nurse obtained simultaneous blood pressure readings from the ABPM device and a mercury manometer by

using a T tube. The common end of the T tube was connected to the cuff, and the bifurcated parts of the T tube were connected to the ABPM device and the manometer, respectively. Measurements were made while the patients were in a sitting, supine, and standing position (2 minutes apart) with the cuff at heart level.

At the conclusion of each 24-hour recording period, simultaneous blood pressure recordings were again made to compare the ABPM device recording with the mercury manometer recording to verify the continued accuracy and reproducibility of the ABPM device. Variations of more than 5 mmHg in diastolic blood pressure or more than 10 mmHg in systolic blood pressure between the two techniques resulted in exclusion of a patient's readings from the study. All patients received instructions in the use and care of the ABPM device. Each patient was monitored for one 24-hour period described as a normal day, be it at a workplace or in the home.

The frequency of blood pressure measurements recorded by the ABPM device was as follows: 2400 hours to 0600 hours — once every 30 minutes, 0600 hours to 1800 hours — once every 15 minutes, 1800 hours to 2400 hours — once every 30 minutes. An activity journal was kept by each patient to identify the type of activity engaged in at the time of the recording. Although average frequency of measurement was stated as above, the actual frequency was randomized by plus or minus 5 minutes to avoid the phenomenon known as programmed response. Patients were able to initiate readings that were supplemental to the programmed schedule at any time.

The monitors used in this study were purchased from Suntech Medical Instruments, Raleigh, NC, for use in the private practice. The study was entirely self-funded. Suntech Medical Instruments provided only technical assistance when needed.

#### **Data Collection and Analysis**

Mean 24-hour ABPM-recorded systolic and diastolic blood pressures, mean morning (0900–1200) ABPM-recorded systolic and diastolic blood pressures, and office-measured systolic and diastolic blood pressures were used for analysis. Blood pressure load (defined as the percentage of readings greater than 140 mmHg systolic blood pressure, or greater than 90 mmHg diastolic blood

pressure) was calculated for office and ABPM recordings. The differences between mean systolic and diastolic blood pressures recorded in the office and those recorded by ABPM were calculated. The data from all groups were subjected to analysis of variance (ANOVA, one way) to test for population variance homogeneity. All blood pressure data were subjected to analysis using a one-tailed Student t-test. Blood pressure load data were analyzed by using chi-square analysis. All statistical manipulations were carried out using an interactive statistical software system (Microstat-II, EcoSoft, Inc.).

#### **Results**

##### ***Patients with No History of Hypertension***

The data in Table 1 indicate that patients with no history of hypertension who had elevated office sphygmomanometer-measured blood pressures had significantly lower mean 24-hour ABPM systolic and diastolic blood pressures. Mean office sphygmomanometer-measured systolic and diastolic blood pressures were significantly higher than those measured at a similar time by ABPM. In our study there was no significant difference between the mean 24-hour ABPM systolic blood pressure and the same ABPM systolic blood pressure recorded during the office visit. There was, however, a significant elevation in mean office-measured ABPM diastolic blood pressures compared with mean 24-hour ABPM-measured diastolic blood pressures. Mean systolic and diastolic blood pressures measured in the office by sphygmomanometer were higher than 140 mmHg and 90 mmHg, respectively, compared with mean office ABPM-measured systolic and diastolic blood pressures, which were lower than 140 mmHg and 90 mmHg, respectively. There were smaller differences when office-visit ABPM pressures were compared with 24-hour ABPM-measured pressures.

Of the 17 systolic pressures measured in the office by sphygmomanometer, 12 (71 percent) were greater than 140 mmHg, whereas 3 (18 percent) of the 24-hour systolic pressures measured by ABPM were greater than 140 mmHg (Table 2). This difference was statistically significant. A similar reduction was found in diastolic pressure: 12 (71 percent) of the diastolic pressures measured in the office were greater than 90 mmHg, whereas none (0 percent) was greater than

**Table 1. Systolic and Diastolic Blood Pressure Measurements Recorded in 17 Patients with No History of Hypertension by Office Sphygmomanometry and an Ambulatory Blood Pressure Monitoring (ABPM) Device.**

Measurements	Mean $\pm$ SEM	Mean $\pm$ SEM	P Value*
	<b>Office Sphygmomanometer</b>	<b>24-Hour ABPM</b>	
Systolic (mmHg)	148 $\pm$ 3	127 $\pm$ 3	0.00001
Diastolic (mmHg)	94 $\pm$ 2	74 $\pm$ 2	0.00000
Mean variation of systolic pressure from 140 mmHg	8 $\pm$ 3	-13 $\pm$ 3	0.00003
Mean variation of diastolic pressure from 90 mmHg	4 $\pm$ 2	-15 $\pm$ 2	0.00001
	<b>Office Sphygmomanometer</b>	<b>Office ABPM†</b>	
Systolic (mmHg)	148 $\pm$ 3	128 $\pm$ 1	0.00001
Diastolic (mmHg)	74 $\pm$ 2	79 $\pm$ 1	0.00001
Mean variation of systolic pressure from 140 mmHg	8 $\pm$ 3	-9 $\pm$ 2	0.00008
Mean variation of diastolic pressure from 90 mmHg	4 $\pm$ 2	-9 $\pm$ 1	0.0018
	<b>Office ABPM†</b>	<b>24-Hour ABPM</b>	
Systolic (mmHg)	128 $\pm$ 1	127 $\pm$ 3	NS
Diastolic (mmHg)	79 $\pm$ 1	74 $\pm$ 2	0.025
Mean variation of systolic pressure from 140 mmHg	-9 $\pm$ 2	-13 $\pm$ 3	0.045
Mean variation of diastolic pressure from 90 mmHg	-9 $\pm$ 1	-15 $\pm$ 2	0.029

\*Statistical significance of difference in means determined by the Student t-test.

†Mean ABPM systolic and diastolic blood pressures recorded between 0900 and 1200.

NS = not significant.

90 mmHg using 24-hour ABPM measurement. Systolic and diastolic pressures higher than 140 mmHg and 90 mmHg, respectively, recorded by the ABPM device were greater during the office recording time (0900 to 1200) than were the 24-hour ABPM-measured pressures. None of the comparisons was statistically significant.

### **History of Hypertension**

The data presented in Table 3 indicate that patients with a history of hypertension whose sphygmomanometer-measured office blood pressures were elevated had significantly lower mean 24-hour ABPM-measured systolic and diastolic blood pressures. Mean sphygmomanometer-measured systolic and diastolic blood pressures were significantly higher than the same pressures measured at the same time by ABPM. There was a significant elevation in office ABPM-measured systolic and diastolic blood pressures. Mean

sphygmomanometer-measured systolic and diastolic blood pressures were higher than 140 mmHg and 90 mmHg, respectively, compared with mean office-measured ABPM systolic and diastolic blood pressures, which were lower than 140 mmHg and 90 mmHg, respectively. There were smaller differences when office-measured ABPM pressures were compared with 24-hour ABPM-measured pressures.

Of 43 systolic pressures measured by sphygmomanometer in the office, 28 (65 percent) were greater than 140 mmHg, whereas 2 (5 percent) of the 24-hour ABPM-measured systolic pressures were greater than 140 mmHg (Table 4). This difference was statistically significant. A similar reduction was found in diastolic pressure: 36 (84 percent) of sphygmomanometer-measured diastolic pressures were greater than 90 mmHg, whereas none (0 percent) was greater than 90 mmHg using 24-hour ABPM measurement.

**Table 2. Systolic and Diastolic Blood Pressure Load Measurements Made in 17 Patients with No History of Hypertension by Office Sphygmomanometry and an Ambulatory Blood Pressure Monitoring (ABPM) Device.**

Method of Measurement	No. (%)	No. (%)	P Value*
<b>Systolic Pressures &gt; 140 mmHg</b>			
Office sphygmomanometer and office ABPM†	12 (71)	7 (41)	NS
Office sphygmomanometer and 24-hour ABPM	12 (71)	3 (18)	0.006
Office ABPM and 24-hour ABPM	7 (41)	3 (18)	NS
<b>Diastolic Pressures &gt; 90 mmHg</b>			
Office sphygmomanometer and office ABPM†	12 (71)	3 (18)	0.006
Office sphygmomanometer and 24-hour ABPM	12 (71)	0 (0)	0.000
Office ABPM and 24-hour ABPM	3 (18)	0 (0)	NS

\*Mean ABPM systolic and diastolic blood pressures recorded between 0900 and 1200.

†Statistical significance of occurrence rates determined using chi-square analysis.

NS = not significant.

Systolic and diastolic pressures higher than 140 mmHg and 90 mmHg, respectively, recorded by the ABPM device were greater during the office recording time (0900–1200) than were the 24-hour ABPM-measured pressures. The increase recorded in office ABPM-measured systolic blood pressure but not the increase in the diastolic pressure recorded over the 24-hour period was statistically significant.

### Discussion

The primary goals of this study were to compare and contrast two different methods of evaluating blood pressure measurement and to determine which method might be of most value to family physicians in diagnosing or managing hypertension in their patients. The traditional mercury sphygmomanometer, which has been the reference standard for decades, has been used for most hypertension research. Although ambulatory blood pressure monitoring is a relatively recent addition to the field of hypertension, this technique offers a great deal of promise.

Before ABPM, patients with either clinical hypertension or suspected blood pressure elevation were encouraged to use a home blood pressure kit to augment office readings. There are advantages of home blood pressure monitoring: several readings can be taken daily, it is simple, blood pressure readings can be taken in both home and work environments, and the cost is lower.<sup>12</sup> The disadvantages, however, are serious: readings can be incorrect; when blood pressure is measured only by the patient, anxiety related to taking measurements can affect the outcome; there is little like-

lihood of recording short-lived elevated blood pressure events; the equipment needs to be calibrated regularly; and the sensor must be totally unimpaired. The ABPM provides 24-hour blood pressure readings at any specified interval during usual daily activities. Measurements at work and at home during the awake hours and during sleep can be useful in the evaluation of circadian rhythms of blood pressure. Patients require little instruction, no alerting reaction is present, the technique allows for numerous measurements to capture short-lived elevated pressure events, and a variety of data analyses are possible. Most importantly, ABPM techniques provide practical solutions to the theoretical problems inherent in analyzing blood pressure variability.

Interpretation of the data obtained with ABPM still remains somewhat controversial.<sup>17,18</sup> When the 24-hour mean blood pressure is used for diagnostic purposes, that mean is based on readings obtained at evenly spaced intervals throughout the day. An undue weighting of measurements during certain parts of the day or omission of measurements during other parts of the day could bias the whole-day mean. Hence, the corresponding whole-day blood pressure means obtained with ABPM should be slightly lower because of the inclusion of nighttime readings. Standards exist, however, for daytime, nighttime, and whole-day means with ABPM.<sup>17</sup> Some investigators continue to use mean blood pressure during these times as a method of evaluating ABPM data.<sup>17</sup> Another concept, that of blood pressure load as defined by Weber<sup>17</sup> and Zachariah, et al.,<sup>16</sup>

**Table 3. Systolic and Diastolic Blood Pressure Measurements Recorded in 43 Patients with a History of Hypertension by Office Sphygmomanometer and an Ambulatory Blood Pressure Monitoring (ABPM) Device.**

Measurements	Mean $\pm$ SEM	Mean $\pm$ SEM	P Value*
	<b>Office Sphygmomanometer</b>	<b>24-Hour ABPM</b>	
Systolic (mmHg)	146 $\pm$ 2	121 $\pm$ 2	0.0000
Diastolic (mmHg)	95 $\pm$ 1	72 $\pm$ 1	0.0000
Mean variation of systolic pressure from 140 mmHg	6 $\pm$ 2	- 19 $\pm$ 2	0.0000
Mean variation of diastolic pressure from 90 mmHg	5 $\pm$ 1	- 18 $\pm$ 1	0.0000
	<b>Office Sphygmomanometer</b>	<b>24-Hour ABPM†</b>	
Systolic (mmHg)	146 $\pm$ 2	127 $\pm$ 3	0.0001
Diastolic (mmHg)	95 $\pm$ 1	78 $\pm$ 2	0.0018
Mean variation of systolic pressure from 140 mmHg	6 $\pm$ 2	- 9 $\pm$ 1	
Mean variation of diastolic pressure from 90 mmHg	5 $\pm$ 1	- 10 $\pm$ 1	0.0002
	<b>Office ABPM†</b>	<b>24-Hour ABPM</b>	
Systolic (mmHg)	127 $\pm$ 3	121 $\pm$ 2	0.015
Diastolic (mmHg)	78 $\pm$ 2	72 $\pm$ 1	0.011
Mean variation of systolic pressure from 140 mmHg	- 9 $\pm$ 1	- 19 $\pm$ 2	0.0015
Mean variation of diastolic pressure from 90 mmHg	- 10 $\pm$ 1	- 18 $\pm$ 1	0.0028

\*Statistical significance of difference in means determined using the Student t-test.

†Mean ABPM systolic and diastolic blood pressures recorded between 0900 and 1200.

eliminates some of this bias inherent in whole-day mean blood pressure. Blood pressure load defines as hypertensive those individuals who have 30 percent of their readings throughout the 24-hour period greater than 90 mmHg diastolic blood pressure or 140 mmHg systolic blood pressure. White, et al.<sup>15</sup> have further defended this concept by stating that "... if the BP loads were greater than 40 percent, the incidence of left ventricular hypertrophy or decreased diastolic function would be quite high, approaching 60-90 percent."

Interpretation and comparison of the observed differences between ABPM and office cuff-recorded blood pressure could be hindered by various problems inherent in both methods: (1) calibration of both devices must be maintained and equated, (2) repeated office blood pressure measurement during a study could cause regression of observed mean blood pressure, (3) the stated purpose for which patients wear an ABPM device could be reason enough to cause patients to alter their normal activity, and (4) wearing the

ABPM device and its periodic inflation cannot be blinded from the patient.

In this study we compared office-recorded blood pressure with 24-hour mean ambulatory blood pressure and blood pressure loads in a group of 60 patients, all of whom on three different occasions came to the office with elevated blood pressure (greater than 140 mmHg systolic blood pressure or greater than 90 mmHg diastolic blood pressure). Using the Joint National Committee definition of hypertension, all those patients would have been judged to have hypertension. The patients were placed into two groups: those who had no documented history of high blood pressure, and those who were known to have hypertension and taking antihypertensive medication.

Ambulatory blood pressures in the patients with no history of hypertension were significantly lower than blood pressures recorded in the office setting. Ambulatory systolic and diastolic blood pressures averaged 21 mmHg and 20 mmHg

**Table 4. Systolic and Diastolic Blood Pressure Load Measurements Made in 43 Patients with a History of Hypertension by Office Sphygmomanometer and an Ambulatory Blood Pressure Monitoring (ABPM) Device.**

Method of Measurement	No. (%)	No. (%)	P Value*
<b>Systolic Pressures &gt; 140 mmHg</b>			
Office sphygmomanometer and office ABPM†	28 (65)	8 (19)	0.000
Office sphygmomanometer and 24-hour ABPM	28 (65)	2 (5)	0.000
Office ABPM† and 24-hour ABPM	8 (19)	2 (5)	0.004
<b>Diastolic Pressures &gt; 90 mmHg</b>			
Office sphygmomanometer and office ABPM†	36 (84)	3 (7)	0.000
Office Sphygmomanometer and 24-hour ABPM	36 (84)	0 (0)	0.000
Office ABPM† and 24-hour ABPM	3 (7)	0 (0)	NS

\*ABPM systolic and diastolic blood pressures recorded between 0900 and 1200.

†Statistical significance of occurrence rates determined using chi-square analysis.

NS = not significant.

lower, respectively, than office-measured systolic and diastolic blood pressures (Table 1). Similarly, if the findings are measured as mean variation from the Joint National Committee criteria of 140/90 mmHg, there is a statistically significant difference between the two methods, with ABPM again recording a lower value. One might argue that this difference reflects the inclusion of nighttime values in the ABPM group, and therefore mean values should not be used as the sole criterion for decision making. If one then evaluates blood pressure load, a clearer picture emerges: ABPM pressure loads are significantly lower than office-measured loads. The same general trends were present in the group of patients known to have hypertension and at about the same values (Tables 3, 4). By using the defined values of normal for ABPM<sup>19</sup> for both means and loads, the entire study group would have to be considered normotensive (or in the case of the known hypertensive patients, well-controlled), whereas by traditional methods they would have been defined as hypertensive (or poorly controlled).

The implications of this study are obvious: all patients would have either had hypertension incorrectly diagnosed or had medication inappropriately increased had ABPM not been done. The mental anguish, increased cost, and impact on insurability by incorrectly diagnosing hypertension can have a devastating impact on a patient. Similarly, the cost of additional medication and the increased potential for drug side effects or interactions are concerns that most patients and physicians share. Rather than traditional casual measurement, ABPM appears to be the best avail-

able technology for determining which patients need treatment or increased dosages of medicine. It is interesting that the observed effect of "white-coat" hypertension exists in both normal and hypertensive patient populations and at a much higher rate than has previously been recognized.

Is there any further use of ABPM besides the diagnosis of hypertension? Data from ABPM and intraarterial recordings have clearly shown a circadian pattern of blood pressure. Blood pressures plateau during daytime hours, from approximately 0800–1800, with two small peaks at midday and 1800 hours. Pressure then falls steadily until the nadir is reached at 0300 hours, after which it sharply rises to daytime levels.<sup>20</sup> Normal and hypertensive age-matched patients have identical circadian variations, but hypertensive patients have consistently higher blood pressures than do normal patients.<sup>21–24</sup>

Studies using the concept of blood pressure load and circadian rhythm changes have provided new insights into the relation between hypertension and end-organ damage.<sup>25</sup> Echocardiographic assessment of left ventricular hypertrophy has been shown to be more sensitive and specific compared with the electrocardiogram. Change in blood pressure load is considered to be one of the earliest quantifiable manifestations of target organ damage caused by hypertension.<sup>9,12,17,26–28</sup> Numerous studies now demonstrate that ABPM is superior to casual office measurements in determining those at risk for left ventricular wall thickness or mass.<sup>27–32</sup> Some investigators have found greater differences between mean daytime and nighttime systolic blood pressures in normoten-

sive patients than in those with hypertension.<sup>16,24</sup> Zachariah, et al.<sup>16</sup> have stated that the blood pressure load could be particularly important with respect to not only left ventricular hypertrophy but also myocardial infarction. White, et al.<sup>15</sup> have produced data indicating that more than 50 percent of hypertensive patients with ambulatory blood pressures of 140/90 mmHg or greater during waking hours have reduced rapid left ventricular filling, increased left atrial size, and increased left ventricular mass index. The data support the concept that average blood pressure measured throughout the day determines the cardiac response in patients with hypertension. Patients with office hypertension, however, have no more evidence of increased risk for cardiovascular disease than normal patients.<sup>16</sup> More recently, Palatini<sup>33</sup> found increased target organ damage in hypertensive subjects with the highest nighttime blood pressures.

The results of this and other studies indicate that ABPM is a useful tool for diagnosing and treating hypertension. As with any new technology, guidelines for its use must be determined. Specific indications for ABPM in primary care of hypertension are (1) to diagnose accurately hypertension and the varying degrees of hypertension (This study determined that many patients thought to be hypertensive are in fact normal. ABPM is the procedure of choice in resolving the disparity between home and office readings.); (2) to evaluate those patients whose office or home blood pressure readings are normal but who have evidence of target organ damage, i.e., left ventricular hypertrophy or renal disease; (3) to furnish useful information pertaining to disorders that are difficult to diagnose in the office setting by correlating symptoms, often recorded in a diary, with data obtained by ABPM that suggest hypotension or brief periods of hypertensive activity; and (4) to evaluate hypertension drug efficacy. Overtreatment,<sup>35</sup> as well as undertreatment, is associated with risk. ABPM is the best available method for documenting both duration and efficacy of therapeutic agents<sup>34-37</sup> and could be of special importance in understanding the relations of blood pressure control and circadian rhythms.

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