AMBULATORY BLOOD PRESSURE MONITORING AS A DIAGNOSTIC AND MANAGEMENT TOOL IN CLINICAL PRACTICE

By

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Abstract

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Early and accurate diagnosis of hypertension by nurse practitioners in the clinic setting is critical in order to have improved patient outcomes and minimize associated cardiovascular events. Despite the risks associated with hypertension, less than optimal diagnosis and management of hypertension continues to be a problem in health care. Studies have shown that ambulatory blood pressure monitoring (ABPM) better represents actual blood pressures when compared to traditional office blood pressure readings by taking multiple readings over a 24-hour period to show daytime, nighttime, and 24-hour averages. Ambulatory blood pressure monitoring also offers better predictability for future cardiovascular events than office readings. The use of ABPM can diagnosis white coat hypertension, as well as provide prognostic significance associated with cardiovascular risk, nocturnal patterns, left ventricular hypertrophy, and provide better therapeutic initiation and management in the treatment of hypertension. ABPM continues to be underused in the diagnosis and management of hypertension despite its potential to avoid unnecessary treatment of people who might otherwise be misdiagnosed as having hypertension and to accurately diagnosis people with hypertension leading to treatment and the prevention of associated cardiovascular risks.
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Introduction

Early, accurate diagnosis and management of hypertension (HTN) is necessary to minimize the morbidity and mortality from cardiovascular events associated with hypertension. In addition, it is essential to avoid inaccurately diagnosing and treating someone for HTN who actually is normotensive (Lefevre & Aronson, 2001). The 2008 Heart Disease and Stroke Statistics published by the American Heart Association and American Stroke Association reports that in 2005 there was an estimated 73 million people with HTN in the United States.

Direct and indirect costs associated with HTN in the United States for 2008 is estimated at $69.4 billion (American Heart Association). Hypertension is also strongly related to cardiovascular disease, including stroke, which comes with an estimated cost of $448.5 billion for 2008 in the United States. If these numbers were not alarming enough, the link between aging and HTN will likely result in an increase in the prevalence of HTN in the coming decades due to the aging of the population. Studies consistently show that lowering blood pressure considerably decreases the risk of cardiovascular events and death (McAlister & Padwal, 2001). It is critical for nurse practitioners to properly diagnose and effectively manage HTN early on.

The purpose of this article is explore the use of ambulatory blood pressure monitoring (ABPM) as a diagnostic and management tool for hypertension based on reviews of current literature. Diagnosing and managing hypertension is a daily challenge for nurse practitioners in clinical practice. The use of ABPM as an adjunct to sphygmomanometers may improve diagnosing and management capabilities of
hypertension, as well as decrease associated risks of cardiovascular events, ultimately providing better care and treatment of the patient in the clinic setting.

Diagnosing Hypertension

The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) (2003) defines hypertension stage I as systolic blood pressure (SBP) of 140-159 or diastolic blood pressure (DBP) of 90-99. Hypertension stage II is SBP >160 or DBP >100. The diagnosis of hypertension is made from an elevated average blood pressure taken on at least two office visits, a minimum of two months apart, with at least two blood pressure measurements taken at each visit. The patient should be resting, with the two blood pressures being taking at least five minutes apart. If the blood pressure is severely elevated the diagnosis should be made more quickly (Schwartz & Sheps, 2002). When first time blood pressure falls into the stage II category, a reevaluation should be made within one month. Blood pressures of 180/110 or higher should be treated immediately or within one week, depending on the situation and any other complications the patient may have (JNC7, 2003).

The most commonly used method for taking blood pressures in a clinic setting is with a mercury sphygmomanometer and stethoscope (Dolan et al., 2005). Unfortunately, blood pressures taken in the clinic setting are subject to a multitude of potentially errant readings. Equipment may not be calibrated correctly, the cuff may be ill fitting, or observer error may occur when measuring blood pressure (Chavanu, Merkel, & Quan, 2008). In addition, the blood pressure reading being taken in the office may be elevated as a result of white coat hypertension (WCH). White coat hypertension is a phenomenon that involves significantly higher blood pressure readings in the office from a conditioned
response to stimuli as compared to blood pressure readings during daily life (Larkin, Schauss, Elnicki, & Goodie, 2007).

Ambulatory blood pressure monitoring (ABPM) is an effective way to assess the patient’s blood pressure readings outside of the clinic setting, eliminating many of the factors associated with errant readings. ABPM is recommended more frequently in clinical practice because its use may help achieve improved blood pressure control and/or reduce the need for unnecessary treatment in patients with suspected white coat hypertension, episodic hypertension, hypertension resistant to medication, and hypotensive episodes while taking medication (Kaplan, 2007).

Guidelines for evaluating blood pressure using ABPM differ from those of JNC 7. The following guidelines are considered optimal by the American Heart Association (White, 2005):

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<td><strong>Daytime mean</strong></td>
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When using ABPM hypertension is defined as (Kaplan, 2007):

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<td><strong>Nighttime (asleep) average</strong></td>
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Overview of Ambulatory Blood Pressure Monitoring

An ambulatory blood pressure monitor is an automated, non-invasive way to record multiple blood pressures over a period of time (Pickering et al., 2005; Kaplan, 2007; McGrath, 2002; Chavanu, Merkel & Quan, 2008). The equipment includes a cuff, which is attached to a monitor via tubing, with the monitor resting against the body by a strap or belt. The monitor is lightweight and typically the size of a small handheld radio (Marchiando & Elston, 2003). The cuff is placed on the patient’s non-dominant arm by a trained technician and the equipment is tested for accuracy at this time by a series of sphygmomanometer readings to ensure calibration (Pickering et al., 2005). The patient is instructed to hold the arm still by his or her side whenever the cuff is taking a reading during the 24 hour period (Pickering et al., 2005). Generally, blood pressures are taken every 15-30 minutes over this 24 hour period, giving the provider a better snapshot of 24 hour averages, nighttime blood pressures and daytime blood pressures. The 24 hour blood pressure monitoring will reflect blood pressures during activities of daily living at home, work, and play for the patient, during stressful situations, as well as times of rest (Pickering et al., 2005; Larkin, Schauss, Elnicki, & Goodie, 2007). The patient is encouraged to maintain a log of times of sleep, wake, any medications, and activities while wearing the monitor (Ernst & Bergus, 2003).

The data collected from a 24 hour ABPM are downloaded into a computer for analysis. The information gathered can be organized in various ways for interpretation (Marchiando & Elston, 2003). The report produced may include systolic and diastolic values by hour, daytime, night time, and 24 hour periods (U.S. Department of Health and Human Services, 2002). Analysis and interpretation of information gathered from ABPM
should be completed by the provider offering the service (O’Brien, Coats, Owens, Petrie et al., 2000) and consideration should be given to the diary maintained by the patient related to activities and drug treatment during the 24-hour period. Blood pressure should decrease by 10 to 20 percent at night. When this reduction is not present the person is at increased risk of cardiovascular events (JNC7, 2003).

Indications for Use of Ambulatory Blood Pressure Monitoring

HTN is a modifiable risk factor for cardiovascular disease. Even in the presence of education and treatment strategies, the management of HTN remains suboptimal with variability among providers and poor consistency of clinical trial evidence application (McAlister & Padwal, 2001). Numerous studies have shown ABPM to be beneficial as a diagnostic and management tool for hypertension. In a study designed to compare different methods of measuring blood pressure readings to see how the readings affect the classification of the patients as hypertensive or normotensive, the 24-hour ABPM was considered the gold standard measurement for classifying patients (Chrubasik, Droste, Glimm, & Black, 2007).

The Dublin Outcome Study was conducted to determine if ABPM predicted cardiovascular mortality better than clinic blood pressure measurements and other cardiovascular risk factors. This is one of the largest studies to date to show ABPM as a greater predictor of cardiovascular mortality than clinic blood pressure readings. The study also showed that nighttime blood pressures are a greater predictor of cardiovascular mortality than daytime ABPM values in Western hypertensive populations who were not on blood pressure medication (Dolan et al., 2005) Other studies have confirmed the superiority of daytime ABPM over clinic readings and the prognostic value of 24 hour
ABPM in regard to cardiovascular events, including mortality, myocardial infarction and stroke (Clement, De Buyzere, De Bacquer, de Leeuw, Duprez, Fagard et al., 2003; Dawes, Coats, & Juszczak, 2006).

The data available from ABPM provide a much more reliable picture of the patient’s status than the current standard recommendations of two readings on two separate occasions, and produces greater prognostic information and methods of identifying high-risk patients (Khatter, Swales, Banfield, Dore, Senior, & Lahiri, 1999). The patient is required to return in 24 hours with the monitor and activity log. At that time the data are downloaded and the results can be reviewed with the patient. This eliminates the need to leave it up to the patient to return in a matter of weeks for a second or third clinic blood pressure reading.

Self monitoring of blood pressure is the only alternative to ABPM. Unfortunately, only about 20% of home blood pressure monitors meet acceptable criteria, so accuracy of self monitoring may not be a reliable source (McGrath, 2002). It is important to note that self monitoring of blood pressure has the potential to improve blood pressure control and should not be discounted. Providing adequate training and periodically checking the patient’s machine for accuracy can help minimize problems (Kaplan, 2007; Niiranen, Kantola, Vesalainen, Johansson, & Ruuska, 2006).

Diagnostic Implications

White Coat Hypertension

White coat hypertension (WCH) is defined as blood pressure that is persistently elevated in the presence of a health care provider, but falls to normal values when the patient leaves the medical environment (Lefevre & Aronson, 2001). WCH is present to
varying degrees in most people; however, some people with greater white coat effects may produce a blood pressure that is 20-30 mm Hg or more above their actual blood pressure. Many people who are diagnosed with hypertension by a provider on their first visit end up with an average drop of 15 mm Hg systolic and 7 mm Hg diastolic drop in blood pressure by the third visit (Chobanian, Bakris, Black, Cushman, Green, Izzo et al, 2003). ABPM is an excellent way to assess the patient’s blood pressures outside of the clinical setting and avoid diagnosing a person as having essential hypertension when in fact it is not present. (Larkin, Scsauss, Elnicki, & Goodie, 2007). Analysis on the effectiveness of ABPM revealed that WCH is present in 15% to 25% of untreated, newly diagnosed hypertensive patients. In addition, 5% to 20% of the patients who had WCH will have sustained hypertension (Krakoff, 2006).

Prognostic Significance of Ambulatory Blood Pressure Monitoring

JNC 7 (2003) supports ABPM for evaluation and detection of white coat hypertension in the absence of target organ injury, and assessing patients with apparent drug resistance, hypotensive symptoms from antihypertensive medications, and episodic hypertension. JNC7 also reports that end organ damage correlates more closely with ABPM than clinic blood pressures. The ability to monitor the patient’s blood pressures with ABPM though out their work day provides a good predictor of left ventricular hypertrophy (McGrath, 2002).

Cardiovascular Risk

Blood pressure control directly affects the risk of premature atherosclerotic events in patients being treated for hypertension (McAlister & Padwal, 2001). Numerous studies suggest that cardiovascular risk and morbid events correlate more closely with ABPM.
than with office blood pressures (Kaplan, 2007). One study was conducted to explore the
relationship between daytime ABPM and office systolic pressures with mortality and
found superiority in the daytime ABPM (Dawes, Coats, & Juszczak, 2006). Another
study concluded that 24 hour ABPM in patients with treated hypertension would better
predict cardiovascular events than clinic blood pressure readings (Clement et al., 2003).
In a review of ABPM related studies conducted by the Agency for Healthcare Research
and Quality U.S. Department of Health and Human Services (2002), several studies
showed an association between ventricular mass and ABPM, as well as greater accuracy
in predicting cardiovascular disease with ABPM as compared to clinic readings.

**Nondippers**

ABPM is the only non-invasive way to measure nocturnal blood pressures
(O’Brien, Coats, Owens, Petrie, et al., 2000). During sleep, a person should have a
lowering of blood pressure by approximately 15% of daytime pressures. When there is
less than a 10% drop in nocturnal blood pressure it is referred to as nondipping (Kaplan,
2007). Nondippers appears to be at increased risk for blood pressure-related
complications such as left ventricular hypertrophy, congestive heart failure, and other
cardiovascular problems compared with those with a normal dipping pattern. Nighttime
blood pressure may be the best predictor of this risk and would only be possible to obtain
through the use of ABPM (Kaplan, 2007; O’Brien et al., 2000). Patients with diabetes
mellitus who are also nondippers have faster progression of nephropathy and
microalbuminuria (Voros, Lengyel, Nagy, Nemeth, Rosivall, & Kammerer, 1998).
Patients with chronic kidney disease and a nondipping pattern may present with a greater
risk of end stage renal disease and a decline in glomerular filtration rate (Agarwal & Andersen, 2006).

*Left Ventricular Hypertrophy*

Left ventricular hypertrophy (LVH) is most commonly caused by an excessive work load from chronic high blood pressure, so there is a greater risk of LVH in patients with sustained HTN, and a lower risk in nonhypertensive patients (Pickering et al., 2005). Kaplan (2007) suggests an echocardiogram to screen for LVH when significant hypertension is found with ABPM since LVH can be an early sign of end-organ damage. Patients with end organ damage such as LVH who were normotensive in the office may benefit from ABPM as it can detect elevated blood pressures outside of the office setting (Schwartz & Sheps, 2006).

*Decision to Initiate Therapeutic Intervention or Assess Response to Treatment*

Some studies have shown that ABPM may decrease the use of prescription medications. In a Belgium study 419 patients with untreated hypertension were repeatedly monitored with either ABPM or office blood pressures to determine the best use of drug therapy (Kaplan, 2007). At the end of the study, 27% of the patients using ABPM were using drug therapy as opposed to 43% of the office monitored blood pressures. Twenty-six percent were able to stop drug therapy with the use of ABPM compared to only 7% with office monitoring.

*Ambulatory Blood Pressure Monitoring and Treatment of Hypertension*

There is evidence to support that tighter blood pressure control can be achieved by monitoring and adjusting drug therapy with ABPM (McGrath, 2002). ABPM provides information on how the patient is responding to treatment in a way that traditional blood
pressure measurements cannot offer by eliminating the white coat effect and assessing peak and trough drug effects over a 24-hour period (O’Brien et al., 2000; Clement et al., 2003). ABPM also eliminates the increased risk of errant readings, faulty equipment, ill fitting cuff, and human error that may occur with clinic blood pressures that could lead to inappropriate treatment of HTN (Chavanu, Merkel & Quan, 2008).

Cost Benefit Analysis

The cost-effectiveness of ABPM in high risk, hypertensive, or white coat hypertensive patients is not known at this time (White 2005). The use of ABPM in these types of patients is supported by clinical consensus, even though its use may not be covered by insurance. Even if there is a reduction in medication and office visits as a result of data obtained from ABPM, savings may be offset by the price of equipment needed to perform ABPM (Marchiando & Elston, 2003). One analysis of the multiple factors associated with costs of ABPM suggests a potential cost reduction of 3% to 14% in the care of hypertension, and a reduction of 10% to 23% in treatment days associated with hypertension when ABPM is used (Krakoff, 2006).

In 2006, the average cost of ambulatory blood pressure monitor equipment ran between $2,500 to $5,000 for one monitor and $3,000 for the computer software (Kaplan, 2007). With start up costs between $7,000 to $10,000 for two monitors and computer software, the health care system would see the cost effectiveness of ABPM before the provider during the first year or two of use (White, 2005).

ABPM is only covered by Medicare if white coat hypertension is suspected (Centers for Medicare and Medicaid Services, 2005). This is defined as a blood pressure >140/90 mm Hg on three separate visits with two readings at each visit, and at least two
documented self blood pressure readings from outside the clinic that are <140/90 mm Hg, and no evidence of end-organ damage. Private insurance coverage is sometimes broader. For example, the CIGNA Healthcare Coverage Position for ABPM currently includes WCH, resistant HTN, episodic HTN, hypotensive episodes thought to be related to drug therapy, suspected masked HTN, nocturnal HTN, and discrepancies between home and office blood pressures (2007).

Barriers to Ambulatory Blood Pressure Monitoring

One of the greatest barriers to ABPM is cost. Until recently, ABPM was considered investigative technology, so many insurers would not reimburse for expenses if used (Ernst & Bergus, 2003). This is slowly changing, which should increase the demand for ABPM use by providers in the management and treatment of HTN (U. S. Department for Health and Human Services, 2002). However, even with reimbursement for ABPM, the cost of equipment and software will continue to have a great impact on the decision to use ABPM for diagnosing and treating hypertensive patients. Many small independent practices and rural clinics may not be able to afford the cost of initial set up even though they would welcome this type of technology. In addition, ABPM requires extra time by already busy providers to maintain, calibrate, and replace units and/or computer software equipment as needed (Larkin, Schauss, Elnicki, & Goodie, 2007).

Currently there is no standardization of graph data provided by ambulatory blood pressures monitors to facilitate universal interpretation of information gathered, as is the case for echocardiograms (O'Brien et al., 2000). Such standardization could make interpretation of data easier for the provider.
In patients with high blood pressure, the cuff pressure may become uncomfortable (Chavanu, Merkel, & Quan, 2008). People who are obese or have very large biceps may also experience increased discomfort. Multiple pressures throughout the night can cause sleep disturbances and multiple readings throughout the 24-hour period may cause petechiae and bruising of the upper arm, which will be more likely in patients on anticoagulation therapy.

Implications for the Nurse Practitioner in a Primary Care Setting

Suboptimal management by health care providers plays a significant role in the fact that blood pressure goals are not met in approximately two-thirds of patients and 40% of hypertensive patients are not being treated (Chavanu, Merkel, & Quan, 2008). ABPM is a valuable diagnostic tool in the detection of WCH, and has prognostic significance with cardiovascular risk, left ventricular hypertrophy, and nocturnal sleep patterns. In addition, ABPM can help nurse practitioner’s improve treatment of hypertensive patients, as well as prevent unnecessary treatment of normotensive patients who may be inaccurately diagnosed with hypertension.

Good outcomes in the management of hypertension are largely related to the level of involvement in care by the patient. One of the benefits of ABPM is that it requires full participation of the patient, which may foster a sense of ownership in management of their care, potentially leading to improved outcomes (Marchiando & Elston, 2003).

Conclusion

Blood pressures taken in the clinic setting may not resemble blood pressures at home, during sleep, or activities of daily living, which can be very problematic for providers to accurately diagnose and manage hypertension (Larkin, Schauss, Elnicki, &
Goodie, 2007). ABPM may facilitate diagnosis of white coat hypertension, detect left ventricular hypertrophy as an early sign of end organ damage that may otherwise be undetectable, and prevent or reduce end organ damage, morbidity, and mortality. In addition, ABPM may be able to reduce or eliminate the number of anti-hypertensive medications the patient is taking, as well as prevent inaccurate diagnosis of hypertension. ABPM continues to be underused in the diagnosis and management of hypertension despite its potential to avoid unnecessary treatment of people who might otherwise be misdiagnosed as having hypertension and to accurately diagnosis people with hypertension leading to treatment and the prevention of the long term consequences of hypertension (Ernst & Bergus, 2003).
References


