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The Utility of Ambulatory Blood Pressure Monitoring for Diagnosing White Coat Hypertension in Older Adults

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Abstract

The beneficial effect of antihypertensive medication on reducing the risk of cardiovascular disease (CVD) events is supported by data from randomized controlled trials of older adults with hypertension. However, in clinical practice, overtreatment of hypertension in older adults may lead to side effects and an increased risk of falls. The diagnosis and treatment of hypertension is primarily based on blood pressure measurements obtained in the clinic setting. Ambulatory blood pressure monitoring (ABPM) complements clinic blood pressure by measuring blood pressure in the out-of-clinic setting. ABPM can be used to identify white coat hypertension, defined as elevated clinic blood pressure and non-elevated ambulatory blood pressure. White coat hypertension is common in older adults but does not appear to be associated with an increased risk of CVD events among this population. Herein, we review the current literature on ABPM in the diagnoses of white coat hypertension in older adults, including its potential role in preventing overtreatment.

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Conflicts of Interest

The authors have no conflicts of interest.

Keywords

Ambulatory blood pressure; Hypertension; White coat hypertension; Elderly; Aged

Introduction

Cardiovascular disease (CVD) remains the leading cause of morbidity and mortality in industrialized nations. As the population ages, the contribution of CVD to total morbidity and mortality will increase [1, 2]. Population-based studies have identified a range of risk factors that contribute to incident CVD events. Hypertension is one of the most common, with a prevalence approaching one fourth to one third of the general population in the United States (US), and is even higher among older adults [3, 4]. Approximately two thirds of adults 60 years and older have hypertension in the US [4].

To identify patients with hypertension and monitor response to antihypertensive medication, guidelines and scientific statements recommend measuring blood pressure in the clinic setting [5, 6]. This recommendation is supported by data demonstrating that elevated clinic blood pressure is associated with increased CVD risk and reduction of risk is associated with the lowering of clinic blood pressure with antihypertensive medication [6]. Notably, it has long been recognized that blood pressure varies by the setting in which it is measured. Consequently, clinic blood pressure may differ substantially from out-of-clinic blood pressure [7].

Ambulatory BP monitoring (ABPM) complements clinic blood pressure by quantifying out-of-office ambulatory blood pressure [8]. ABPM can identify the presence of white coat hypertension, defined as elevated clinic blood pressure but non-elevated blood pressure on ABPM [9]. ABPM can also assess the white coat effect, defined as the difference between clinic blood pressure and ambulatory blood pressure [7, 8]. Compared to younger adults, older adults have a higher risk of white coat hypertension and a greater white coat effect [10–12]. Herein, we review the current literature on using ABPM to diagnose white coat hypertension with a particular focus on older adults.

Methods

MEDLINE was searched through July 2015 using the following key words: “ambulatory blood pressure”, “out of office blood pressure”, “elderly” “aged”, “old” and “older”. Searches were limited to publications in English. We focused on studies published in the past 3 years including original articles; systematic reviews, meta-analyses, narrative reviews; and hypertension guidelines, scientific statements, and position papers. A PubMed related articles search and a cited reference search through ISI Web of Science were conducted using identified articles. A manual search was also performed using the reference lists from identified articles. This article does not contain any studies with human or animal subjects performed by the authors.

Overview of ABPM

Ambulatory blood pressure monitors are compact, worn on a belt or in a pouch, and connected by a tube to a sphygmomanometer cuff on the upper arm. Commonly worn for 24 hours, the monitors are most often configured to obtain automatic readings every 15 to 30 minutes [7]. At the end of the 24-hour recording period, the readings are downloaded onto a computer to process and generate a report. The feasibility of conducting ABPM in older adults has been shown to be comparable to younger adults [13•].

To estimate mean blood pressure for different time periods, readings are averaged over three time intervals: daytime, nighttime, and the full 24 hours [7, 8]. Several studies have demonstrated that, independent of mean clinic blood pressures, higher mean ambulatory blood pressures during the daytime, nighttime, and 24-hour period are associated with an increased risk of CVD outcomes [14•, 15–18]. In the published literature, mean blood pressure values ≥135/85 mmHg, ≥120/70 mmHg, and ≥130/80 mmHg are commonly considered to be “elevated” for mean daytime, nighttime, and 24-hour blood pressure, respectively [8].

Definition of White Coat Hypertension and the White Coat Effect

White coat hypertension is typically defined as having elevated clinic blood pressure without elevated daytime blood pressure or alternatively non-elevated 24-hour blood pressure on ABPM in individuals not taking antihypertensive medication [7, 8, 19]. White coat hypertension may also refer to individuals taking antihypertensive medication. However, the preferred terms for this subset of patients is “treated white coat hypertension” or “white coat uncontrolled hypertension.”

Figure 1 shows an example case of a 69 year old adult with treated white coat hypertension who underwent ABPM after having clinic blood pressure measured. In this treated patient taking antihypertensive medication, clinic blood pressure was elevated, but ambulatory blood pressures at daytime, nighttime, and over 24-hours were all normal. To the physician or other caregiver taking care of the patient, the patient appears to have uncontrolled hypertension in the clinic setting. In untreated and treated individuals, ABPM can assess the white coat effect, defined as the difference between mean clinic blood pressure and mean ambulatory blood pressure.

Other Blood Pressure Phenotypes Assessed Using ABPM

ABPM can identify sustained normotension and sustained hypertension, blood pressure phenotypes associated with the lowest and highest CVD risk, respectively [7, 20]. Sustained normotension is defined as non-elevated clinic and non-elevated ambulatory blood pressure; sustained hypertension is defined as elevated clinic and elevated ambulatory blood pressure. ABPM can also identify masked hypertension, defined as non-elevated clinic blood pressure but elevated ambulatory blood pressure in untreated individuals [21]. In addition, ABPM can assess 24-hour blood pressure variability and diurnal blood pressure patterns, including blood pressure dipping [6, 8] and morning surge [22]. Finally, ABPM can be used to assess hypotension and evaluate syncope, vertigo, or dizziness, all conditions that disproportionally

affect older adults [8, 10]. The reader is referred to recent excellent reviews on these topics [7, 23–25].

White Coat Hypertension in Older Adults

In a recent systematic review, the prevalence of ABPM-assessed white coat hypertension ranged from 5% to 65% in individuals not taking antihypertensive medication [14•]. Compared to sustained normotension, white coat hypertension in untreated individuals is not associated with an increased risk for CVD outcomes in most studies [9, 26•, 27–29]. In the few studies that have found increased CVD risk associated with white coat hypertension [30], mean out-of-clinic blood pressure in the white coat hypertension group was higher than the group with sustained normotension, which may have partially explained the increased CVD risk [30, 31].

In a meta-analysis of population-based studies, Ishikawa et al. [11] found clinic blood pressure increased more steeply with age than ambulatory blood pressure. At younger ages, clinic blood pressure was lower than ambulatory blood pressure, while the reverse is true at older ages. This suggests that the white coat effect is greater in older versus younger adults. In a recent population-based study of African Americans [32••], we found that among individuals with clinic hypertension, the white coat effect for systolic blood pressure was greater for individuals 60 years and older (12 mmHg) versus those younger than 60 years (8 mmHg). Several studies have found that the prevalence of white coat hypertension is also higher among older adults [8, 10]. Therefore, the evidence suggests that white coat hypertension and the white coat effect are common in older adults.

White coat hypertension in older adults is not associated with increased CVD outcomes compared to sustained normotension [26•]. In a meta-analysis that used data from the International Database of Ambulatory Blood Pressure in Relation to Cardiovascular Outcomes (IDACO), the hazard ratio (HR) for CVD events was 1.17 (95% CI: 0.87–1.57) for untreated individuals with white coat hypertension compared to their counterparts with sustained normotension [26•]. The results were similar when the sample was stratified by age (≥60 years vs. <60 years). These findings were echoed by a second meta-analysis of individual-level data from four population samples of ABPM [16]. Overall, white coat hypertension is not associated with an increased risk of CVD events in older adults.

Treated White Coat Hypertension in Older Adults

Treated white coat hypertension is common in older adults. In the IDACO, the prevalence of treated white coat hypertension was 47% in adults [26•]. The prevalence of treated white coat hypertension was 50% in an ABPM substudy of the Hypertension in the Very Elderly Trial (HYVET) [33••], which enrolled individuals older than 80 years with predominantly systolic hypertension. The prevalence of white coat hypertension was lower, approximately 19%, in an ABPM substudy of the Systolic Hypertension in Europe (Syst-Eur) trial, which enrolled individuals 60 years and older with systolic hypertension [34].

Several studies have also shown that the white coat effect is large in older adults taking antihypertensive medication. In an ABPM substudy of the Hypertension Optimal Treatment (HOT) trial, the white coat effect was 22 mmHg for systolic blood pressure and 15 mmHg

for diastolic blood pressure [35]. In the HYVET ABPM substudy [33••], the white coat effect was 36 mmHg for systolic blood pressure and 12 mmHg for diastolic blood pressure. Further, in the Syst-Eur ABPM substudy [34], the white coat effect was 22 mmHg for systolic blood pressure and 2 mmHg for diastolic blood pressure.

In prior studies of ABPM, treated white coat hypertension was not associated with an increased risk of CVD events, compared with treated sustained normotension [9, 26•]. In a meta-analysis using the IDACO data, the HR for CVD events was 1.09 (95% CI: 0.79–1.52) for treated white coat hypertension, compared to their counterparts with treated sustained normotension [26•]. The results were similar when the sample was stratified by age (≥60 years vs. <60 years). Therefore, treated white coat hypertension and the white coat effect are common in older adults taking antihypertensive medication, and treated white coat hypertension is not associated with an increased risk of CVD events in older adults.

The Use of ABPM in Assessing White Coat Hypertension in Older Adults

Experts most commonly recommend ABPM to exclude white coat hypertension in individuals with elevated clinic blood pressure [6, 8, 10, 36–39]. In a recent draft statement from the US Preventive Services Task Force (USPSTF) [36], ABPM was recommended for confirming the diagnosis of hypertension and excluding white coat hypertension. A 2011 Expert Consensus Document on Hypertension in the Elderly by the American College of Cardiology Foundation and the American Heart Association recommended ABPM not only to exclude white coat hypertension in untreated older adults but also to assess blood pressure response to antihypertensive medication [8, 10].

Since 2001, the US Centers for Medicaid and Medicare Services has reimbursed the use of ABPM for suspected white coat hypertension [40]. In our previous study, we found that the percentage of US Medicare beneficiaries 65 years and older with ABPM claims was very low and did not change from 2007 through 2010: 0.10%, 0.11%, 0.10%, and 0.09% for 2007, 2008, 2009 and 2010, respectively [41••]. Although a diagnosis of white coat hypertension was more common in hypertensive individuals with an ABPM claim versus individuals without an ABPM claim, only 60.1% of individuals with an ABPM claim had a white coat hypertension diagnosis. Further, 86.9% of Medicare beneficiaries with an ABPM claim, and 95.2% of hypertensive Medicare beneficiaries with an ABPM claim were taking antihypertensive medication. These data suggest that the overall use of ABPM is low in older US adults. Further, among older adults, ABPM is not being used primarily for the diagnosis of white coat hypertension in untreated individuals but rather for assessing for treated white coat hypertension in individuals taking antihypertensive medications. It is unknown whether the use of ABPM for the diagnosis of white coat hypertension will increase after the USPSTF draft statement on ABPM was published [36].

The use of ABPM for identifying treated white coat hypertension and assessing the white coat effect in individuals taking antihypertensive medication is more controversial. This is because of the large body of evidence supporting the cardiovascular benefits of antihypertensive treatment guided by clinic blood pressure. The comparative reduction in CVD events by targeting blood pressure on ABPM versus clinic blood pressure is unknown. A prior randomized trial [42] has shown that titrating antihypertensive medication using

diastolic blood pressure from ABPM versus titrating using the clinic blood pressure was associated with greater antihypertensive medication discontinuation and less blood pressure control, but no change in left ventricular mass. However, in this study, the follow-up period was relatively short (i.e. less than a year) and the long-term benefit or harm of using ABPM to guide treatment in individuals with hypertension was not assessed.

The Use of ABPM to Prevent Overtreatment of Older Adults with Hypertension

CVD risk reduction with antihypertensive medication has been demonstrated among carefully selected older adults with hypertension in randomized controlled trials [39, 43]. However, there may be unintended harm with the risk of overtreatment in this population. Older adults appear more susceptible to lower on treatment blood pressures, which may potentially result in paradoxically greater CVD risk [44]. Observational studies in treated hypertension patients have shown that older adults have greater mortality with lower treated blood pressures [45, 46•]. The ACCORD BP study among an older population (mean age 62 years) demonstrated that lower treated blood pressures had greater adverse events including hyperkalemia and worsening renal function [47•]. Older adults with hypertension are also susceptible to adverse side effects associated with antihypertensive medication use including postural hypotension, balance and gait impairment, confusion, and dizziness [10]. Further, many but not all studies have shown that antihypertensive medication use is associated with an increased risk of falls and serious fall injuries among older treated adults with hypertension [48–50••, 51, 52•, 53]. Falls are a major public health concern for elderly individuals [54]. Among older adults, 85% of all injury-related hospital admissions are related to falls [51, 55]. One in three individuals older than 65 years of age fall annually, and approximately one half of falls will result in an injury [54, 56, 57]. The high rate of falls and associated increased risk for adverse outcomes has generated an immense interest to prevent falls.

Clinicians primarily use clinic blood pressure to make decisions about whether antihypertensive medication should be initiated or intensified in their treated patients with hypertension. As described above, ambulatory blood pressure is substantially lower than clinic blood pressure in older patients who are not taking or who are taking antihypertensive medication. Therefore, in older adults, reducing clinic blood pressure using antihypertensive medication may lead to even lower ambulatory blood pressure, and a potentially higher risk of the sequelae of overtreatment including side effects and falls. Currently, there is a lack of empiric data on using ABPM in older adults for decision-making regarding the initiation and intensification of antihypertensive medication in order to prevent non-CVD-related sequelae of overtreatment. Given the ability of ABPM to determine out-of-clinic blood pressure, ABPM holds much promise for older adults for the diagnosis and treatment of hypertension. The use of ABPM in older adults in clinical practice may prevent hypertension overtreatment and its adverse sequelae including side effects and an increased risk of falls and fall injuries.

Conclusions

ABPM complements clinic blood pressure by measuring out-of-clinic blood pressure. Ambulatory blood pressure has a stronger association with CVD events than clinic blood pressure. Among those not taking and those taking antihypertensive medication, older adults have a higher risk of white coat hypertension and have a greater white coat effect, compared to younger adults. In older adults, white coat hypertension and treated white coat hypertension are not associated with an increased risk of CVD events. Therefore, clinic blood pressure provides a poor estimate of out-of-clinic blood pressure in older adults. Reliance on clinic blood pressure for the diagnosis and treatment of hypertension in older adults may lead to overtreatment, which is associated with important adverse sequelae. Therefore, ABPM holds great promise for preventing overtreatment and its associated sequelae in older adults with hypertension.

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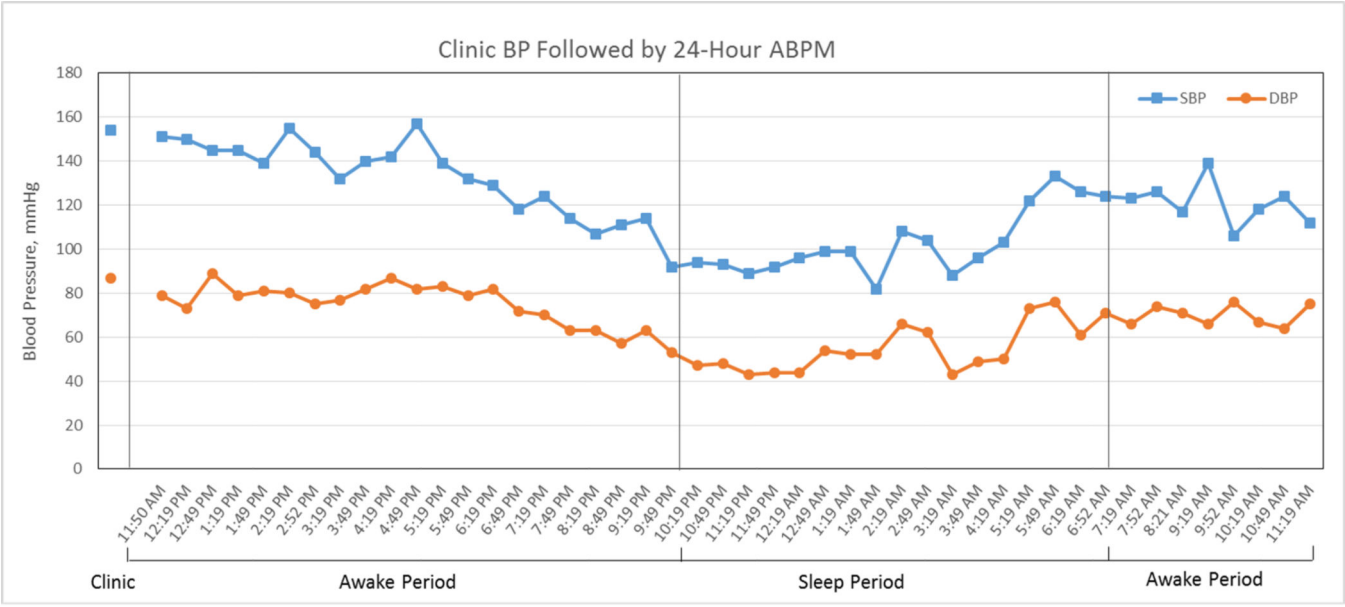

Figure 1.

Blood pressure data from a treated individual who underwent 24-hour ambulatory blood pressure monitoring.