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Review

A New Algorithm for the Diagnosis of Hypertension in Canada

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ABSTRACT

Accurate blood pressure measurement is critical to properly identify and treat individuals with hypertension. In 2005, the Canadian Hypertension Education Program produced a revised algorithm to be used for the diagnosis of hypertension. Subsequent annual reviews of the literature have identified 2 major deficiencies in the current diagnostic process. First, auscultatory measurements performed in routine clinical settings have serious accuracy limitations that have not

RÉSUMÉ

L'exactitude de la mesure de la pression artérielle est essentielle pour identifier et traiter correctement les individus atteints d'hypertension artérielle. En 2005, le Programme éducatif canadien sur l'hypertension a produit un algorithme révisé à utiliser pour le diagnostic de l'hypertension. Les révisions annuelles subséquentes de la littérature ont identifié 2 lacunes importantes dans le processus actuel de diagnostic. Premièrement, les mesures auscultatoires réalisées

Hypertension affects an estimated 7.3 million Canadians[1,2] and is the most common modifiable risk factor for death or disability in the world.[3] If not identified and treated, hypertension will invariably lead to complications affecting numerous organ systems including the brain, heart, eyes, kidneys, and the peripheral vasculature. Control of hypertension in Canada has improved markedly in the past 15 years with a 5-fold increased rate of control observed, from 13.2% in 1992 to 64.6% in 2007.[4] However, one-third of the hypertensive population remains uncontrolled and 17% remain unaware that they have hypertension.

Accurate blood pressure (BP) measurement is essential to properly identify and treat individuals with hypertension. Office BP has been traditionally measured by nurses or doctors using auscultatory methods, with 4 to 5 visits required to

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been overcome despite great efforts to educate health care professionals over several years. Thus, alternatives to auscultatory measurements should be used. Second, recent data indicate that patients with white coat hypertension must be identified earlier in the process and in a systematic manner rather than on an ad hoc or voluntary basis so they are not unnecessarily treated with antihypertensive medications. The economic and health consequences of white coat hypertension are reviewed. In this article evidence for a revised algorithm to diagnose hypertension is presented. Protocols for home blood pressure measurement and ambulatory blood pressure monitoring are reviewed. The role of automated office blood pressure measurement is updated. The revised algorithm strongly encourages the use of validated electronic digital oscillometric devices and recommends that out-of-office blood pressure measurements, ambulatory blood pressure monitoring (preferred), or home blood pressure measurement, should be performed to confirm the diagnosis of hypertension.

dans le cadre de la pratique clinique courante montrent de sérieuses limites d'exactitude qui n'ont pas été surmontées en dépit de grands efforts depuis plusieurs années pour former les professionnels de la santé. Par conséquent, les solutions de rechange aux mesures auscultatoires soit des mesures électroniques oscillométriques devraient être utilisées. Deuxièmement, de récentes données montrent que les patients souffrant d'hypertension de sarrau blanc doivent être identifiés plus tôt au cours du processus et de manière systématique plutôt que sur une base ponctuelle ou volontaire afin d'éviter qu'ils ne soient pas traités inutilement par des antihypertenseurs. Les conséquences sur le plan économique et de la santé de l'hypertension de sarrau blanc sont décrites dans le texte. Dans le présent article, nous présentons les résultats probants concernant un algorithme révisé pour diagnostiquer l'hypertension artérielle. Nous révisons les protocoles de la mesure de la pression artérielle à domicile et du monitorage ambulatoire de la pression artérielle ambulatoire de la pression artérielle. Nous traitons du rôle des mesures de la pression artérielle en clinique - oscillométriques en série. L'algorithme révisé encourage fortement l'utilisation des appareils de mesure oscillométriques validés à capteur électronique et lecture numérique, et recommande que les mesures de la pression artérielle en ambulatoire, le monitorage ambulatoire de la pression artérielle (préférée) ou la mesure de la pression artérielle à domicile à domicile soient réalisées pour confirmer le diagnostic d'hypertension.

establish the diagnosis.[5] Standardized measurement methods were proposed to clinicians in 1984 by the Canadian Hypertension Society and in 1999 by the Canadian Hypertension Education Program (CHEP) to guide the performance of these measures.[6] In 2005, out-of-office measurements using ambulatory BP measurement (ABPM) or home BP measurement (HBPM) were added to the CHEP algorithm to complement OBPM.[7,8]

A reappraisal of the CHEP recommendations to diagnose hypertensive patients is imperative because of 2 main shortfalls in the current algorithm. First, office auscultatory measurements performed in routine clinical settings have serious limitations that have not been overcome despite great efforts to educate health care professionals over several years. Second, recent data indicate that patients with white coat hypertension (WCH; ie, not truly hypertensive) should be identified earlier in the process and in a systematic manner rather than on an ad hoc or voluntary basis so they are not unnecessarily treated with antihypertensive medications.

We present evidence for the need to de-emphasize the use of routine auscultatory OBPM and encourage use of electronic digital devices, and evidence for preferentially using more accurate and reproducible out-of-office methods for earlier and systematic detection of WCH. A revised algorithm (Fig. 1) for the diagnosis of hypertension is introduced. HBPM and ABPM protocols will be reviewed, and the role of automated office BP (AOBP) updated.

New Algorithm

In our new algorithm we strongly recommend performing out-of-office measurement (ABPM or HBPM) after the first visit, specifically to identify patients with WCH early in the process. Another important addition to the algorithm concerns AOBP, which has been shown to reduce the white-coat effect, and, thus the number of patients who will require further assessment with ABPM or HBPM.[9] AOBP implies multiple oscillometric measurements taken while the patient is alone in a quiet room. The mean of these measurements is used to make clinical decisions.

In patients who do not have severely increased BP on visit 1 (≥180/110 mm Hg), serial standardized OBPMs have been retained as a potential pathway to arrive at the diagnosis of hypertension. However, this method is cumbersome because it requires 4 or 5 visits over 6 months to be truly certain that the BP level is increased.[5] We emphasize that out-of-office measurement is preferred to serial standardized office measurement—the latter should be used only when the resources (human, technical, or financial) to perform out-of-office measurement are not available.

Diagnosis of Hypertension in Canada From 1999 to 2005

The approach to the diagnosis of hypertension has evolved since the Canadian recommendations for the management of hypertension first proposed a systematic approach to diagnose hypertension based on clinic BP measurement in 1999.[10] These initial recommendations indicated that patients who present with hypertensive urgency (≥180/105 mm Hg) could be diagnosed at the first visit, patients with increased BP readings and target organ damage (TOD) could be diagnosed at/after the third visit, and all other patients with clinic BP between 140/90 and 180/105 mm Hg would require at least 4 further visits over the next 6 months to be diagnosed with hypertension. This recommendation was supported by studies that showed that the number of visits at which clinic BP is assessed and the duration of the observation period are important because BP tends to decrease over the course of several visits.[11-15]

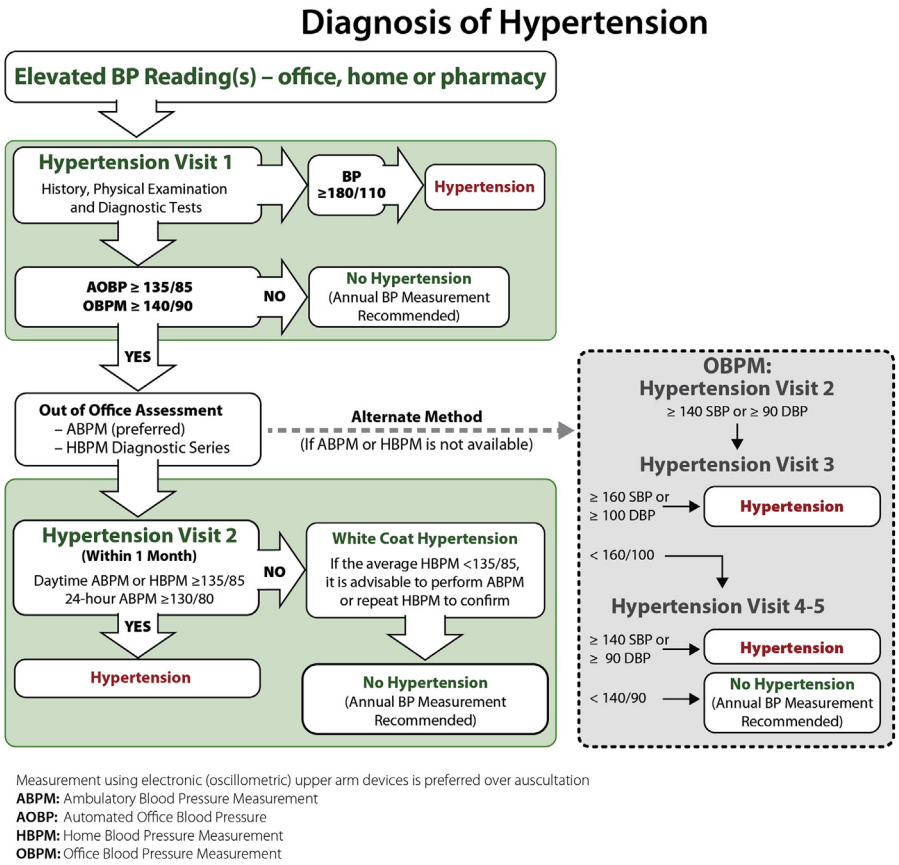

Figure 1. Diagnostic algorithm for hypertension. BP, blood pressure; DBP, diastolic blood pressure; SBP, systolic blood pressure.

In 2004, this approach was modified to allow patients without TOD and/or increased cardiovascular risk to be diagnosed at the third visit if clinic BP remained ≥ 160/100 mm Hg, because the greatest decrease in BP was shown to occur between visit 1 and 2.[16] If the BP at visit 3 was 140-159/90-99 mm Hg, up to 3 additional visits over a total assessment period of 6 months were still required to diagnose a patient as hypertensive.[17-19] In the 2015 algorithm, after 2 visits including the use of out-of-office measurements, a diagnosis of hypertension can be established.

In 2005, the CHEP, recognizing the accumulation of prognostic evidence in favour of ABPM and HBPM, recommended the addition of these measurement methods as alternative pathways to expedite the diagnosis of hypertension after the second visit.[8] Since 2005, for uncomplicated patients (absence of TOD or diabetes mellitus with average BP of 140-179/90-109 mm Hg after 2 visits), 3 approaches to diagnose hypertension could be taken: repeated OBPMs over the next several weeks to months, 24-hour ABPM, or HBPM. Using the latter 2 out-of-office modalities, clinicians could diagnose uncomplicated hypertension earlier (at the third visit) rather than taking up to 5 visits over 6 months with repeated OBPM.

Limitations of Routine OBPM

Benefits in terms of decreased morbidity and mortality from cardiovascular and cerebrovascular causes can be derived by achieving and sustaining published BP targets. In hypertension management, this largely relies on an accurate measurement and proper subsequent evaluation.[20] Many investigators over the past 4 decades have studied the errors observed in routine office auscultatory measurement, in nurses and in physicians, because of issues concerning the observer, the preparation of the patient, the technique, and the device used.[21-29] In addition, studies concerning the knowledge and practice of doctors and nurses have clearly demonstrated that there are serious deficiencies in all areas despite extensive and repeated educational programs in the initial education of health care professionals and through continuous professional education activities.[22,30-35] Accurate OBPM when properly performed in a standardized method (sometimes called "research-quality OBPM"), correlates well with ambulatory measurements and can predict target organ changes.[36-38] Unfortunately, there is overwhelming evidence that truly standardized OBPMs are not usually performed in routine clinical practice. Indeed, comparisons of BP research-quality manual BP readings with routine manual BP in a number of studies have shown that the BP obtained in routine clinical practice is on average 9/6 mm Hg higher than corresponding research-quality BP measurements.[39,40]

"Routine" or "casual" (ie, nonstandardized) BP measurements should never be used to diagnose a patient as hypertensive or to follow a patient's progress. Examples of deviations from standardized protocols include among others measurement of BP in patients without a rest period, while

conversing, with the back unsupported, and legs crossed. Although this is not a new recommendation, it is imperative to stress this issue because nonstandardized BP measurements are still widely performed.

In place of auscultatory OBPM we strongly encourage the use of validated electronic digital oscillometric devices. These devices are preprogrammed to take either single measurements or an automated series of measurements with averaging of the results. Electronic oscillometric digital BP measurement has been available for many years, and has been shown to decrease a number of errors linked to auscultation measurement ranging from clinicians' hearing deficits, rounding errors to 0 or 5, improper use of diaphragm or bell, improper use of Korotkoff sounds, and rapid deflation.[41,42] Using published validation protocols, many devices for clinical and public use have been found to be accurate and reproducible compared with research-quality OBPM (www.dableducational.com). For these reasons, we strongly recommend that electronic oscillometric digital device methods should be used for OBPM. Electronic oscillometric digital devices will reduce terminal digit preference,[36,39,43] however, a study performed in Switzerland demonstrated that terminal digit preference can still occur with the use of these devices when BP values are transferred onto case report forms.[44] Thus, care must be taken to record the readings exactly as calculated by the device. The protocol for OBPM with an electronic oscillometric digital device is presented in Table 1.

There might be an argument for using an auscultation method in the office in the case of arrhythmias, such as atrial fibrillation when an automated device might have difficulty, although there is evidence that the auscultation method has similar difficulties.[45] Recent published studies have shown that most electronic oscillometric digital devices measure systolic BP just as accurately as auscultation methods in patients with atrial fibrillation, with diastolic BP measured slightly higher on average.[46-48]

AOBP Can Overcome OBPM Limitations

AOBP measurement is a specific type of OBPM designed to overcome some of the limitations of OBPM. Multiple (3-6, depending on the device) measurements, usually spaced 1 minute apart over 4-7 minutes, are taken while the patient is alone in a quiet room. The patient must be sitting quietly with legs uncrossed, back supported, and with arm supported at heart level. The proper cuff has to be selected as proposed by the manufacturer. AOBP devices are preprogrammed to take serial oscillometric BP measurements and are currently used in many Canadian clinical settings. To be recognized as true AOBP, all of these conditions must be met. The mean of these measurements is used to make clinical decisions. Commonly used devices include the BpTRU (BpTRU Medical Devices, Coquitlam, Canada), Omron HEM 907 (Omron Corporation, Kyoto, Japan), and the MicroLife WatchBP Office (Microlife, Widnau, Switzerland).

AOBP provides a more standardized assessment of BP compared with routine manual office measurement and is more reproducible than manual office measurement. Because the patient is left alone, error introduced by conversing with the patient during the measurement process is eliminated.[49,50] Importantly, compared with manual office measurements, AOBP has repeatedly been demonstrated to correlate closely with daytime ABPM.[9,40,51-54]

Furthermore, use of AOBP reduces office-induced BP increases (ie, white coat effect) and is associated with a lower prevalence of masked hypertension.[9,53] On the basis of this evidence, the CHEP Recommendations Task Force endorsed the use of AOBP for OBPM in 2011.[55]

Three cross-sectional studies demonstrating high correlations between AOBP levels and surrogate measures of end-organ damage (left ventricular mass index, urinary albumin excretion, and carotid intima-medial thickness) have been published.[56-58] Although these surrogate marker studies provide evidence to support the use of AOBP, additional and more definitive data are needed and such studies should be considered a top research priority. AOBP can be used for assessment of BP in the office although the diagnosis of hypertension cannot be solely based on this method until high-quality prognostic data demonstrate strong, independent, and graded relationships between increasing AOBP levels and incident cardiovascular morbidity and/or mortality events. When using AOBP, an average reading of $\geq$ 135/85 can be considered as high.

WCH: The Primary Reason to Perform Out-of-Office Measurement

WCH is defined as increased OBPM ($\geq$ 140/90 mm Hg) with normal out-of-office readings ($<$ 135/85 mm Hg

Table 1. Office BP measurement protocol

1. Measurements should be taken with a sphygmomanometer known to be accurate. A validated electronic device should be used
2. Choose a cuff with an appropriate bladder size matched to the size of the arm. When using an automated device, select the cuff size using the marks, as recommended by its manufacturer
3. The patient should be resting comfortably for 5 minutes in the seated position with back support
4. Place the cuff so that the bladder is centred over the brachial artery. The arm should be bare and supported with the BP cuff at heart level, because a lower position will result in an erroneously higher SBP and DBP. The patients' legs should not be crossed
5. There should be no talking during measurement
6. Press the start button. The first reading should be discarded and the latter 2 averaged
7. BP should also be assessed after 2 minutes of standing (with arm supported) and at times when patients report symptoms suggestive of postural hypotension. Supine BP measurements might also be helpful in the assessment of elderly and diabetic patients
8. Record the BP displayed and the arm used and whether the patient was supine, sitting, or standing. Record the heart rate
9. The seated BP is used to determine and monitor treatment decisions. The standing BP is used to examine for postural hypotension, if present, which might modify the treatment
10. BP should be taken in both arms on at least 1 visit and if 1 arm has a consistently higher pressure, that arm should be subsequently used for BP measurement and interpretation

BP, blood pressure; DBP, diastolic blood pressure; SBP, systolic blood pressure.

daytime ABPM or HBPM and/or < 130/80 mm Hg for 24-hour ABPM). A meta-analysis of 4 population studies found a prevalence of WCH of 13% with a range of 9%-16%.[59] Recently, this prevalence has been challenged and some authors indicate that WCH occurs in up to 30% of subjects with increased office BP readings.[60,61] The likelihood of having WCH is greater in women, older subjects, nonsmokers, subjects recently diagnosed with hypertension with a limited number of routine OBPMs, subjects with mild hypertension, pregnant women, and subjects without evidence of TOD. The white coat phenomenon has been shown to be reasonably reproducible.[62-64]

In 4 meta-analyses, WCH has been shown to have an overall risk of cardiovascular events similar to normotension.[61,65-67] However, one other meta-analysis of the **I**nternational **D**atabase of **Ho**me BP in Relation to **C**ardiovascular **O**utcome (IDHOCO) found an increased event rate among adults with WCH (adjusted hazard ratio, 1.42; 95% confidence interval, 1.06-1.91).[67] It has been suggested that WCH is associated with a greater risk of developing sustained hypertension in the next decade, as shown in the **P**ressione **A**rteriose **M**onitorate **E** **L**oro **A**ssociazioni (PAMELA) and Ohasama studies, and that subjects with WCH might have greater left ventricular mass index compared with normotensive subjects.[68,69] However, in these studies participants with WCH had other cardiovascular risk factors. Subjects with WCH have been shown to be more likely to progress to sustained hypertension if they also have high-normal awake ABPM, additional cardio-metabolic risk factors, or increased nighttime ABPM.[61] The clinical bearing of WCH is not fully comprehended probably in part because of the presence of significant heterogeneity across studies that assessed its prognosis. Studies differ with respect to population characteristics, inclusion of treated and/or untreated participants, protocol for OBPM, reference out-of-office BP monitoring method, cutoff values used, and the duration of follow-up.[70]

The diagnosis of hypertension using OBPM alone can misclassify patients who do not have hypertension (WCH).[43,71,72] Every day, more than 1000 people are newly diagnosed in Canada as hypertensive. BP assessment using OBPM alone will daily misdiagnose approximately 100 patients with WCH as hypertensive (36,500 annually).[73] This estimate is conservative and the actual number of patients with WCH misdiagnosed as hypertensive might be even higher. Many of these patients will be treated unnecessarily with antihypertensive medications. Currently, there is no evidence to support pharmacologic treatment of subjects with WCH.[61,74-76] In subjects with WCH, it has been shown that antihypertensive treatment might decrease OBPM but not ABPM and second that unnecessary treatment might lead to partial reduction in white coat effect but with cardiovascular risk similar to the normotensive comparator group. It has also been shown in subjects with WCH that the influence of treatment on electrocardiogram voltages and on the incidence of stroke and cardiovascular events is similar to placebo.[61,74-76] Importantly, treated and untreated subjects with WCH were noted to have similar long-term cardiovascular risk compared with treated and untreated normotensive subjects, respectively.[61]

A false diagnosis of hypertension in people with WCH can also have a significant effect on actual or future employability, and workplace issues, such as absenteeism.[61] If long-term antihypertensive treatment is initiated, there will be unnecessary costs and potential adverse side effects.

WCH is not entirely benign, therefore it is critical for patients with WCH to be identified early so that lifestyle improvements can be instituted where necessary, and they can be followed closely. Left untreated, some patients with WCH will develop hypertension over time[68,69] or might have higher left ventricular mass index compared with normotensive subjects.[77] Patients at greater risk for progression include those with increased ABPM nighttime average and patients with high-normal ABPM daytime average, especially the middle-aged, elderly, and those with associated metabolic risk factors.

By definition, OBPM alone cannot determine WCH. The diagnosis of WCH must be made by comparing out-of-office BP with office BP measurements. ABPM and HBPM have been shown to be effective in diagnosing WCH, and both methods have been shown to be more strongly associated with cardiovascular outcomes than OBPM.[65,78-87]

There is a larger body of evidence for ABPM than HBPM with respect to prediction of TOD but the evidence for HBPM has been growing in recent years.[88] The diagnostic agreement between ABPM and HBPM has been shown to be moderate and it has been suggested that the 2 methods are to a certain extent complementary.[89] ABPM was found to predict silent cerebrovascular lesions better than HBPM, and HBPM was more closely associated with the risk of carotid atherosclerosis than ABPM.[90] However, HBPM has been shown to correlate similarly with ABPM with left ventricular mass index, but better than OBPM; the evidence for other TOD markers is limited.[91]

It has been suggested that HBPM showing borderline WCH should be confirmed with ABPM[88] or with a second set of HBPM measures.[83,92-95] If WCH is shown (ie, increased OBPM and normal out-of-office BP measurement), the out-of-office measurement should be used by health care practitioners to guide diagnosis and management of hypertension.

Economic Analyses

Several published reports have demonstrated the economic argument for identifying WCH before making a diagnosis of hypertension. The most recent systematic review[96] identified 14 published cost-effectiveness studies—9 clinical trials and 5 model-based decision analyses. Nine studies compared ABPM with OBPM alone, 4 compared HBPM with OBPM, and 1 compared all 3 methods. In most (8 of 9) studies that compared ABPM with OBPM investigators found short-term (lower medication costs from not treating patients with WCH) and long-term (decreased overall treatment costs) savings over 1-7 years for hypertension diagnosis confirmation using ABPM. Only one observational trial[97] showed a small increased cost over 1 year. For HBPM compared with OBPM the evidence is not as robust but 1 of 2 randomized controlled trials and 3 of 4 modelling analyses showed a cost benefit. The only modelling analysis that examined all 3 methods[98] concluded, "ABPM is cost effective compared with further monitoring in the clinic or home for confirming the diagnosis of hypertension in a population with suspected BP greater

than 140/90 mm Hg on the basis of a clinic screening measurement."

An extensive cost-benefit analysis that examined ABPM and HBPM vs OBPM for the diagnosis of hypertension was published by the UK National Institute for Clinical Excellence.[99] This analysis concluded that confirming a diagnosis of hypertension with ABPM instead of OBPM or HBPM was the most cost-effective option in all age/sex subgroups. In addition, "In most subgroups ABPM was associated with higher quality-adjusted life years... as well as lower costs, than OBPM and HBPM," (that is, ABPM was the dominant option). The National Institute for Clinical Excellence determined that, "Under real world conditions, the use of a 24-hour ABPM device would reduce inappropriate treatment of patients with WCH. The key driver of cost savings with ABPM compared with OBPM was hypertension treatment costs avoided due to more accurate diagnosis (increased specificity)."[99]

In a Canadian context, the Ontario Health Technology Assessment Centre (OHTAC)[100] investigated the cost-effectiveness of using ABPM to confirm the diagnosis when OBPM is increased, "considering that over $2.3 billion (Can) were spent on hypertension in Canada in 2003 (physician, medication, and laboratory costs), reducing or eliminating the population of white coat hypertensive individuals who might inappropriately be treated would potentially result in cost savings on multiple levels of the health care system." Based on their literature review, the OHTAC group found in the short-term that patients diagnosed using ABPM were more likely to have control of BP and to discontinue drug therapy. The OHTAC analysis concluded that the budget effect in Ontario over the next 5 years (ie, FY2011-FY2015) of providing 24-hour ABPM to patients only for increased BP readings, or when BP is not in control, is a cost savings of approximately $19 million (Can) per year. However, if the test is given once annually to anyone suspected of having hypertension, the budget effect is an additional $37 million (Can) per year.

Considering the importance of WCH, the serious limitations of auscultatory OBPM and the importance of identifying hypertension correctly but in a timely manner, it is crucial at this time to update the diagnostic algorithm.

ABPM Method, Reporting, and Interpretation

Method

ABPM has certain advantages, including the requirement for minimal subject training, and importantly its ability to provide nighttime BP measurement. This is particularly important because there is increasing evidence supporting that nighttime BP is an important predictor of cardiovascular events, and according to some studies, even more important than daytime or 24-hour ABPM.[78,90,101-104] Several pathophysiological mechanisms have been proposed to be implicated in the occurrence of cardiovascular events with higher nighttime BP, including disturbed baroreflex sensitivity, alterations in the sympathetic modulation of the nighttime BP, sleep apnea, increased salt sensitivity necessitating a higher BP at night to drive pressure natriuresis, and nighttime BP is better standardized than the daytime BP in terms of physical and mental activity and body position.[101]

Similar to other methods of BP measurement, ABPM must be performed in a standardized manner. A validated upper arm device must be used and the appropriate sized cuff[29] should be applied to the nondominant arm unless the systolic BP difference between arms is $>$ 10 mm Hg, in which case the arm with the highest value obtained should be used.[105] The device should be set to record for a duration of at least 24 hours,[78,106-115] and the measurement frequency set at 20-30 minute intervals during the day, and 30-60 minute intervals during the night.[78,106,107,110,112-114] A patient-reported diary to define daytime (awake) and nighttime (sleep) activities, symptoms, and medication administration is preferable for study interpretation. Alternatively, predefined thresholds can be used; for example, defining the daytime period as 0800 hours to 2200 hours and nighttime as 2200 hours and 0800 hours.

Reporting of ABPM results

The ABPM report, preferably displayed on a single page, should include all of the individual BP readings (numerically and graphically), the percentage of successful readings, the weighted averages for each time frame (daytime, nighttime, 24-hour), and the "dipping" percentage (the percentage decrease in average nighttime BP from average daytime BP—normally between 10% and 20%). The time frame averages can be calculated automatically by the device software, however there is some difficulty making assumptions regarding the actual awake and sleep time periods for individual subjects. Some of the newer devices are equipped with accelerometers, which might facilitate this in the future. The report should also include either an automated interpretation or space for an expert interpretation to be added.

Interpretation of ABPM reports

An ABPM test is considered successful if at least 70% of the readings are valid and at least 20 daytime readings and 7 nighttime readings are valid. The threshold for diagnosis of hypertension is a daytime average of $\geq$ 135/85 mm Hg or 24-hour average of $\geq$ 130/80 mm Hg. Recent literature shows the critical importance of increased nighttime average and "nondipping" (ie, $<$ 10% decrease in average nighttime BP from average daytime BP) as predictors of increased cardiovascular disease risk, so the 24-hour average might be more advantageous because it includes the nighttime period. Many ABPM reports include a "BP load" percentage for systolic and diastolic BP, but the evidence supporting the interpretation of BP load remains limited, and currently it is useful only for research purposes.

HBPM Diagnostic Series

Over the years, increased HBPM use has been undeniably linked to its powerful predictive value in the occurrence of cardiovascular events for morbidity and mortality. Prospective studies have led to a better understanding of the predictive power of HBPM compared with clinic-based measurements.[78,81,87,90,101,102,116] Ward et al. concluded in a recent meta-analysis of prospective studies in which the relationship of HBPM with cardiovascular disease was reported that

HBPM is a significant predictor of cardiovascular mortality and cardiovascular events after adjusting for office BP.[87]

HBPM has a singular capacity that differentiates it from other types of BP measurement. It helps patients to better control their hypertension[117,118] and increases therapeutic adherence.[119] Moreover, the acceptance of the public of HBPM is remarkable.[120] Manufacturers and suppliers have witnessed explosive sales of HBPM devices.[121,122] From a population health perspective, the motivation of patients to become involved in follow-up of their chronic diseases such as hypertension is outstanding news. However, the popularity of HBPM means that health care professionals need to be prepared to guide patients in best practices. Like other BP measurement methods, HBPM can be performed incorrectly, and the risk of reporting bias is increased. However, proper education on HBPM can improve its performance.[123]

For several years the CHEP has been publishing recommendations on how to perform HBPM correctly for the purpose of diagnosing hypertension (HBPM diagnostic series) and these recommendations remain unchanged—using a validated upper arm electronic device with the correct cuff size, take 2 readings in the morning and evening approximately 1 minute apart for 7 days. The first-day readings are discarded and the remaining readings are averaged. If the average is $\geq$ 135/85 mm Hg, a diagnosis of hypertension is made.

Future Revisions of the Algorithm

The role of AOBP in the diagnosis and follow-up of hypertension requires further assessment. This is currently under study through a CHEP-initiated grant.[124] Other issues that are under review include the need for guidance on how to identify and diagnose patients with masked hypertension and whether a lack of nocturnal dipping should be targeted with bedtime administration of antihypertensive drugs.

Conclusion and Recommendations

Many patients in Canada are currently being misdiagnosed as hypertensive on the basis of increased manual "routine" office BP readings. In the real-world setting of clinical practice, most of these manual office BP readings are poorly performed using auscultatory techniques.[125] Evidence supports the use of electronic oscillometric digital BP measurements in the office setting and the need for out-of-office BP measurements using ABPM or an HBPM diagnostic series to corroborate increased BP readings performed in the office or clinic setting to properly diagnose hypertension (ie, identify WCH). Because the cardiovascular risk for WCH has been shown to be similar to that of normotensive comparator groups, there is no evidence to support pharmacologic treatment in subjects with WCH at the present time. Misdiagnosing patients with WCH as hypertensive might have important negative implications at the individual and the health care system level.

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