Blood Pressure Measurement and Hypertension Diagnosis in the 2017 US Guidelines

First Things First

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The 2017 US guidelines for hypertension have given a lot of attention to the accurate evaluation of blood pressure (BP) and the importance of out-of-office measurements for confirming diagnosis.[1] This emphasis is to be welcomed, and at the time of writing, these guidelines provide the most comprehensive recommendations for both out-of-office and office BP measurement (OBPM). As such, the guidelines have provided to doctors clear BP measurement recommendations for managing the white-coat and masked hypertension phenomena in both untreated and treated subjects.

Inadequate evaluation of BP often leads to overdiagnosis, resulting in unnecessary investigation and long-term treatment, or to underdiagnosis with consequent undertreatment and increased risk of cardiovascular disease. Because the 2017 guidelines recommend a more aggressive strategy for treatment initiation and hypertension control, it is imperative that (1) OBPM becomes more standardized, yet feasible for clinical practice; and (2) BP levels are confirmed with out-of-office measurements.

We have critically reviewed the methodological issues of BP measurement and hypertension diagnosis in the 2017 US guidelines, which are the first and essential steps before further evaluation and intervention can be decided. Other important aspects, such as the new definition of hypertension and the treatment BP targets, are not discussed in this article.

Office BP Measurement

The 2017 US guidelines provide detailed instructions for OBPM, including the auscultatory method.[1] However, it is now accepted that although in a research laboratory the auscultatory technique remains the reference for testing the accuracy of novel BP measuring devices, in clinical practice it has too many sources of error and therefore electronic (oscillometric) devices are preferable.[1] Moreover, the use of electronic devices is currently evidence based, given that all the hypertension outcome trials in the past two decades have used such devices for OBPM. Only, validated upper-arm-cuff devices should be used.[2,3] If these devices are used in special populations (eg, children, pregnancy, atrial fibrillation), separate validations must be performed for each.[2,3] The use of auscultatory OBPM should be limited to special situations where electronic devices may not be accurate. With the increasing use of electronic devices, training in the auscultatory technique is likely to disappear. Meanwhile, appropriate training for auscultatory OBPM will remain an unresolved concern.

Besides problems specific to the auscultatory method, OBPM is inherently inaccurate because it induces the white-coat effect, it fails to detect masked hypertension, and has poor reproducibility.[4] Thus, OBPM alone is not appropriate for the diagnosis of hypertension in untreated subjects, or titration of therapy in treated patients. However, OBPM, albeit imperfect, does have a role in screening for hypertension. Individuals with borderline or elevated office BP should be referred for confirmatory out-of-office BP measurement. Indeed, this approach is supported by the 2017 US guidelines that recommend out-of-office BP evaluation in subjects with office BP 120 to 160 mm Hg systolic and 80 to 100 mm Hg diastolic aiming to exclude white-coat or masked hypertension.[1]

Accumulating evidence suggests that automated OBPM (3–6 automated measurements with the patient resting alone in a quiet room) reduces the white-coat effect.[5] Automated OBPM gives lower BP values than routine OBPM in clinical practice, which are generally similar to average daytime ambulatory or home BP, yet the exact thresholds have not been precisely defined.[4,5]

The cuff selection is crucial for accurate BP measurement. For auscultatory BP measurement, the length of the inflatable bladder should cover 75% to 100% of the individual's arm

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circumference and the width 37% to 50%.[2] For arm circumference 23 to 28, 28 to 35, and 33 to 42 cm, a cuff with bladder length 23, 28, and 33 cm should be used, respectively.[2] Smaller cuffs are needed for thinner arms and larger cuffs for arm circumference >42 cm, which should have conical shape to fit the arm shape.[4] For electronic (oscillometric) devices for office, home, or ambulatory use, the recommendations of the manufacturer for cuff selection according to arm size should be followed, which should be supported by appropriate validation studies. Wide-range cuffs for oscillometric devices have been developed, which cover a wider range of arm circumference than with the auscultatory devices.[4]

Ambulatory BP Monitoring

The 2017 US guidelines now follow those of the UK National Institute for Health and Clinical Excellence (NICE),[6] the Canadian Hypertension Education Program,[7] and the US Preventive Services Task Force[8] in recommending ambulatory BP monitoring (ABPM) as the definitive test for hypertension diagnosis. However, although the guidelines state that ABPM is the best measure of out-of-office BP, home BP monitoring (HBPM) is later favored because of its wide availability.[1] This is a pragmatic recommendation that is not based on evidence and which will unfortunately lead to ambivalence in practice. The fact that a proven procedure, for whatever reason, is not currently available, is no excuse for using an inferior albeit more accessible one. Instead, a strong recommendation should be made to promote/increase the use of the best procedure (ABPM) in clinical practice.

Although the 2017 guidelines acknowledge the growing evidence supporting nocturnal ambulatory BP as being the stronger predictor of cardiovascular risk (superior to office or daytime ambulatory BP), daytime ABPM is recommended for the diagnosis of white-coat and masked hypertension.[1] This approach is consistent with the UK National Institute for Health and Clinical Excellence guidelines[6] but not with the recommendations of the European Society of Hypertension Working Group of BP Monitoring and Cardiovascular Variability[4,9] and is probably because of the fact that most of the prognostic ABPM studies have used daytime ambulatory BP for defining white-coat and masked hypertension.

There are several reasons why 24-hour average ambulatory BP should now be preferred to daytime only. First, daytime ABPM misses the most important aspect of the 24-hour profile (night-time BP). Second, some treated hypertensives with masked uncontrolled hypertension have isolated nocturnal hypertension, which is missed by all the other measurement methods. Third, average 24-hour ABPM is based on a larger sample of measurements and therefore is more reproducible than the daytime average.

Priority should be given to promoting ABPM by encouraging appropriate reimbursement and to reduce its cost and making it more accessible to patients, such as in pharmacies.

Home BP Monitoring

The 2017 US guidelines state that HBPM is a "reasonable alternative to screen for white-coat hypertension" if ABPM is not readily available and recommend that the white-coat hypertension diagnosis made by HBPM should be confirmed by ABPM.[1] However, for the diagnosis of masked uncontrolled hypertension (which is often because of isolated nocturnal hypertension and can be missed by HBPM), the 2017 US guidelines recommend that the diagnosis can be made by HBPM, and confirmation by ABPM is not necessary.[1] These conflicting recommendations are likely to confuse practicing doctors. The evidence for ABPM indeed is stronger than for HBPM (as also stated in the US guidelines), and promoting the latter is mostly because of its wider availability. In addition, although the evidence is not the same for white-coat and masked hypertension and for untreated and treated subjects, a uniform conclusion can be made about the performance of these methods and their clinical uses. Of course, the availability of the 2 methods will influence their use in practice.

An important issue with HBPM is that its use in clinical practice is often subject to inferior unstandardized methodology and reporting bias.[4,10] Priority should be given to training doctors on how to supervise their patients in performing reliable HBPM using validated upper arm-cuff devices with automated storage and averaging of BPs and with physician verification of measurements, or personal computer–link capacity, or telemonitoring if available.[4,10] Before each visit to the doctor, 7-day (at least 3) HBPM with duplicate morning and evening measurements (at least 12 readings) should be performed, and the average BP should be evaluated after excluding the first day which usually gives higher and unstable readings.[4,10,11]

Guidance should also be provided to treated hypertensives for the long-term HBPM, which improves hypertension control rates.[10] In the absence of direct evidence to support a recommendation, expert opinion for HBPM between office visits is to measure on 1 to 2 occasions per week.[4,10]

The 2017 US guidelines mention that there is agreement between ABPM and HBPM in detecting white-coat and masked hypertension in only 60% to 70% of individuals.[1] However, it should be noted that the reproducibility of these diagnoses using the same method (ABPM or HBPM) is also imperfect, which explains most of the disagreement between them.[11] Thus, the diagnosis of white-coat and masked hypertension requires confirmation with repeated office and out-of-office BP measurements before treatment decisions are made.[4]

Conclusions

The 2017 US guidelines are a major step forward in the optimal evaluation of BP and the accurate diagnosis of hypertension in the 21st century by recommending that treatment decisions be based on out-of-office BP measurements. Thus, doctors are now encouraged to identify white-coat and masked hypertension in both untreated and treated subjects and to base treatment decisions on out-of-office BP measurements.

The recommendations for clinical practice should be scientifically correct but also balanced and realistic. It is accepted that at the present time in many subjects and medical settings decisions will be based only on OBPM. Moreover, out-of-office BP evaluation, when performed, will be mostly based on HBPM rather than ABPM. However, barriers to clinical implementation can be overcome by strong and persistent scientific commitment. While acknowledging the major advances in BP monitoring made in the 2017 US guidelines,

we propose the following statements that can further optimize the evaluation of BP in clinical practice.

Office BP Measurement

- OBPM is an imprecise screening method for diagnosing hypertension and titrating treatment and therefore requires confirmation by out-of-office BP evaluation.Validated electronic devices, which automatically take triplicate BP measurements and calculate the average should be preferred, so as to provide a more standardized and unbiased evaluation of office BP.
- OBPM taken with the patient resting quietly and alone has the advantage of reducing the white coat effect, but the exact threshold awaits clarification.

Ambulatory BP Monitoring

- ABPM is the recommended method for out-of-office measurement and hypertension diagnosis.ABPM identifies white-coat, masked, masked uncontrolled, and nocturnal hypertension.
- The average 24-hour BP should be considered in treatment decisions.
- ABPM use should be encouraged by appropriate reimbursement and should be made more widely available to patients.

Home BP Monitoring

- HBPM should be encouraged in untreated and treated subjects.
- HBPM identifies white-coat, masked, and masked uncontrolled hypertension but not nocturnal hypertension (novel technology for nocturnal HBPM is currently being tested).
- HBPM is often subject to inferior, unstandardized methodology and reporting bias.
- Validated electronic upper arm-cuff devices must be used with automated storage and averaging of BP readings and physician verification of readings or personal computer–link capacity or telemonitoring. A 7-day monitoring schedule before each visit to the doctor should be followed.
- HBPM is useful for long-term follow-up of treated hypertension and can improve control rates.

Disclosures

G. Stergiou, P. Palatini, R. Asmar, E. O'Brien, and G. Parati conducted validation studies for various manufacturers and advised manufacturers on device development. A. de la Sierra conducted validation studies for various manufacturers and developed the CRADLE VSA. J. Wang conducted validation studies for various manufacturers. The other authors report no conflicts.

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