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HOME BLOOD PRESSURE MONITORING

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Introduction

Home blood pressure (BP) monitoring is more and more frequently employed in clinical practice to assess a subject's BP status in hypertension diagnosis and follow-up. This increasing use is due to a number of advantages of home BP over conventional office BP measurement, and to the rapid technological development in the field leading to accurate and cheap automated BP monitoring devices that are easy to use in the patient's home (Table 1) [1]. The growing interest in this approach is testified by the almost simultaneous publication in 2008 of updated ESH guidelines for home BP monitoring [2] and the US recommendations on the same topic [3].

Features of home blood pressure monitoring and its reference values

The main advantages of home BP over office BP monitoring are related to the ability of the former approach to provide a much larger number of measurements [4], obtained automatically by validated devices over extended periods of time in subjects' daily life conditions. The average values derived from repeated home BP measurements are more reproducible than office BP [5, 6], are not affected by observer bias or end digit preference [7], and are devoid of a systematic error related to the presence of the white coat effect [8]. In general, home BP tends to be lower than office BP and similar to daytime ambulatory BP. In fact, based on both epidemiological and outcome studies, the commonly accepted threshold for hypertension diagnosis with home BP monitoring (corresponding to an office BP threshold of 140/90 mm Hg) is ≥ 135/85 mm Hg, which is the same as with average daytime ambulatory BP [2, 9–11]. More longitudinal and outcome studies are still needed, however, to determine the home BP targets for antihypertensive treatment, as well as the home BP diagnostic thresholds to be used in high-risk subjects, such as those with diabetes and kidney disease.

Table 1. Advantages and limitations of home blood pressure monitoring ([2] modified by permission)

Advantages
A number of measurements during the day and over several days, weeks, or months are possible.
Assessment of treatment effects at different times of the day and over extended periods
No alarm reaction to BP measurement
Good reproducibility
Better prognostic value than isolated office BP readings
Relatively low cost
Patient-friendliness (with semiautomated and automated devices)
Involvement of patient in hypertension management
Possibility of digital storage, printout, PC download or tele-transmission of BP values (in some devices/systems)
Improvement of patient compliance to treatment
Improvement of hypertension control rates
Limitations
Need for patient training (short for automated devices)
Possible use of inaccurate devices (need to check their validation)
Measurement errors
Limited reliability of BP values reported by patients
Induction of anxiety, resulting in excessive monitoring
Treatment changes made by patients on the basis of casual home measurements without doctor's guidance
Normality thresholds and therapeutic targets still debated
Lack of night BP recordings

BP — blood pressure

Prognostic significance

Recently, a number of studies have been published which document the prognostic value of home BP in terms of cardiovascular events [12–17]. All these studies have demonstrated that home BP may be a better risk predictor than office BP. Moreover, the results of PAMELA suggest that home BP might provide additional prognostic information independent of that provided by 24-hour ambulatory BP monitoring (ABPM) [12].

When proper diagnostic thresholds are considered, the classification of subjects as hypertensive or normotensive based on home BP monitoring is not always in accordance with that based on office BP, a finding in line with previous observations based on the comparison between office BP and ABPM. While some subjects can be classified as "true" normotensive (both office and home BP normal) or sustained hypertensive (both office and home BP elevated), in other subjects either an association between elevated office BP and normal home BP (isolated office hypertension or "white coat hypertension") or between normal office BP and elevated home BP (masked hypertension) can be observed. As shown by several studies, isolated office hypertension may, if anything, only moderately increase cardiovascular risk compared with true normotensive subjects, while masked hypertension is associated with a cardiovascular risk close to that of sustained hypertension [8, 12, 17, 18]. Thus, unless home BP (or ABPM) is used, in the latter case a high BP-related cardiovascular risk will not be identified, with the consequent inability to adequately manage subjects with masked hypertension, who constitute 10–20% of the general population (Fig. 1).

Usefulness of home blood pressure monitoring

In the diagnosis of hypertension, home BP monitoring does not substitute office BP but is a useful complementary tool in defining BP-related cardiovascular risk more accurately, especially in patients in whom office BP provides questionable results (high BP variability, pronounced "white coat" effect, inconsistent relation with organ damage, *etc.*) [1, 2]. In this regard, home BP monitoring may be used as a first line tool, being cheaper than ABPM. Home BP monitoring is even more useful in the follow-up of treated hypertensive patients. This is because of its prognostic value, low cost, and additional advantages related to the fact that home BP monitoring may, by itself, improve BP control [19] probably by promoting patients' involvement in the management of their high BP condition and thus favouring their adherence to prescribed antihypertensive treatment [20]. Therefore, home BP monitoring may be particularly valuable in refractory hypertension, often caused by poor compliance [1, 2]. Home BP monitoring may also be useful in clinical research [21]. In clinical trials, home BP measurements, being more reproducible and free from the "white coat" effect, improve the statistical power and minimize or eliminate the placebo effect and may thus facilitate the detection of differences in BP between treatments [22, 23]. Moreover, morning and evening home BP values may be used for assessing the duration of action of a given drug or drug combination, and for evaluating the effects of different dosing patterns [24]. Home BP is also an interesting option for obtaining information on BP levels in outcome studies with large populations and long follow-up, where it may be considered a particularly suitable

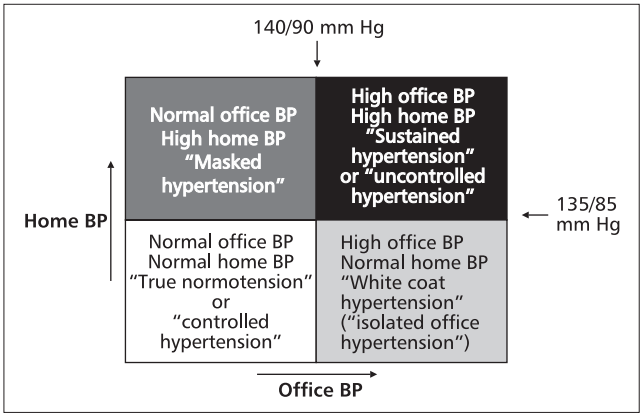

Figure 1. Classification of subjects based on office and home blood pressure (BP) being above or below the respective accepted thresholds for hypertension diagnosis (modified from [2], by permission). Sustained hypertensives are at greatest risk of cardio-vascular events, and true normotensive subjects at lowest risk. White coat and masked hypertensives lie in-between, subjects with isolated office hypertension having a risk closer to that of true normotensives, and subjects with masked hypertension carrying a risk closer to that of true hypertensive patients

tool, being more precise than office BP and less expensive and easier to implement on a large scale than ABPM [2].

Practical issues

A number of methodological requirements have to be fulfilled in order to maximize the clinical value of the information obtained with home BP monitoring. Measurement conditions should be standardized similarly as with office BP (Table 2).

Only fully automated oscillometric upper arm devices, validated according to internationally acknowledged protocols, are currently recommended (lists of validated devices are available at dedicated websites, *e.g.* www.dableducational.org) [2]. The auscultatory technique is not recommended with home BP monitoring because it is difficult for patients and is associated with problems of device accuracy (especially in the case of aneroid devices), with the possible exception of patients with important arrhythmias (atrial fibrillation), in whom the oscillometric technique is inaccurate. Finger devices should not be used at all. Validated wrist devices might be considered but only in selected cases (*e.g.* obese subjects with conical arm shape, elderly subjects with motor impairment), although their routine use is not recommended at the present time [2]. For clinical decisions, the average value of a number of home BP measurements should be used. While even a few home BP readings may provide information of prognostic significance, a larger number of them provide information that is more reproducible and more closely associated with risk of events [4]. Therefore, it is proposed that an average of measurements obtained over 7 days (two in the morning — before drug intake if treated — and two in the evening) before each doctor's visit should be used, discarding the values of the initial day, which are higher and less stable [2, 4]. Patient education is crucial for the correct performance of home BP monitoring [25]. It should include information about hypertension and cardiovascular risk, training in BP measurement, advice on the equipment, and information about measurement protocol and interpretation of BP readings. In particular, self-modification of treatment by patients based on home measured BP values should be discouraged, and home BP monitoring should always be performed under the supervision of the physician in charge of the patient. Special training for doctors and nurses might be needed as well.

Table 2. Methodological requirements for the correct implementation of home blood pressure measurements

Measurements obtained over ≥ 5 minutes, after a period ≥ 30 minutes without smoking or ingesting caffeine
Patient seated for at least 5 min, with his/her back supported and the arm resting on the table
The lower edge of the cuff being about 2.5 cm above the bend of the elbow and the cuff itself being positioned at heart level
Patient immobile and not talking during the measurement
Repeated readings taken 1–2 minutes apart
Measured blood pressure values recorded immediately on log-book and/or stored in device memory) [2]

When care is taken to ensure that the above requirements are fulfilled, the vast majority of subjects are expected to be able to perform good quality and clinically valuable home BP readings [26].

Finally, home BP may be very useful in special populations such as pregnant women, high risk subjects (*e.g.* those with diabetes or renal disease), children, and elderly subjects, although further studies are still needed to define diagnostic thresholds for home BP in these groups, and only a few devices validated to be used in these special conditions are currently available [2].

Conclusions

Home BP monitoring offers many advantages over clinic BP measurements, and may improve the overall management of hypertension [27, 28]. Its use in clinical practice is currently supported by robust scientific evidence, but proper methodology, adequate patient training, and correct data interpretation are indispensable for the safe and effective use of this method in hypertension diagnosis, monitoring, and treatment.

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