New and older proofs regarding the reliability of Automatic Blood Pressure Monitoring in the management of hypertension

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Abstract

Nowadays, there’s an universal consensus that has been imposed by the reality: the casual/office determinations of blood pressure values are accompanied by numerous disadvantages: they cover only a small portion of the 24 hour values; the existence of many sources of error (including an important percentage of “white coat hypertension” [WCH]) and, more important than anything, the fact that it can not provide data regarding the nighttime evolution of BP values. On the other hand, ABPM is the only method by which we can obtain them, making it the most reliable method in determining cardiovascular prognosis of hypertensives. The data of important and reliable studies, including significant number of subjects: Dublin Outcome Study, MAPEC, IDACO, HYGIA have recently been confirmed by an impressive, considering the number of subjects and the duration of the monitoring, study, by Banegas et al., which examined the associations between the casual BP values and those determined by ABPM with mortality, either cardiovascular or any other cause. The conclusions highlight the necessity of addressing hypertensives by ABPM, as long as WCH proves to be not a benign condition and, on the other hand, demonstrated that “masked hypertension” MH is associated with a higher risk of death than sustained HBP. The SBP mean during sleep (the most significant predictor of cardiovascular events), as well as WCH and MH, can be demonstrated only by ABPM, considered currently the golden standard of HBP management.

Keywords: Hypertension (HT), systolic blood pressure (SBP), office blood pressure measurements (OBPM), automated blood pressure measurement (ABPM), white coat hypertension (WCH), masked hypertension (MH), golden standard

Hypertension (HT), the “silent killer” of present times continues to deserve this denomination because it represent the leading cause of cardio-vascular (CV) diseases and death [1], being the main reason of about 55% of haemorrhagic stroke and ischaemic heart disease, of about 50% of ischaemic stroke and of 58% of different CV diseases, and his prevalence continues to increase [1–3].

In 2005 about 9,2 million premature deaths were considered generated by hypertension and in the last decade this number increased to 11,7 million deaths. [2 , 4].

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Many reliable, large trials: Dublin Outcome Study (DOS) [43, 44], MAPEC [29], IDACO [45–48] and HYGIA [49], as many others [50–62], documented clearly that ABPM-derived sleep BP mean and especially SBP evolution during the night is the strongest predictor of future C-V events.

DOS included 11,291 patients who were not on antihypertensive medication, with a median follow-up of 5.3 years, demonstrated that ABPM is superior to clinic or office blood pressure measurement in predicting cardiovascular mortality, and that nighttime blood pressure is the most potent predictor of outcome.

MAPEC: 2,156 patients with untreated or resistant hypertension that were followed for a median of 5.6 years with a primary composite endpoint of all-cause mortality and total cardiovascular events; highlighted the same conclusions.

The International Database of Ambulatory blood pressure in relation to cardiovascular Outcome (IDACO) [45–48] – the first study conceived and realised for the assessment of the absolute and relative CV risks, women vs. men – 9,357 subjects (statistically analyzed), in 11 centers (67, 6% europeans; 17, 8% asians; 14,7% South Americans) and studied hard end-points as: strokes, coronary and cardiac events, CV deaths. The data obtained proved that the nighttime SBP evolution is the most important predictor in CV morbidity and mortality.

HYGIA [49] – The first outcomes prospective study conducted within primary care-based in common clinical practice to assess the prognostic significance of BP data by repeated 48 h ABPM (due to the higher reproducibility) (the largest cohort so far): 18,078 subjects with baseline Ambulatory BP ranging from normotension to HT; a median follow-up of 5,1 years.

The asleep SBP mean was the most significant BP-derived risk factor for the primary outcome (from normotension to hypertension): hard endpoints and the progressive decrease of asleep SBP was the most significant marker of event-free survival (regardless of changes in office or awake SBP mean) during follow-up.

Besides these very important data, universally accepted, ABPM offers also some others, until now considered not significantly reliable: regarding resistant HT, sodium sensibility and the possibility to diagnose secondary HT, and last, but not least,
the possibility to have meaningful data about the result of drug or non-drug HT treatment. [63–81], the “smoothness index”: that means a decrease of BP values without huge variations (considered now an important target in HT management) [82–84].

The data of above mentioned studies have recently been confirmed by a reliable, very impressing study: data from 223 primary centres, within the Spanish National Health System (a registry-based, multicentre, national cohort), including 63,910 adults, within a median follow-up of 4, 7 years, comparing 24-hour and OBP, using two kind of devices: oscillometric type for OBP, Spacelabs model 90207, Space labs Healthcare. [85], which examined the associations between the casual and ABPM BP values with CV or other any other cause of death.

They divided the subjects studied in the following hypertensive phenotypes, using the definitions and classification of OBP and 24-h BP:

Definitions and classification of office BP levels and out-of-office hypertension levels [66]:

- White-coat HT (clinic SBP ≥ 140 mm Hg; clinic DBP ≥ 90 mm Hg and 24-h SBP < 130 mm Hg; 24-h DBP < 80 mm Hg);
- Masked HT (clinic SBP < 140 mm Hg; clinic DBP < 80 mm Hg and 24-h SBP ≥ 130 mm Hg; 24-h DBP ≥ 80 mm Hg);
- Sustained HT (clinic SBP ≥ 140 mm Hg; clinic DBP ≥ 90 mm Hg and 24-h SBP ≥ 130 mm Hg; 24-h DBP ≥ 80 mm Hg);
- Normotension (clinic SBP < 140 mm Hg; clinic DBP < 90 mm Hg and 24-h SBP ≤ 130 mm Hg; 24-h DBP ≤ 80 mm Hg).

Of very important significance are the conclusions of this study that also recommend ABPM as a mandatory method in HT management), demonstrating that “white coat hypertension”: (WCH) is not a benign condition (similar to normotension) and that “masked hypertension” (MH) has a worst prognosis than sustained HT.

The main conclusions of this study are considered the following:

- 24-h SBP mean was more strongly associated with all-cause mortality: [hazard ratio (HR) 1.56-1.60 after adjustment for clinic BP than the clinic SBP (HR 1.00-1.04 after adjustment for 24-hour BP];
- MH was more strongly associated with all-cause mortality than sustained HT (HR 2.83 vs. 1.80);
- MH was more strongly associated with all-cause mortality or WCH (HR, 1.79; 95% CI, 1.38 to 2.32).

HRs was calculated per 1-SD increment in BP. The reference group for hypertension phenotypes was untreated normotensives.

About 1/3 in this Spanish registry patients considered by office blood pressure measurement (OBPM) to have resistant HT, with normal ABPM data demonstrated a “white coat” effect (WCE) or “false” resistance (FR) [86].

The study demonstrated (a fact already mentioned by others) [87–110] that WCH is not a benign condition that may be a consequence of either their metabolic phenotype [2, 87, 88, 90-94] or to a higher BP load mean (higher mean BP over 24 h) [100-103, 106]. 15-30% of subjects had normal BP values, due to: measurement errors, systolic HT, WCH; 5-65% of patients with elevated office BP were not diagnosed with HT after an ABPM session.

Increased SBP as measured by ABPM was significantly associated with increased risk for fatal and

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<tr>
<th>Category</th>
<th>Systolic BP</th>
<th>Diastolic BP</th>
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<td>Grade 3 HT</td>
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non-fatal stroke and CV events, independent of OBPM. Subjects with high normal BP, overweight or obese and afro-americans had a 2-fold increased incidence of HT on rescreening within 6 years than those without these risk factors. So, for these, and also for adults over 40 years or older, for those at increased risk for high BP is recommended an annual ABPM screening.

Some of the main reasons for ABPM use is represented by the desire to avoid misdiagnosing and over-treating of WCH. The overall estimated prevalence of WCH is between 18 and 40% [92, 94, 95, 100] and the increased usage of ABPM improved CV risk stratification and diminished the cost of HT management, creating a better benefit/cost ratio, in comparison to OBPM [111–114].

And, very important, results for cardiovascular mortality were similar to those for all-cause mortality. Cumulative mortality, after full adjustment: the strongest predictor of risk is masked hypertension (MH), followed by masked uncontrolled hypertension (MUHT), that compared with the group of controlled HT. and making possible to discover “masked hypertension” (MH), that has been proven, by this study, to be associated with a higher risk of death than sustained HT. [78–110].

One can consider that the significant greater mortality associated with MH than with sustained HT is due to a delayed and sometimes postponed for ever diagnosis of HT having as cause only clinic BP data. [91, 93, 97, 98, 101, 115–117].

That’s why in the European Society of Hypertension position paper on ambulatory blood pressure monitoring [66, 67] are mentioned the following reliable reasons for ABPM, not only regarding WC phenomena and WCH, MH, but also the possibility to discover abnormal 24-h blood pressure patterns, associated with (see below):

Clinical indications for ambulatory blood pressure monitoring [66]

- Identifying white-coat HT phenomena: WCH in untreated patients; WC effect in treated or untreated patients; false-resistant hypertension in treated patients.
- Identifying masked hypertension phenomena: MH in untreated patients; Masked uncontrolled hypertension in treated patients.
- Identifying abnormal 24-h blood pressure patterns: Daytime hypertension; Siesta dipping/postprandial hypotension; Nocturnal hypertension; Dipping status; Morning hypertension and morning blood pressure surge; Obstructive sleep apnea; Increased blood pressure variability; Assessment of treatment; Increased on-treatment blood pressure variability.

Due to these important and reliable qualities of the method, there is an agreement between ESH and ESC [68] regarding this tremendous method in HT management:

Biases of casual/office BP values: systematic over-estimation (in at least 1/3 of patients with WCH); no data of BP values evolution during the night; all values are obtained in artificial conditions: physical and psychical; lack of precision in estimating the hypotensive of the treatment; device-associated; observer-associated (even the presence of this one is generating WC effect).

Advantages of ambulatory blood pressure monitoring over clinic blood pressure [66-68]: gives a larger number of readings than office blood pressure measurement; provides a profile of blood pressure behavior in the patient’s usual daily environment; allows identification of white-coat and masked hypertension phenomena; demonstrates nocturnal hypertension; assesses blood pressure variability over the 24-h period; assesses the 24-h efficacy of antihypertensive medication; is a stronger predictor of cardiovascular morbidity and mortality than office measurement. Also, by identifying those that besides being normotensives have a “non-dipping” circadian profile, it is possible, in the future, to consider, due to higher CV risk of the “non-dipping” profile (left ventricular hypertrophy, microalbuminuria, renal function damage, cerebro-vascular disease [associated with cognitive dysfunction], glucose intolerance, increased plasma fibrinogen (PIUMA – [118], Syst-Eur – [119], Ohasama study [87] are trials that document the deleterious impact of this circadian profile and trials as MAPEC [27, 29,30] and HYGIA [49] present the data of a test to therapeutically transformation of this deleterious profile to the normal one: “dipper” [27, 31].

Before presenting all the arguments that make us consider ABPM in HT management “the golden standard”, keep in mind that only ABPM offer us
Hypertension is on the move! European, British, American and Canadian scientists recommend that ABPM is a mature and reliable method in HT diagnosis and management that should become mandatory, as a “golden standard” of HT management [126–132], but underlining that the validation of the devices used must be a very thoroughly process [133–135].

The future will provide all the necessary for his implementation, for depassing his actual limitations.

Limitations of ambulatory blood pressure monitoring

Application: limited availability; may cause discomfort, particularly at night; reluctance to use by some patients, especially for repeat measurement; cost implications (although the cost of devices is reducing and possibly more cost-effective than office measurements).

Function: imperfect reproducibility; provision of intermittent measurements in sedentary rather than ambulatory conditions; possibility of inaccurate readings during activity; inability to detect genuine artefactual measurements [66].

Conflict of interest

The authors confirm that there are no conflicts of interest

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