The validity of a daytime ambulatory blood pressure to diagnose masked hypertension

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Abstract

Masked hypertension (MH) is traditionally diagnosed with 24-hour ambulatory blood pressure monitoring (24-ABPM). This is relatively costly and could cause discomfort during the night. We studied the validity of daytime ABP (DT-ABPM) in young National Guard soldiers and determined the prevalence in comparison to the standard 24-ABPM.

A prospective study of 196 soldiers aged 21-50 years, without a history of hypertension or antihypertensive medication use. Each participant was fitted with a 12h-ABPM. Patients were diagnosed with MH if the office blood pressure (OBP) was <140/90 mmHg and the average DT-ABPM was ≥ 135/85 mmHg.

By pairing the average OBP with the 12h-ABPM, the prevalence of MH was estimated as 18/196 (9.2%), the SBP MH (systolic blood pressure) of 8.2% and the DBP MH (diastolic blood pressure) of 3.1%. When we compared the daytime prevalence with the 24 h-ABPM, and the average OBP, the prevalence of MH was 29/196 (14.8%). No statistically significant difference was noted (kappa=0.74; 95%, CI: 0.59 to 0.88).

We conclude that DT-ABPM is a good method and convenient to detect MH, with no statistically significant difference when compared to the 24 h-ABPM. The prevalence of MH in young healthy soldiers was unexpectedly high.

Introduction

Hypertension is an important risk for cardiovascular disease and remains a major public health burden globally [1,2]. The prevalence of hypertension varies widely depending on the geographical location, demographic, socioeconomic, and environmental factors. As an example, a systematic review reported the overall prevalence of hypertension in the Middle East as 21.7% (95%, CI: 18.7-24.9) [3]. ABPM is useful in many situations, including evaluating the white-coat syndrome, resistance hypertension, masked hypertension and labile blood pressure (BP) [4].

ABPB do have disadvantages if compared to office or home BP recordings, which precludes its widespread use in general practice. These disadvantages include cost, a long waiting list as well as patient discomfort due to wearing the equipment for a 24-hour period during both waking and sleeping hours. Although patient discomfort appears minimal, it has been well documented. [5].
The aim of our study was to decide whether a shortened (12-hours) time of ABPM could reflect the overall mean BP obtained from a 24-hour ABPM.

Methods

Healthy male soldiers, aged 21-50 years, were randomized to a prospective three-year study conducted as previously described [6]. The study was approved by the Institutional Review Board of King Abdullah International Medical Research Center. Patients provided written informed consent to participate in the study.

MH was defined as patients with an OBP of <140/90 mmHg and the daytime average blood ≥135/85 mmHg [7,8]. Data were analysed using the Statistical Package for the Social Sciences (SPSS) software version 24.0 for Windows (SPSS Inc., IL, USA). A P-value <0.05 was considered statistically significant.

Results

The mean age of the group diagnosed with MH, using the DT-ABPM, were older than the normotensive group, 36.3 vs. 32.4 years (P=0.018). Comparing the systolic MH group with the systolic normotensive group, the mean age was 35.8 years vs. 32.5 years (P=0.042) and for the diastolic MH group compared to the diastolic normotensive group, 39.3 years and 32.4 years respectively (P=0.012), Table 1.

A marked difference was noted between the mean OBP and mean DT-ABPM methods. The mean systolic OBP compared to the DT-ABPM was 121.5±8.4 and 138.9±4.8 mmHg (P<0.001) and for the diastolic measurements, 70.7±7.0 vs. 82.3±4.9 mmHg (P<0.001).

The overall prevalence of MH was 9.2%, with the SBP MH prevalence 8.2% and the DPB MH prevalence 3.1%, Figure 1. The 24h-ABPM (unpublished data) prevalence of MH was 14%. The level of agreement between the two BP measurement methods in detecting MH was very good (kappa=0.74; 95% CI: 0.59 to 0.88), Table 2.

The study group was further stratified based on the OBP into systolic groups: (110-119, 120-129, and 130-139 mmHg) and diastolic groups: (75-79, 80-84, and 85-89 mmHg). The 18 patients diagnosed with DT-BP MH occurred in the pre-hypertension range: 120-139 mmHg.

Discussion

A 24-hour ABPM is the standard method to diagnose MH. Shortened ABPM sessions, representing the results of the whole session, could possibly produce similar clinical decision-making and being more cost-effective on patients’ daily lives. To provide evidence, we compared 12 hour with 24 hour monitoring to diagnose MH, but kept in mind that the two methods are using a different cut-off value.

Prior studies reported that the average of serial BP readings obtained during a 2-hour monitoring period is a consistent predictor of the whole-day BP [9,10]. In 2008, Ernst et al. studied ABPM in 569 patients with shortened intervals of 4-, 6- and 8 hour sessions and indicated that the shortened ABPM time period of 6 to 8 hours may potentially approximate the patient’s overall BP obtained from a full 24 hour average [11].

An important finding in the current study is that screening for MH may have to be extended to individuals with no cardiac risk factors. The challenge will be to decide which individual will be a candidate for such screening. Research is required to explore this under-researched topic [11,12]. Another contribution of the current study was using young healthy soldiers and determining the prevalence of MH in that sub-group.

Pairing the average OBP and DT-ABP yielded a prevalence of

Figure 1. Masked HTN in relation to screened group.
MH of 18/196 (9.2%) and the best OBP cut-point for detecting MH was 130/82 mm Hg (SBP: sensitivity=87.5%, specificity=58.3%, AUC=76.4±5.6%, CI=65.4–87.5% and P=0.001; DBP: sensitivity=1.00%, specificity=73.2%, AUC=87.9±3.7%, CI: 80.6-95.2%, and P=0.002) with false positive rates 42% and 27%; respectively. The fact that the AUC were statistically significant suggests that systolic and diastolic OBP were able to predict DT-ABPM MH.

Although we used day time as a convenient method, we have to address that in a multivariable Cox model of 6 prospective studies included 7112 untreated hypertensive, night-time BP variability was an independent predictor of cardiovascular events, cardiovascular mortality and all-cause mortality. In fully adjusted models, a night-time systolic BP SD of ≥12.2 mm Hg was associated with a 41% greater risk of cardiovascular events, a 55% greater risk of cardiovascular death, and a 59% increased risk of all-cause mortality while The corresponding values for a diastolic BP SD of ≥7.9 mm Hg were 48%, 132%, and 77% [13].

Our study highlighted the importance of 12H for improving the tolerability but the findings cannot be extended to women, as our study population was men only. Larger studies might change the recommendation in the guideline towards a day time ABP only.

### Table 1. Comparison of office blood pressure with DT-Masked Hypertension.

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### Table 2. Characteristics of patients with Day time-Masked Hypertension.

MH of 18/196 (9.2%) and the best OBP cut-point for detecting MH was 130/82 mm Hg (SBP: sensitivity=87.5%, specificity=58.3%, AUC=76.4±5.6%, CI=65.4–87.5% and P=0.001; DBP: sensitivity=1.00%, specificity=73.2%, AUC=87.9±3.7%, CI: 80.6-95.2%, and P=0.002) with false positive rates 42% and 27%; respectively. The fact that the AUC were statistically significant suggests that systolic and diastolic OBP were able to predict DT-ABPM MH.

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### Conclusions

DT-ABPM demonstrated a 9% prevalence of MH, which was comparable to the results of 24 h-ABPM when tested in young healthy soldiers.

### References


