White-coat Hypertension on Automated Blood Pressure Measurement: Implications for Clinical Practice

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SUMMARY

White-coat hypertension is a condition in which an individual is hypertensive during repeated blood pressure measurement in the clinical setting, but blood pressure measured outside the medical environment by ambulatory blood pressure monitoring or self blood pressure measurement at home are normal. With the increasing availability of ambulatory techniques many physicians are faced with the diagnosis of white-coat hypertension. The aim of this review is to summarise the current literature on white-coat hypertension on ambulatory monitoring and self blood pressure measurement at home.

INTRODUCTION

In 2002, Thomas G. Pickering wrote, ‘the addition of ambulatory blood pressure monitoring to conventional clinic measurement for defining blood pressure (BP) status in clinical practice has added a new complexity to the process, because the separation of normotension and hypertension can be assessed independently by each of the two methods’. The two groups of patients that arise from this classification and require special attention are individuals with white-coat hypertension and those with masked hypertension. Self measurement of BP at home is increasingly becoming an alternative to ambulatory blood pressure monitoring. The 2007 European Guidelines recommend the same threshold for daytime ambulatory BP monitoring and self measurement of blood pressure (135/85 mmHg).

Most of the current evidence is consistent with the concept that masked hypertension carries an increased cardiovascular risk and should therefore be managed as sustained hypertension, that is, hypertension on both office and out-of-office measurement. However, the evidence supporting the prognostic value and the potential benefits of medical intervention are more elusive for white-coat hypertension. The purpose of this review, therefore, is to summarise recent studies on white-coat hypertension on ambulatory monitoring and self measurement of BP at home.

Ambulatory white coat hypertension

We constructed the International Database on Ambulatory blood pressure monitoring in relation to Cardiovascular Outcomes (IDACO) [2]. Studies were eligible for inclusion, if they involved a random population sample, if information on the conventional and ambulatory BP and cardiovascular risk factors were available at baseline, and if the subsequent follow-up included fatal and nonfatal outcomes. Among the 7030 IDACO participants, 49.4% were normotensives, 10.6% had white-coat hypertension, 14.6% had masked hypertension, and 25.4% had sustained hypertension [3].

Figure 1 shows the incidence of cardiovascular events over 9.5 years of follow-up in the four BP groups with rates standardised to the sex distribution and mean age of the whole study population. The incidence of cardiovascular events increased from normotension over white-coat hypertension to masked hypertension to sustained hypertension (P for trend <0.0001). Figure 2 shows the hazard ratios (95% CI) for all fatal and nonfatal cardiovascular events. Cardiovascular risk increased across the hypertensive groups with the highest risk in the patients with sustained hypertension (P-value for trend <0.0001).

Compared to normotension, white-coat hypertensive patients had a slightly increased risk, but none of the hazard ratios reached significance (0.63≥P≥0.09). The hazard ratios, relative to normotension, were similar for masked hypertension and sustained hypertension (P≥0.14).
By censoring the adjusted Cox models for all cardiovascular events at 6, 9 and 12 years\cite{4}, we furthermore explored whether the risk of white coat hypertension, compared to normotension, changed with longer follow-up. The hazard ratios were 1.08 (P=0.79), 1.20 (P=0.29) and 1.30 (P=0.043), when censoring at 6, 9 and 12 years, respectively. The corresponding hazard ratios for white coat hypertension compared to sustained hypertension were 0.64 (P=0.11), 0.65 (P=0.013) and 0.73 (P=0.014), respectively. For the entire follow-up period (without censoring), the hazard ratio for white-coat hypertension compared to sustained hypertension was 0.68 (P=0.003).

In summary, the risk conferred by white-coat hypertension is closer to normotension than to masked or sustained hypertension. Only after a prolonged period of follow-up white coat hypertension carries a higher risk than normotension, but smaller than that associated with sustained hypertension.

White coat hypertension on self-measurement at home

Even as early as 1971, investigators from Leuven promoted the use of self measurement of BP at home in clinical research\cite{5}. The development of cheap and properly validated devices for self measurement of BP, over the past 20 years, carried this technique to clinical application. Self measurement offers several of the well-recognised advantages of the more complex approach of ambulatory monitoring. The greater number of readings and the absence of the white-coat effect contribute to a better diagnostic accuracy, compared with conventional sphygmomanometry.

If automated devices are used, self-recorded BP values are free of observer bias. Moreover, self measurement of BP increases adherence to antihypertensive treatment and allows reducing the number of clinic visits required for the diagnosis and treatment of hypertension.

Several longitudinal studies in populations\cite{6-12} or patient cohorts\cite{13-16} attempted to find a justification for diagnostic cut-off limits of the self measured BP in terms of mortality or fatal and nonfatal end points. The Japanese investigators of the Ohasama study were the first to demonstrate that the self-measured blood pressure at home is a more precise predictor of outcome than the office blood pressure\cite{6} and in consecutive publications proposed and refined diagnostic thresholds for its use in clinical practice.

The Ohasama researchers initially proposed 137 mm Hg systolic and 84 mm Hg diastolic as acceptable upper limits for home BP readings on the grounds that the risk of death increased above these thresholds\cite{6}. These levels were comparable with the thresholds previously suggested by an international research consortium (137/85mmHg\cite{17}). Rounding these thresholds to 135 mmHg systolic and 85 mmHg produced diagnostic limits similar to those in the meta-analysis of aggregate data\cite{18} and in several guidelines. Two meta-analyses\cite{17,18}, prospective studies in populations\cite{6,19} hypertensive patients\cite{13-16} and pregnant women, as well as the consensus in current guidelines (Table 1)\cite{20} support the idea that hypertension on self-monitoring at home starts at blood pressure levels of 135mmHg systolic or 85mmHg diastolic.

### Table 1: Diagnostic thresholds for Self measurement of blood pressure at home.
Summary of current guidelines for the management of hypertension.

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Year</th>
<th>Target group</th>
<th>Systolic/diastolic threshold (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First European consensus meeting</td>
<td>2000</td>
<td>Adults</td>
<td>≥130/85 (HT) &lt;125/75 (D-NT) ≥135/85 (D-HT)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Older age pregnancy</td>
<td>≥135/85 (HT)</td>
</tr>
<tr>
<td>Japanese elderly</td>
<td>2002</td>
<td>≥65 years</td>
<td>≥125/80 (NT) ≥135/85 (HT)</td>
</tr>
<tr>
<td>JSH</td>
<td>2003</td>
<td>Adults</td>
<td>&lt;125/75 (D-NT) ≥125/80 (NT) ≥135/80 (HT) ≥135/85 (D-HT)</td>
</tr>
<tr>
<td>ESH</td>
<td>2003</td>
<td>Adults</td>
<td>≥135/85 (HT)</td>
</tr>
<tr>
<td>WHO/ISH</td>
<td>2003</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>US Task Force</td>
<td>2003</td>
<td>Adults</td>
<td>...</td>
</tr>
<tr>
<td>JNC7</td>
<td>2003</td>
<td>Adults</td>
<td>&lt;130/80 (NT)</td>
</tr>
<tr>
<td>ESH Working Group</td>
<td>2004</td>
<td>Adults</td>
<td>&lt;130/80 (NT) ≥135/80 (HT)</td>
</tr>
<tr>
<td>BHS</td>
<td>2004</td>
<td>Adults</td>
<td>≥136/83 (HT)</td>
</tr>
<tr>
<td>CHEP</td>
<td>2004</td>
<td>Adults</td>
<td>≥130/80 (HT)</td>
</tr>
<tr>
<td>JSH</td>
<td>2004</td>
<td>Adults</td>
<td>&lt;125/80 (NT) ≥135/80 (HT)</td>
</tr>
<tr>
<td>ESH</td>
<td>2005</td>
<td>Adults</td>
<td>&lt;130/80 (NT) ≥135/80 (HT)</td>
</tr>
<tr>
<td>AHA</td>
<td>2005</td>
<td>Adults</td>
<td>&lt;130/80 (NT)</td>
</tr>
<tr>
<td>BJS</td>
<td>2006</td>
<td>Adults</td>
<td>≥135/85 (HT)</td>
</tr>
<tr>
<td>ESH Working Group</td>
<td>2008</td>
<td>Adults</td>
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</tr>
<tr>
<td>JSH</td>
<td>2009</td>
<td>Adults</td>
<td>&lt;125/80 (NT) ≥135/80 (HT)</td>
</tr>
<tr>
<td>CHEP</td>
<td>2011</td>
<td>Adults</td>
<td>≥135/85 (HT)</td>
</tr>
</tbody>
</table>

An ellipsis indicates that the guideline did not provide any concrete recommendation.


Modified with permission from ref.[20]

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Instead of using either ambulatory monitoring or self-measurement of BP, some investigators have proposed to use an algorithm combining both techniques. According to this algorithm, patients with persistently high office BP values and no evidence of target organ damage should engage in self-monitoring of their BP. Self-measurement of BP has a high specificity and negative predictive value for the diagnosis of hypertension [21-23]. However, it has only moderate sensitivity (61-68%) and moderate agreement with ambulatory BP measurement [21-23].

The result of this study suggests that sensitivity of the self-measured BP is low in the detection of truly hypertensive patients, but that home BP and ambulatory monitoring are complementary diagnostic methods. If self-measurement of BP shows normal values, ambulatory BP monitoring is used to confirm the diagnosis of white-coat hypertension. On the other hand, when home BP is high, white-coat hypertension can be excluded and therefore there is no need for ambulatory BP monitoring.

CONCLUSION

Conventional BP measurement at the office remains the standard method for assessment of BP in the clinical setting. However, self-measurement, ambulatory monitoring, or both must be used to exclude white-coat hypertension or masked hypertension. In the absence of other cardiovascular risk factors and signs of target organ damage, treatment of patients with white-coat hypertension can be restricted to lifestyle measures and yearly follow-up of the self-measured or ambulatory BP [24].

Patients with white-coat hypertension on ambulatory monitoring or self-measurement must be followed up, because they have high risk of becoming hypertensive [25,26] and are vulnerable to the complications associated with high BP [21].

REFERENCES

REFERENCES (Continued)


