

## COMMENTARY

# The measurement of orthostatic blood pressure as a screening tool for masked hypertension with abnormal circadian blood pressure rhythm

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It has been repeatedly noted that cardiovascular events often occur in individuals who have never been diagnosed with hypertension. These events occur in part because it is difficult to identify masked hypertension in untreated individuals. However, the elevation of subclinical blood pressure (BP) in individuals with masked hypertension can exacerbate damage to the hypertensive target organ and result in an overt cardiovascular event.<sup>1,2</sup>

Although home BP measurements in the morning and evening are recommended by the Japanese Society of Hypertension 2014 guidelines,<sup>3</sup> home BP monitoring may not always detect a BP elevation if the BP is elevated at times other than the time of the home BP measurement (for example, other than in the morning and evening). Ambulatory BP monitoring (ABPM) is thus useful to detect masked hypertension because it provides BP data at many more time points compared with home BP monitoring.

Physicians should try to identify individuals who are at a high risk for masked hypertension, with the goal of preventing cardiovascular events in this population. The reported characteristics of masked hypertension are male sex, middle age, smoking, regular alcohol drinking and high daytime physical activity;<sup>4</sup> in fact, such populations show increased arterial damage.<sup>5</sup> However, an effective method for identifying masked hypertension has not yet been established.

In this issue of *Hypertension Research*, Tabara *et al.*<sup>6</sup> demonstrate a relationship between masked hypertension and orthostatic hypertension in healthy individuals. Although this association between orthostatic hypertension and masked hypertension has been reported in hypertensive patients,<sup>7</sup> it is notable that the subjects in the study by Tabara *et al.* were healthy individuals, and the results illustrate an association between orthostatic BP changes and awake BP obtained by ABPM. The findings by Tabara *et al.* clearly demonstrate that orthostatic hypertension has a common pathophysiology with masked hypertension. However, the mechanisms underlying the link between orthostatic hypertension and masked hypertension are not clearly understood.

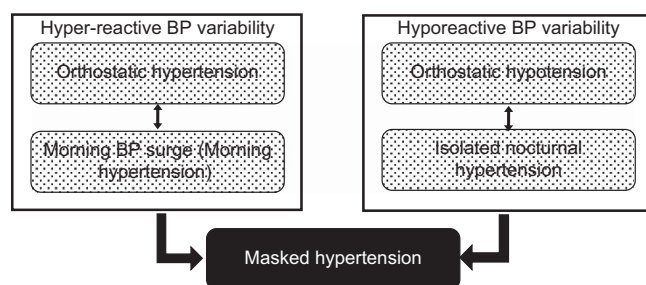
One possible mechanism underlying this link is enhanced sympathetic nervous system activity. It was observed that the plasma noradrenaline level was increased after standing in patients with orthostatic hypertension.<sup>8,9</sup> This abnormality in the sympathetic nervous system would cause an abnormal circadian BP rhythm, such as a morning BP surge, stress hypertension or exercise-induced hypertension, and these conditions may be expressed as masked hypertension. In a study by Tabara *et al.*, the average awake BP values measured by ABPM and office BP are used to define masked hypertension. The masked hypertension observed in that study would thus include morning hypertension-type masked hypertension. Considering past and present findings, it is apparent that masked hypertension, orthostatic hypertension and the morning BP surge are closely related to one another<sup>9,10</sup> (Figure 1).

According to the results reported by Tabara *et al.*, orthostatic hypertension could be a marker of masked hypertension. Orthostatic BP changes can be measured with an easy and helpful method to screen for masked hypertension in clinical practice. However, there are some unsolved problems; one problem is that a method of measuring orthostatic BP changes has not been established and standardized. In a study by Tabara *et al.*, orthostatic BP changes were measured at 1 and 3 min after standing from the sitting position. The methods of evaluating orthostatic BP changes have been inconsistent, including head-up tilting,<sup>11,12</sup> active standing from a supine position in a clinic<sup>13</sup> and active standing from the sitting position at home.<sup>14</sup> In addition, the definition of orthostatic hypertension is still not standardized and has ranged from a 5-mm Hg increase in systolic BP (SBP) to a 20-mm Hg SBP increase.<sup>9</sup> An appropriate method of measuring orthostatic BP and a definition of orthostatic hypertension should be established in the near future.

Another problem is the association between orthostatic hypotension and nocturnal hypertension in masked hypertension. Individuals with orthostatic hypotension frequently show isolated nocturnal hypertension<sup>15</sup> and high arterial stiffness.<sup>16</sup> Nocturnal hypertension is one of the phenotypes of masked hypertension. Therefore, both orthostatic hypertension and orthostatic hypotension can be markers of masked hypertension.

Individuals with orthostatic hypertension or orthostatic hypotension could have an abnormal circadian BP rhythm and show masked hypertension. Even in healthy

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**Figure 1** The relationships among orthostatic BP changes, abnormal circadian BP rhythm and masked hypertension. Orthostatic hypertension and the morning BP surge are closely related to each other. Orthostatic hypotension is associated with nocturnal hypertension. Both BP abnormalities present as masked hypertension.

individuals, if an abnormal pattern of orthostatic BP change is identified, home BP measurement and ABPM should be performed to evaluate masked hypertension.<sup>17</sup>

**CONFLICT OF INTEREST**

The authors declare no conflict of interest.

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