Behavior of Ambulatory Blood Pressure Surrounding Episodes of Headache in Mildly Hypertensive Patients

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Background: Headache is usually associated with high blood pressure (BP) despite the lack of evidence of such an association in most observational studies. Ambulatory BP monitoring provides an opportunity to analyze this relation because it permits measurement of BP before, during, and after episodes of headache.

Methods: We evaluated 76 patients with mild hypertension who underwent clinical evaluation, ambulatory BP monitoring, and questioning about the occurrence of headache and its characteristics during monitoring. The 24-hour BP curves of patients with and without headache during monitoring were compared using analysis of variance for multiple factors and repeated measurements. Hourly averages of BP surrounding the episode and 24-hour mean BP of patients with headache were compared using paired sample t tests.

Results: Twenty-five participants (33%) experienced headache during monitoring. Their 24-hour BP curves did not differ from those of participants without headache. Mean 24-hour BP was not different from BP registered during the episode of headache (mean±SD systolic BP: 137.0±17.3 vs 139.4±21.1; P=.13; diastolic BP: 83.3±12.8 vs 85.0±18.2; P=.30). Blood pressure values registered during the episode of headache and in the hours before and after the episode were not different from each other. Analysis restricted to 8 patients with migraine-like headache showed a similar pattern.

Conclusions: In patients with mild hypertension, there is no association between the occurrence of headache and variation of BP. Health professionals must discourage patients with hypertension from believing that they can rely on the presence of such a symptom to know about their BP levels.

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The 1997 report from the Joint National Committee identified a decline in the identification, treatment, and control of hypertension in the United States in recent years, a situation that may have a worldwide dimension. Identification of individuals unaware of the diagnosis of hypertension or of its degree of control by patients with hypertension persists as a challenge to policies about cardiovascular disease prevention. The characterization that a symptom is associated with the elevation of blood pressure (BP) before the development of signs of target organ damage would be useful for the recognition of individuals with undiagnosed or uncontrolled hypertension. Of various symptoms, headache is still the most frequently associated with high BP levels, despite the absence of such an association in most studies. The design of these studies, however, does not rule out an association between the occurrence of headache and elevation of BP because they measure cross sectionally the symptom and BP levels or are based on a retrospective history of headache or BP levels. The direction of an eventual association is not established because BP could cause the symptom or vice versa. Despite these controversial issues, mechanisms linking the elevation of BP to the occurrence of headache are still reported.

Ambulatory BP (ABP) monitoring provides a unique opportunity to analyze the relation between headache and variation of BP because it can register BP before, during, and after episodes of headache. In this study we demonstrate that BP does not differ significantly between hypertensive patients with and without headache during 24-hour ABP monitoring and does not vary in the period surrounding episodes of tension-type or migraine-like headache.
PATIENTS AND METHODS

A prospectively planned cohort study of patients with hypertension is under way in the hypertension clinic of the Divisions of Cardiology and Clinical Pharmacology of the Hospital de Clínicas de Porto Alegre, Porto Alegre, Brazil. Some results have been reported elsewhere. During baseline evaluation, patients answer an extensive questionnaire and undergo a detailed physical examination. Classification of their BP is based on the average of 6 BP measurements taken at 3 different visits. The diagnosis of hypertension and its classification are established during the first visit when BP is within the reference range, in patients with severe hypertension, and in patients with clinical consequences of high BP.

The study sample consists of patients who underwent the initial evaluation plus 24-hour ABP monitoring and who answered a detailed questionnaire about the occurrence and characteristics of headache during the examination. None had secondary hypertension or evidence of severe target organ damage. Monitoring of ABP was done with a SpaceLabs 90702 device (SpaceLabs Medical Inc, Redmond, Wash). A large cuff was used on patients with an arm circumference greater than 33 cm. For analysis, the daytime period was considered to be from 7 AM to 11 PM (with measurements taken every 15 minutes), and the nighttime period was from 11 PM to 7 AM (with measurements taken every 20 minutes). Patients were oriented to go to bed around 11 PM. Participants were considered dippers if they had a reduction in mean systolic and diastolic BP values of more than 10% from day to night. Blood pressure load was defined as the percentage of measurements higher than 140/90 mm Hg during the daytime period and higher than 120/80 mm Hg during the nighttime period.

The questionnaire about the occurrence of headache during BP monitoring included identification of the moment of beginning, length, and characteristics of the episodes. The symptom was considered to be a migraine-like headache if there were at least 2 of the following characteristics: unilateral occurrence, pulsating, moderate to severe intensity (disturbing or precluding daily activities), or episodes aggravated by movement. If these criteria were not fulfilled the episode was classified as tension-type headache. Only episodes that lasted longer than 60 minutes were analyzed. The first episode was considered for analysis when multiple episodes occurred during monitoring. Other anthropometric and medical data were obtained from the baseline database of the cohort.

Blood pressure and other continuous variables in patients with and without headache were compared using the t test for independent samples. Analysis of variance for multiple factors (presence or absence of headache during monitoring and repeated measurements (hourly averages) were used to compare systolic and diastolic ABP in patients with and without headache during the examination. Hourly average BP levels surrounding the episode of headache (1 and 2 hours before, during, and 1 and 2 hours after the episode) and 24-hour mean BP levels were compared using paired sample t tests.

RESULTS

Twenty-five (33%) of 76 patients reported the occurrence of headache during 24-hour ABP monitoring. The average length of the episodes was 120 ± 51 minutes. Three patients experienced the index episode during the dawn, 10 in the morning, 6 in the afternoon, and 6 in the evening. Table 1 shows that the groups with and without headache did not differ regarding several characteristics except that more women had headaches. About 60% of patients in both groups were using antihypertensive drugs. The 24-hour ABP curves did not differ significantly between the 2 groups (Figure 1), although patients with headache had higher absolute values in the periods near installation and removal of the device. The proportion of dippers and BP loads did not differ between the 2 groups.

Mean systolic and diastolic BP values during the 24-hour period and during the episodes of headache in 25 patients with the symptom were not different (Table 2). Hourly average BP values 1 hour before, during, and 1 hour after the symptom and the first measurement taken during the symptom were not different from each other. The overall behavior of systolic and diastolic BP in the hours surrounding the episode of headache is shown in Figure 2.

Eight patients (10% of the whole sample) had migraine-like headache. Their BP during the episode and in the hour preceding it did not differ from their 24-hour average BP (Table 3).

Most observational studies have not confirmed the hypothesis that there is a relation between headache and chronic hypertension. It seems that the association detected in a few studies might be artifactual because BP is more likely to be measured in patients with headache. The possibility of any relation between headache and the variation of BP seems to be low. Results of studies conducted for several years confirmed that the aura phase of migraine is associated with a reduction in cerebral blood flow, although the progression of oligemia across the cortex does not respect vascular territories, and, therefore, it is unlikely to be primarily a vasospastic phenomenon. Recently, images of positron emission tomography during a migraine attack without aura open up the possibility that blood flow changes might occur in migraine with and without aura. Vascular changes during migraine are epinephrines, secondary to neurogenic mechanisms. Depolarization of trigeminal ganglion or its perivascular nerve terminals activates the trigeminovascular system, giving rise to central transmission of nociceptive information and retrograde perivascular release of powerful vasoactive neuropeptides. The consequences would be dural vasodilation mediated by calcitonin gene-related peptide and dural plasma extravasation mediated by neurokinin A and substance P from trigeminal C-fibers.
Tension type is the most common type of headache in population surveys. Rasmussen et al. identified a prevalence of 79% of the symptom in adults lifelong. The relation between this kind of headache and hypertension could be explained by a common pathophysiological mechanism. Traditionally, tension-type headache was thought to be caused by contraction of skeletal muscles of the head and neck that might induce ischemia, generating a vascular component of headache,25 a hypothesis that has been discharged.29 Electromyographic studies have shown more muscle contraction with migraine than with tension-type headache.25 The absence of a primary vascular pathophysiological mechanism that could justify the relation between headache and the variation of BP is a consistent explanation for our results. Blood pressure did not differ between mildly hypertensive patients with and without headache.

Table 1. Characteristics of 76 Patients With and Without Headache During ABP Monitoring

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Yes (n = 25)</th>
<th>No (n = 51)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women, No. (%)</td>
<td>19 (76)</td>
<td>30 (59)</td>
<td>.14</td>
</tr>
<tr>
<td>Use of antihypertensive drugs, No. (%)</td>
<td>15 (60)</td>
<td>31 (61)</td>
<td>.78</td>
</tr>
<tr>
<td>Age, mean ± SD, y</td>
<td>48.6 ± 14.9</td>
<td>51.6 ± 14.0</td>
<td>.55</td>
</tr>
<tr>
<td>ABP ≥ 140/90 mm Hg, No. (%)</td>
<td>11 (44)</td>
<td>25 (49)</td>
<td>.92</td>
</tr>
<tr>
<td>24-h ABP, mean ± SD, mm Hg</td>
<td>137.0 ± 17.3</td>
<td>134.6 ± 15.4</td>
<td>.38</td>
</tr>
<tr>
<td>Systolic</td>
<td>83.3 ± 12.8</td>
<td>83.1 ± 12.1</td>
<td>.57</td>
</tr>
<tr>
<td>Blood pressure load, % during 24 h</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td>49 ± 32</td>
<td>48 ± 31</td>
<td>.98</td>
</tr>
<tr>
<td>Diastolic</td>
<td>38 ± 32</td>
<td>37 ± 28</td>
<td>.42</td>
</tr>
<tr>
<td>Systolic dippers, No. (%)</td>
<td>7 (28)</td>
<td>13 (25)</td>
<td>.81</td>
</tr>
<tr>
<td>Diastolic dippers, No. (%)</td>
<td>17 (68)</td>
<td>25 (49)</td>
<td>.11</td>
</tr>
</tbody>
</table>

*ABP indicates ambulatory blood pressure.

Table 2. Comparison of Blood Pressure Values in Different Periods Surrounding an Episode of Migrainelike Headache in 8 Patients

<table>
<thead>
<tr>
<th>ABP, mm Hg</th>
<th>24 h</th>
<th>1 h Before Headache</th>
<th>During Headache</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic</td>
<td>134.2 ± 18.4</td>
<td>133.0 ± 18.4</td>
<td>134.6 ± 18.1</td>
<td>.58</td>
</tr>
<tr>
<td>Diastolic</td>
<td>82.2 ± 14.4</td>
<td>82.2 ± 14.2</td>
<td>81.9 ± 13.3</td>
<td>.99</td>
</tr>
</tbody>
</table>

*Data are given as mean ± SD. ABP indicates ambulatory blood pressure.

Table 3. Comparison of Blood Pressure Values in Different Periods Surrounding an Episode of Headache During ABP Monitoring in 25 Patients

<table>
<thead>
<tr>
<th>ABP, mm Hg</th>
<th>24 h</th>
<th>During Headache</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic</td>
<td>137.0 ± 17.3</td>
<td>139.4 ± 21.1</td>
<td>.13</td>
</tr>
<tr>
<td>Diastolic</td>
<td>83.3 ± 12.8</td>
<td>85.0 ± 18.2</td>
<td>.30</td>
</tr>
</tbody>
</table>

*Data are given as mean ± SD. ABP indicates ambulatory blood pressure.

Figure 1. The 24-hour ambulatory blood pressure curves of patients with and without headache. Error bars represent SEM.

Figure 2. Systolic and diastolic blood pressure headache before, during, and after episodes of headache (n=20). Error bars represent SEM.
ache during 24-hour ABP monitoring. Systolic and diastolic BP values in the periods surrounding the episodes of headache were not different from each other and from the 24-hour ABP average. This happened in patients with tension-type and migrainelike headache, but the small number of patients with migrainelike symptoms precludes a conclusive interpretation about the relation between BP and migraine.

To our knowledge, this is the first time that the absence of an association between variation of BP and the occurrence of episodes of headache was recorded with this observational design. Among its strengths are the possibility to measure, in a masked fashion, BP several times during the day and, especially, to evaluate the behavior of BP in the hours preceding, accompanying, and following the episode of headache. In general, our results agree with those obtained in studies with other designs.8-13

The nature of our sampling criteria should be taken in account before generalizing our findings. Because we studied only patients with mild hypertension, we cannot extend our findings to patients with more severe forms of hypertension. Also, our data do not compare the incidence of headache in normotensive and hypertensive individuals because all participants were hypertensive. The fact that patients with headache tended to have higher BP levels near the periods of installation and withdrawal of the device might be because of an exaggerated alert reaction presented by them. Anxiety could be the common mechanism to explain the occurrence of headache and the alert reaction in these patients.

Textbooks and reviews5-7,30 still present headache as a symptom of hypertension or of some of its presentation. The Headache Classification Committee of the International Headache Society31 states that chronic arterial hypertension of mild or moderate degrees does not cause headache but does not comment about whether this is the case in patients with severe hypertension. The classification considers that headache can be caused by elevation of BP in 4 situations: acute pressure response to an exogenous agent, pheochromocytoma, malignant hypertension, and preeclampsia and eclampsia.

The inconsistency in the literature about the relation of these 2 prevalent situations, hypertension and headache, has created some myths among patients. Cantillon et al32 reported that at least 50% of 102 patients with hypertension believed that they could tell when their BP was elevated based in the presence of symptoms, such as headache. Most of them (86%), however, could not accurately predict their BP.

In conclusion, our findings show that in patients with mild hypertension there is no association between headache, classified as tension type or migrainelike, and BP. Health professionals must discourage patients with hypertension from believing that they can rely on the presence of such a symptom to know about their BP levels.

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