Brain Stem and Cerebellar Hyperintense Lesions in Migraine

Mark C. Kruit, MD; Lenore J. Launer, PhD;
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Background and Purpose—Migraineurs are at increased risk of cerebellar infarcts and supratentorial white matter lesions. The prevalence, frequency, and distribution of infratentorial hyperintense lesions in migraine are unknown.

Methods—Migraineurs with aura (n = 161), without aura (n = 134), and controls (n = 140) from a population-based sample of adults (30 to 60 years of age) were evaluated with MRI.

Results—Infratentorial hyperintensities were identified in 13 of 295 (4.4%) migraineurs and in 1 of 140 (0.7%) controls (P < 0.04). Twelve cases had hyperintensities, mostly bilaterally, in the dorsal basis pontis. Those with infratentorial hyperintensities also had supratentorial white matter lesions more often.

Conclusion—We found an increased prevalence of infratentorial (mostly pontine) hyperintensities in migraineurs from the general population. This extends the knowledge about vulnerable brain regions and type of lesions in migraine brains. A hemodynamic ischemic pathogenesis is likely, but further research is needed. (Stroke. 2006;37:1109-1112.)

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parts of the corticopontine (pyramidal tract) or medial lemniscus fibers. PHLs were in the territories supplied by the anteromedial and anterolateral groups arising from the basilar artery.

Compared with those without, those with IHLs significantly more often had high PVWML load (8% versus 31%; \( P < 0.005 \)) and high DWML load (19% versus 43%; \( P < 0.05 \)), but there were no significant differences in infarct prevalence (7% versus 18%) or, more specifically, in cerebellar infarct prevalence (4% versus 0%). Migraine cases with and without IHLs were similar with respect to migraine type, attack frequency, age at onset, or treatment status.

**Discussion**

Population-based migraineurs had IHLs more often than controls. IHLs were associated with PVWML and DWML but not with cerebellar infarcts, as described previously in migraineurs.\(^1\) In the majority of cases (86%), hyperintensities were located in the midpontine parenchyma (PHLs).

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**Table 1. Case Summary of Participants With Infratentorial Hyperintense Lesions**

<table>
<thead>
<tr>
<th>Cases</th>
<th>Age/Sex</th>
<th>Risk Factors*</th>
<th>Diagnosis</th>
<th>Age of Onset-End</th>
<th>Average Attacks per Year</th>
<th>Infratentorial Hyperintensity</th>
<th>DWML Score‡</th>
<th>PVWML Score‡</th>
<th>Infarcts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41/Female</td>
<td>ht, hcr</td>
<td>MA</td>
<td>33–51</td>
<td>12</td>
<td>Pons (3)</td>
<td>1</td>
<td>1</td>
<td>…</td>
</tr>
<tr>
<td>2</td>
<td>42/Female</td>
<td>ht</td>
<td>MO</td>
<td>11–7</td>
<td>7</td>
<td>Cerbellum (1)</td>
<td>1</td>
<td>2</td>
<td>…</td>
</tr>
<tr>
<td>3</td>
<td>43/Female</td>
<td>ht</td>
<td>MA</td>
<td>14–43</td>
<td>43</td>
<td>Cerbellum (3)</td>
<td>0</td>
<td>0</td>
<td>…</td>
</tr>
<tr>
<td>4</td>
<td>52/Male</td>
<td>ht</td>
<td>MA</td>
<td>32–14</td>
<td>14</td>
<td>Pons (5)</td>
<td>1</td>
<td>2</td>
<td>…</td>
</tr>
<tr>
<td>5</td>
<td>52/Female</td>
<td>ht</td>
<td>MO</td>
<td>33–51</td>
<td>12</td>
<td>Cerbellum (3)</td>
<td>7§</td>
<td>4§</td>
<td>1 temporal lobe (10 mm)</td>
</tr>
<tr>
<td>6</td>
<td>52/Female</td>
<td>MO</td>
<td>25–6</td>
<td>6</td>
<td>Pons (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>55/Male</td>
<td>ht</td>
<td>MA</td>
<td>25–6</td>
<td>6</td>
<td>Pons (5)</td>
<td>0</td>
<td>1</td>
<td>…</td>
</tr>
<tr>
<td>8</td>
<td>56/Male</td>
<td>ht, hcr</td>
<td>MO</td>
<td>22–15</td>
<td>15</td>
<td>Pons (5)</td>
<td>9§</td>
<td>5§</td>
<td>…</td>
</tr>
<tr>
<td>9</td>
<td>60/Female</td>
<td>ht</td>
<td>MO</td>
<td>14–54</td>
<td>12</td>
<td>Pons (5)</td>
<td>6§</td>
<td>2</td>
<td>…</td>
</tr>
<tr>
<td>10</td>
<td>61/Male</td>
<td>ht</td>
<td>MA</td>
<td>7–3</td>
<td>3</td>
<td>Pons (5)</td>
<td>3</td>
<td>0</td>
<td>1 corona radiate (4 mm)</td>
</tr>
<tr>
<td>11</td>
<td>61/Female</td>
<td>ht</td>
<td>MA</td>
<td>20–6</td>
<td>6</td>
<td>Pons (5)</td>
<td>13§</td>
<td>3§</td>
<td>…</td>
</tr>
<tr>
<td>12</td>
<td>61/Female</td>
<td>ht</td>
<td>MA</td>
<td>15–56</td>
<td>32</td>
<td>Pons (5)</td>
<td>10§</td>
<td>2</td>
<td>…</td>
</tr>
<tr>
<td>13</td>
<td>61/Female</td>
<td>hcr</td>
<td>Co</td>
<td>…</td>
<td>…</td>
<td>Pons (5)</td>
<td>17§¶</td>
<td>4§</td>
<td>2 capsula interna (both 3 mm); 1 thalamus (2 mm)</td>
</tr>
<tr>
<td>14</td>
<td>63/Female</td>
<td>ht, hcr</td>
<td>Co</td>
<td>30–30</td>
<td>30</td>
<td>Pons (5)</td>
<td>6</td>
<td>3§</td>
<td>…</td>
</tr>
</tbody>
</table>

*ht indicates hypertension; hcr, high cholesterol ratio.
†Location (Scheltens score/size); ‡Scheltens score; §also classified as having “high DWML load” or “high PVWML load”; ¶large confluent white matter lesion.
The brain stem is involved in migraine pathophysiology, and specific activation of the dorsal rostral pons and periaqueductal gray matter have been reported during migraine. However, the specific “migraine areas” were not involved in our cases.

In cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL), a disorder in which MA often is the presenting symptom, similar brain stem hyperintensities are frequent. In CADASIL, decreased cerebral perfusion secondary to changes in the wall of cerebral arteries leads to early damage of the periventricular and deep supratentorial white matter. Those regions are irrigated by the longest perforating arteries and are thus the most vulnerable to hypoperfusion. This is particularly the case for the central part of the pons. Repeated or prolonged reduced perfusion has been described in migraine attacks, although not specifically in the pons. There is evidence for impaired adaptive cerebral hemodynamic mechanisms in the posterior circulation of migraine patients.

We are not aware of reports on PHLs in migraine. Most reports on PHLs describe an association with an increased cardiovascular burden, leukoaraiosis, lacunar infarcts, and poor clinical outcome. A histopathological study reported a good correlation between PHLs and MRI changes. Symmetrical PHLs (histologically corresponding to myelin pallor and reactive astrocytosis) have a comparable pathophysiology as lesions in subcortical arteriosclerotic encephalopathy, ie, ischemia secondary to small-artery sclerosis. Small vessel disease or repetitive perfusion deficits are likely to be common pathophysiological mechanisms for PHLs, DWMLs and PVWMLs, and lacunar infarction.

The origin of PHLs is not known. A number of specific relatively infrequent clinical entities, including multiple sclerosis, encephalitis, Behcet disease, osmotic myelinolysis, hypertensive encephalopathy, neoplasm, chemotherapy, and radiation, have been implicated but were excluded in our sample. Similarly, enlarged perivascular spaces or brain stem infarcts as a cause for pontine T2 hyperintensities were excluded because of the absence of concomitant hypointense changes on T1 or FLAIR images.

In summary, we found an increased prevalence of infratentorial (mostly pontine) hyperintensities in migraineurs from the general population. This extends the knowledge about vulnerable brain regions and type of lesions in migraine brains. The etiology of these lesions in migraine is unknown but likely attributable to small-vessel disease (arteriosclerosis), repetitive perfusion deficits, or both; further research is needed.

**Acknowledgments**

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**References**


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