Lobar Hemorrhage in the Elderly
The Undimining Importance of Hypertension

Joseph Broderick, MD; Thomas Brott, MD; Thomas Tomsick, MD; and Alan Leach, BS

Background and Purpose: We sought to determine whether hypertension is less common in primary lobar hemorrhage than intracerebral hemorrhage in other locations and whether the frequency of hypertension in lobar hemorrhage diminishes with advancing age.

Methods: We identified all cases of intracerebral hemorrhage in Greater Cincinnati during 1988 by review of hospital and autopsy records as well as computed tomographic and magnetic resonance scans.

Results: During 1988, 66 primary lobar hemorrhages occurred, constituting 46% of all intracerebral hemorrhages in those under 75 years of age and 34% in those age 75 and older. A history of hypertension was present in 67% of patients with lobar, 73% of those with deep, 73% of those with cerebellar, and 78% of those with pontine hemorrhages. Left ventricular hypertrophy was present in 21% of patients with lobar, 27% of those with deep, and 47% of those with pontine/cerebellar hemorrhages. The frequency of hypertension in patients with lobar hemorrhage did not decrease with advancing age.

Conclusions: The proportion of all intracerebral hemorrhages that are lobar does not increase with advancing age. Hypertension is nearly as common in primary lobar hemorrhage as in deep, cerebellar, and pontine hemorrhages, and its importance as an associated condition for lobar hemorrhage does not diminish with advancing age. (Stroke 1993;24:49–51)

KEY WORDS • aged • amyloid • cerebral hemorrhage • hypertension

Intracerebral hemorrhage in the thalamus, basal ganglia, periventricular white matter, pons, and cerebellum is closely linked with preexisting hypertension as well as a characteristic vasculopathy of the small penetrating arteries and arterioles in these same locations.1-15 Similar but less pronounced vascular changes are seen also in the first several centimeters of the long subcortical penetrating arteries in hypertensive patients.11 However, preexisting hypertension is reported to be present in only 31–55% of patients with a lobar intracerebral hemorrhage.6,16-20

The present study, part of a large, population-based study of spontaneous intracranial hemorrhage in Greater Cincinnati, addresses three questions: 1) Is hypertension less common in primary lobar hemorrhage than hemorrhage in other locations classically associated with hypertension? 2) Does the frequency of hypertension in patients with primary lobar hemorrhage diminish with advancing age? 3) Is lobar hemorrhage relatively more common in the very elderly?

Methods

The medical records of all patients with possible intracerebral or subarachnoid hemorrhage in the Greater Cincinnati metropolitan area during 1988 were reviewed, including those in the record systems of all 20 acute-care hospitals and five coroners’ offices in the five-county region. Detailed methodology of case ascertainment and data collection has been reported previously.21 The abstracted clinical data and all available computed tomographic (CT) and magnetic resonance imaging films were evaluated by a neurologist. Films were unavailable for 25 of the 253 hospitalized patients with an intracranial hemorrhage. In these cases the CT report in the medical record was used.

Intracerebral hemorrhage was defined as a clinical history and examination consistent with an intracerebral hemorrhage (sudden onset of headache, change in level of consciousness, or focal neurological deficit), accompanied by a focal collection of blood within the brain parenchyma that was detected by CT scanning or at autopsy. Traumatic intracerebral hemorrhage and hemorrhagic cerebral infarction were excluded. A neuroradiologist reviewed the CT films when both intracerebral and subarachnoid hemorrhage were present. Cases with both intracerebral and subarachnoid hemorrhage were categorized as intracerebral if no aneurysm was demonstrated and a parenchymal source of bleeding was thought more likely by the neuroradiologist. Cases of brain hemorrhage limited to the ventricles were classified as intracerebral hemorrhage unless an aneurysmal source of bleeding was demonstrated. Only first-ever cases of primary intracerebral hemorrhage that occurred during 1988 were included. Cases in which there was a clear cause or associated condition, such as arteriovenous malformation, aneurysm, tumor, anticoagulants, thrombolytic therapy, or cocaine, were excluded from the present analysis. The
number of blacks (171,718) and whites (1,086,462) in the five counties, according to the 1980 US Census, served as the denominators for calculating age-specific incidence rates of primary intracerebral hemorrhage (age-specific incidence rate equals incidence cases in a given age group divided by the total population of that age group during 1988).

Each brain region (putamen, globus pallidus, thalamus, internal capsule, deep periventricular white matter, cerebral cortex, subcortical white matter, cerebellum, pons, midbrain, and ventricles) that contained hemorrhage demonstrated by CT was recorded. The origin of each hemorrhage was categorized as deep (thalamus, putamen, globus pallidus, internal capsule, deep periventricular white matter, and ventricles only), lobar (cortical and subcortical locations primarily), pontine, or cerebellar. For a few larger hemorhages, the distinction between a lobar and a deep periventricular white matter hemorrhage was difficult because both areas were involved. However, deep periventricular hemorrhages had to have been within a centimeter of the body of the lateral ventricles, with the majority of the hemorrhage within the deep white matter.

All but 15 patients had information regarding the presence or absence of hypertension or treatment for hypertension documented in their medical records. Each electrocardiogram in the medical record was reviewed for the presence of left ventricular hypertrophy by Estes criteria (a score of 4 or more). Patients were classified as hypertensive if they had a clinical history of hypertension, multiple systolic blood pressures greater than 160 mm Hg or diastolic pressures greater than 90 mm Hg before onset of stroke, or left ventricular hypertrophy demonstrated electrocardiographically. The 10 patients (five lobar hemorrhages) without documentation of the presence or absence of hypertension in their medical records and without left ventricular hypertrophy were classified as nonhypertensive. We used χ² tests for group comparisons; probability values of 0.05 or less were considered statistically significant.

**Results**

There were 188 cases of spontaneous intracerebral hemorrhage. We excluded intracerebral hemorrhage associated with ruptured arteriovenous malformations (nine), tumor (two), anticoagulants (eight), thrombolytic therapy (one), anticoagulant and thrombolytic therapy (one), or acute cocaine ingestion (one). In one other case the location of the hemorrhage could not be determined because of missing films and inaccurate information regarding the origin of the hemorrhage on the CT report in the medical record. Two other cases identified by autopsy alone were not included in the present analysis.

Of the remaining 163 cases of primary intracerebral hemorrhage, there were 77 deep (47%), 66 lobar (40%), 11 cerebellar (7%), and nine pontine hemorrhages (6%). The incidence rate of primary lobar intracerebral hemorrhage increased exponentially with advancing age, but the combined incidence rates of deep, cerebellar, and pontine hemorrhages increased at an even greater rate (Figure 1). Thus, the proportion of lobar hemorrhages in patients 75 years or older (34%) was lower than that in those under age 75 (46%), although the difference did not reach statistical significance (p=0.12).

Of the 163 cases, 118 (72%) were classified as hypertensive. Hypertension was similarly present in patients with a lobar (67%), deep (73%), cerebellar (73%), or pontine (78%) hemorrhage (p=0.33). The frequency of hypertension in patients with lobar, deep, or cerebellar/pontine hemorrhage did not vary significantly with age after age 44 (Table 1; all probability values >0.85). Of the 118 hypertensive patients, 113 had a history of hypertension and five had no documented history but met criteria for left ventricular hypertrophy documented by electrocardiogram. Of the 113 patients with a history of hypertension, 34 (30%) met electrocardiographic criteria for left ventricular hypertrophy. Left ventricular hypertrophy was present in 21% of the patients with lobar, 27% of those with deep, and 47% of those with pontine/cerebellar hemorrhages (p=0.11).

![Table 1. Frequency of Hypertension by Age and Location of Intracerebral Hemorrhage](http://stroke.ahajournals.org/content/24/1/50)

**Table 1. Frequency of Hypertension by Age and Location of Intracerebral Hemorrhage**

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Lobar</th>
<th>Deep</th>
<th>Cerebellar/pontine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>% HTN</td>
<td>n</td>
</tr>
<tr>
<td>25-34</td>
<td>3</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>35-44</td>
<td>5</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>45-54</td>
<td>6</td>
<td>67</td>
<td>9</td>
</tr>
<tr>
<td>55-64</td>
<td>9</td>
<td>67</td>
<td>12</td>
</tr>
<tr>
<td>65-74</td>
<td>17</td>
<td>65</td>
<td>15</td>
</tr>
<tr>
<td>75-84</td>
<td>17</td>
<td>71</td>
<td>23</td>
</tr>
<tr>
<td>85+</td>
<td>9</td>
<td>78</td>
<td>16</td>
</tr>
</tbody>
</table>

n, Number of total hemorrhages; % HTN, percentage of total hemorrhages in each category with hypertension.
Discussion

Drury and colleagues\(^1\) have suggested that amyloid angiopathy is a more important cause of intracerebral hemorrhage in the elderly than hypertension. If this is true, lobar hemorrhage should be proportionately more common in the elderly because amyloid angiopathy is found almost exclusively in cortical or subcortical blood vessels of elderly individuals.\(^{23-25}\) Instead, in the present study we found that lobar hemorrhages were relatively less common. In addition, prior hypertension was present in nearly three quarters of patients 75 years and older who had a lobar hemorrhage. These findings indicate that hypertension is an important associated condition for intracerebral hemorrhage, regardless of hemorrhage location or patient age.

Autopsy and surgical pathological studies support the importance of both hypertensive vasculopathy and amyloid angiopathy in lobar intracerebral hemorrhage. Of 17 patients with a primary lobar hemorrhage who underwent operation, Wakai and colleagues\(^26\) documented microaneurysms as the most likely cause in 11 patients (65%). Six of the 11 had a clear history of hypertension, and five had no other condition associated with the formation of microaneurysms except age. Of the 17 patients, five (29%) had amyloid deposition in surrounding blood vessels; two of the five had hypertension.

Amyloid angiopathy and hypertensive vascular changes may coexist, as both are common in the elderly.\(^24\) Clinical or pathological evidence of hypertension has been reported in up to 59% of the cases of intracerebral hemorrhage associated with amyloid angiopathy.\(^{27-29}\) In a comparative postmortem study of amyloid-containing vessels in patients with and without intracerebral hemorrhage, Vonsattel and colleagues\(^30\) found that fibrinoid necrosis with or without microaneurysms was significantly related to the occurrence of lobar hemorrhage. Similar vascular changes have been also associated with chronic hypertension.\(^{11-14}\) These pathological studies and the present population study suggest that hypertension is at least as important in the development of lobar hemorrhages as amyloid angiopathy.

The greater frequency of hypertension in patients with lobar hemorrhage in the present study as compared with previous studies has several potential explanations. Some reports included young patients with known causes such as arteriovenous malformation. None of the previous studies were population based,\(^6,16-20\) and they often represented the experience of tertiary referral centers. Thus, patients in these studies were generally younger with smaller hemorrhages. The completeness of medical record information regarding hypertension probably varied among the studies because patients with intracerebral hemorrhage often have a decreased level of consciousness upon arrival at the hospital. Other reasons for variability among the studies include different criteria for hypertension and location of hemorrhage on CT images. However, the proportion of lobar hemorrhages in the present study (40%) is similar to that reported for other population studies from 1973 to the present (44–47%).\(^{1,2}\)

References

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