Differences in Stroke Between White, Hispanic, and Native American Patients

The Barrow Neurological Institute Stroke Database

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**Background and Purpose**—Identification of specific features of stroke in minority populations should lead to more effectively focused treatment and prevention.

**Methods**—We examined 1290 white (WHI), 242 Hispanic (HIS), 83 Native American (NA), and 101 other stroke and transient ischemic attack (TIA) patients hospitalized at the Barrow Neurological Institute from 1990 through 1996.

**Results**—Chi-square analysis detected significant ($P < 0.05$) differences as follows: (1) Stroke types—lacunes more prevalent in NA than WHI and HIS (30% versus 16% and 15%); cardioembolic more prevalent in WHI than HIS (16% versus 9%, NA 14%); hemorrhages more prevalent in HIS than WHI and NA (48% versus 37% and 27%); (2) Risk factors—hypertension more prevalent in HIS than WHI (72% versus 66%; NA 71%); diabetes more prevalent in NA than HIS and WHI (62% versus 36% and 17%); cigarette smoking more prevalent in WHI than HIS and NA (61% versus 46% and 41%); cardiac disease more prevalent in WHI than HIS (34% versus 24%; NA 27%); heavier alcohol intake in NA than HIS than WHI (43% versus 24% versus 17%). There were no significant outcome differences between races for any stroke type. ANOVA detected significantly lower mean age at stroke onset in NA than HIS than WHI (56 versus 61 versus 69 years).

**Conclusions**—There are significant differences in prevalence of risk factors and stroke types between WHI, HIS, and NA in our hospital-based population. Although the three races appear to respond to risk factors similarly, Hispanics may be especially susceptible to hemorrhage. Further evaluation of these observations in community-based studies will be important. (Stroke. 1998;29:29-33.)

**Key Words:** epidemiology ■ Hispanic Americans ■ Indians, North American ■ racial differences ■ stroke

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Documentation of specific features of stroke in minority populations should lead to more effectively focused diagnosis, treatment, and prevention. The scope of epidemiological data regarding stroke in Hispanics is limited,1–13 and only two studies have compared information for whites, Hispanics, and Native Americans from the same region.6,11

We have utilized unique access to stroke data on hospitalized Hispanics and Native Americans to analyze features of stroke in these groups and to compare them with our white patients, as well as with Hispanic and Native American populations elsewhere. We describe our hospital-based data recorded from these populations and discuss the implications for stroke prevention.

**Subjects and Methods**

Data were collected on 1716 subjects (1290 white, 242 Hispanic, 83 Native American, 101 other) admitted to the Barrow Neurological Institute from 1990 through 1996. Patients were identified through emergency department admission logs, and data were collected from concurrent and retrospective chart review and interviews with patient or family.

Race/ethnicity was determined by the patient or family’s response to the question, “What is your race—white, black, Hispanic white (referred to as ‘Hispanic’), Native American, Asian, or other?”

Because of the small number of black and Asian subjects, evaluation was limited to data on white, Hispanic, and Native American groups. Risk factor identification was in accordance with the following definitions: hypertension—history of hypertension (treated or untreated) or left ventricular hypertrophy on ECG or echocardiogram; diabetes—history of diabetes (treated or untreated); cigarette smoking—history of more than 20-pack years, currently smoking or not; cardiac disease—history of either congestive heart failure, angina, myocardial infarction, pacemaker, or atrial fibrillation; alcohol intake—history of heavy alcohol intake defined as >12 oz of wine, 24 oz of beer, or 3 oz of liquor per day; hypercholesterolemia—abnormal cholesterol elevation by history (treated or untreated) or documented during hospitalization.

See editorial on page 2

After review of the entire medical record, stroke type was assigned to each subject based on uniform diagnostic criteria. Lacunar, atherothrombotic, intraparenchymal hemorrhage, hemorrhagic infarct, cardioembolic, TIA, “unknown,” and “other” strokes were identified. TIA was defined as stroke symptoms resolving within 24 hours.

Criteria for lacunar infarction included an appropriate clinical syndrome with or without lesion on CT and/or MRI scan, or an atypical clinical syndrome with a sub-cortical lesion <1.5 cm diameter on CT and/or MRI. Less than 50% ipsilateral carotid stenosis by ultrasound, magnetic resonance angiography, or conventional angiography, and negative testing for potential cardioembolic source were required. A history of diabetes mellitus or hypertension was supportive.
Criteria for atherothrombotic infarction included an appropriate clinical syndrome with or without lesion on CT and/or MRI or an atypical syndrome with an appropriate scan lesion. Greater than 50% stenosis of an appropriate large artery and negative cardiac evaluation were required. A history of previous TIAs in the same vascular territory was supportive.

Criteria for intraparenchymal hemorrhage included appropriate clinical syndrome with or without lesion on CT and/or MRI or an atypical clinical syndrome with an appropriate scan lesion. Cardiac evaluation disclosing a potential intracardiac or trans-thoracic (paradoxical) embolic source and absence of relevant cerebrovascular stenosis were required. Evidence of stroke in more than one vascular territory was supportive.

A stroke was classified as “unknown” when criteria for the above categories could not be fulfilled or when two or more causes could not be differentiated.

“Other” strokes were those caused by conditions such as migraine, vessel dissection, vasculitis, or coagulopathies. Hemorrhagic infarctions were included in this category because numbers were small (1.2% for white, 2.5% Hispanic, and 1.2% Native American).

“Time-to-examination” was defined as the time between symptom onset to time of examination at our facility.

“Outcome” was defined as either favorable (discharged to home or to a rehabilitation facility) or unfavorable (discharged to long-term care facility or death).

Statistical Analysis
Differences were determined by \( \chi^2 \) and ANOVA methodology where appropriate. Significance was defined as \( P<.05 \).

Results
Seventy-five percent of our patients were white, 14% Hispanic, 5% Native American, and 6% other. This distribution is representative of the proportion of each of these ethnic groups within the Arizona population.\(^1\)

Sociodemographics and Risk Factors
Mean age at stroke onset was significantly lower in Native Americans than Hispanics and whites, and age in Hispanics was significantly lower than in whites (Table 1). Hypertension was significantly more prevalent in Hispanics than whites. Diabetes was significantly more prevalent in Native Americans than Hispanics and whites and more prevalent in Hispanics than whites. Cigarette smoking was significantly more common in whites than Hispanics and Native Americans. Cardiac disease was significantly more prevalent in whites than Hispanics. History of hypercholesterolemia was not significantly different between the races. Heavy alcohol intake was significantly more prevalent in Native Americans than Hispanics and whites and significantly more prevalent in Hispanics than whites.

Stroke Types
Hemorrhages were predominant in all races but were significantly more prevalent in Hispanics than either whites or Native Americans. Lacunes were significantly more prevalent in Native Americans than whites. Cardioembolic strokes were significantly more prevalent in whites than Hispanics. Atherothrombotic strokes occurred without significant differences between the races (Table 2). Fourteen percent of all patients had TIAs and were excluded from this analysis.

Outcomes
Chi-square analysis detected no significant interracial outcome differences for the four known stroke types. However, analysis of each stroke type for all races together disclosed the greatest likelihood of a favorable outcome for lacunar stroke, a lesser likelihood of favorable outcome for cardioembolic and atherothrombotic strokes, and the least likelihood of favorable outcome for hemorrhages (Table 3).

Discussion
Our white patients exhibit the highest proportion of cardioembolic stroke. This is consistent with the higher prevalence of cardiac disease in whites. These findings are also consistent with data from both the northern Manhattan and the San Diego stroke studies with respect to comparison of whites with other racial/ethnic subgroups.

\[ \text{TABLE 1. Distribution of Stroke Risk Factors by Race} \]

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>White (n=1290)</th>
<th>Hispanic (n=242)</th>
<th>Native American (n=83)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, y</td>
<td>69</td>
<td>61</td>
<td>56</td>
<td>&lt;.05*</td>
</tr>
<tr>
<td>Male</td>
<td>52%</td>
<td>51%</td>
<td>50%</td>
<td>Not analyzed</td>
</tr>
<tr>
<td>Hypertension</td>
<td>66%</td>
<td>72%</td>
<td>71%</td>
<td>&lt;.05†</td>
</tr>
<tr>
<td>Diabetes</td>
<td>17%</td>
<td>36%</td>
<td>62%</td>
<td>&lt;.05‡</td>
</tr>
<tr>
<td>Smoking</td>
<td>61%</td>
<td>46%</td>
<td>41%</td>
<td>&lt;.05§</td>
</tr>
<tr>
<td>Cardiac disease</td>
<td>34%</td>
<td>24%</td>
<td>27%</td>
<td>&lt;.05¶</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>19%</td>
<td>13%</td>
<td>15%</td>
<td>.18</td>
</tr>
<tr>
<td>Heavy alcohol intake</td>
<td>17%</td>
<td>24%</td>
<td>43%</td>
<td>&lt;.05¶</td>
</tr>
</tbody>
</table>

\* ANOVA test. Native American compared with Hispanic and white; Hispanic compared with white.  
\( \chi^2 \) test for the following: †Hispanic compared with white; ‡Native American compared with white and Hispanic; Hispanic compared with white; ¶White compared with Hispanic and Native American; ‡‡White compared with Hispanic and Native American; ‡§Native American compared with white and Hispanic; Hispanic compared with white.

\[ \text{TABLE 2. Distribution of Stroke Type by Race} \]

<table>
<thead>
<tr>
<th>Stroke Type</th>
<th>White (n=1085)</th>
<th>Hispanic (n=220)</th>
<th>Native American (n=70)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemorrhage</td>
<td>37%</td>
<td>48%</td>
<td>27%</td>
<td>&lt;.05†</td>
</tr>
<tr>
<td>Lacunar</td>
<td>16%</td>
<td>15%</td>
<td>30%</td>
<td>&lt;.05*</td>
</tr>
<tr>
<td>Cardioembolic</td>
<td>16%</td>
<td>9%</td>
<td>14%</td>
<td>&lt;.05‡</td>
</tr>
<tr>
<td>Atherothrombic</td>
<td>14%</td>
<td>10%</td>
<td>11%</td>
<td>.10</td>
</tr>
<tr>
<td>Unknown</td>
<td>11%</td>
<td>9%</td>
<td>14%</td>
<td>.17</td>
</tr>
<tr>
<td>Other</td>
<td>6%</td>
<td>9%</td>
<td>4%</td>
<td>Not analyzed</td>
</tr>
</tbody>
</table>

Table represents strokes only (TIAs excluded from analysis).  
\( \chi^2 \) test for the following: *Native American compared with white; Native American compared with Hispanic; †Hispanic compared with white; Hispanic compared with Native American, and ¶White compared with Hispanic.
Hispanics. Also, the higher proportion of smokers in our white patients with stroke is consistent with the trend for more atherothrombotic strokes in whites, as well as with data regarding stroke risk from cerebral atherosclerosis.

Our data indicate a lower age at stroke onset in Hispanics and Native Americans. Data from the northern Manhattan and San Diego stroke studies also document a tendency for younger age at stroke onset in Hispanics than in whites (67 years in the northern Manhattan study, 60 vs. 63 years in the San Diego study). Although it is tempting to construe the younger age at stroke onset in our Hispanics and Native Americans as an indication of poorer vascular health, data disclose that Hispanic and Native American populations are younger than whites. United States census data disclose a median age in Hispanics of 26 years, in Native Americans of 27 years, and in whites of 35 years. Thus, our finding of a lower age at stroke onset in Hispanics and Native Americans is more likely a reflection of the generally younger ages of Hispanic and Native American populations than of poorer vascular health.

Our Hispanics with stroke have the highest proportion of hypertension, the second highest proportion of diabetes, and the second highest proportion of heavy alcohol intake. The prevalence of hypertension and diabetes in our Hispanic stroke patients is higher than in the age matched southwestern Hispanic population (72% vs. 46% for hypertension, 36% vs. 31% for diabetes), implying a relation between these risk factors and stroke.

As in the northern Manhattan study, Hispanics in our study have the highest proportion of hemorrhages. This proportion is four times higher than in the northern Manhattan study and is likely contributed to by referral bias (hemorrhages are the most frequent stroke type for all three races in our center). However, the higher proportion of hemorrhages among Hispanics with stroke may also reflect the effects of combined risk factors. These include less vigorous blood pressure control, something that has been documented in Hispanic population studies; sensitivity to the effect of hypertension because of relative arterial wall thinness; and alcohol intake, which has been implicated as a contributor to hemorrhage, and which has been identified as a potential risk factor in southwest Hispanic population studies.

Our Native American patients have the highest proportion of diabetes mellitus and the second highest proportion of hypertension. The prevalence of diabetes mellitus in our Native Americans with stroke is higher than that of the age matched Arizona Native American population (62% and 64%). The prevalence of hypertension in our Native Americans with stroke is higher than that of the age matched Arizona Native American population (71% versus 44%). It is not surprising that this risk factor combination is associated with a higher percentage of lacunar strokes in our Native Americans, given the documented relationship between these two risk factors and lacunar infarction in whites.

Although there are definitional differences between studies, the proportion of heavy alcohol users in our Native American patients with stroke is higher than that of southwestern Native American populations in general (43% versus 22%). Heavy alcohol use is a documented risk factor for stroke and therefore may be a contributor in our Native American patients. The higher proportion of heavy alcohol intake in our Native Americans might have been expected to correlate with a higher percentage of hemorrhages. However, this was not the case, perhaps because of increased arterial wall thickness secondary to diabetes.

Although the proportion of smoking in our Native American stroke patients is lower than for whites and Hispanics, it is higher than that of the non-age matched southwestern Native American population (41% versus 16%). This raises concern about the role of smoking as a stroke risk factor for Native Americans, which could be better addressed with more specific age-focused population studies.

Although cholesterol differences between the races were not significant, the trend for hypercholesterolemia in our white patients is compatible with a higher proportion of atherothrombotic infarctions in this population. Similarly, the trend for lower cholesterol in our Hispanic patients is compatible with a higher proportion of hemorrhages. These findings are consistent with other studies, which have validated these relationships between cholesterol and stroke type.

The observed favorable outcomes for lacunar and atherothrombotic infarctions and less favorable outcomes for cardioembolic strokes and hemorrhages are consistent with what is generally known about the prognosis for these stroke types. The lack of significant racial outcome differences for each stroke type is not necessarily surprising. We are unaware of any biological reasons why such outcome differences should exist, and there are no published data regarding outcome differences for stroke types between races.

**Special Discussion**

There are two large Hispanic populations in the United States. Those in the southwest (Mexican Americans) are thought to represent a genetic mixture of Spanish and Native American. Those in the east (Puerto Ricans and Cubans) represent a genetic mixture which is predominantly Spanish, with contributions from Africa and other European countries. Nonetheless, the Southwestern and Eastern Hispanic populations have similar heritable vascular risk factors: higher prevalence of diabetes and a lower prevalence of hypertension than whites. Hispanics also have a lower prevalence of cigarette smoking.

Our data and those from the northern Manhattan study support the notion of similar vascular risk profiles between these two Hispanic subgroups. Both sets of data document a higher proportion of hemorrhages in Hispanics than whites, a lower proportion of cardioembolic strokes, and a slightly lower

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**TABLE 3. Relative Likelihood of Favorable and Unfavorable Outcome by Stroke Type**

<table>
<thead>
<tr>
<th>Stroke Type</th>
<th>Favorable</th>
<th>Unfavorable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacunar (n=249)</td>
<td>93%</td>
<td>7%</td>
</tr>
<tr>
<td>Atherothrombotic (n=190)</td>
<td>78%</td>
<td>22%</td>
</tr>
<tr>
<td>Cardioembolic (n=205)</td>
<td>66%</td>
<td>34%</td>
</tr>
<tr>
<td>Hemorrhage (n=544)</td>
<td>50%</td>
<td>50%</td>
</tr>
</tbody>
</table>

Favorable outcome defined as discharged to home or a rehabilitation facility. Unfavorable outcome defined as discharged to a long term care facility or death.
proportion of atherothrombotic strokes.\textsuperscript{1,2} These data also suggest that susceptibility to risk factors is similar between Hispanics and whites. Hispanics are known to have less cardiac disease and smoking, correlating with fewer cardioembolic and atherothrombotic strokes.\textsuperscript{3,5} The notable exception is the propensity of Hispanics to develop brain hemorrhage despite a lower general population prevalence of hypertension.\textsuperscript{1,9} This phenomenon may ultimately be explained by analysis of other risk factors in Hispanics with hemorrhage.

Native Americans are thought to have migrated to this continent from eastern Asia via the arctic regions of western Canada between the thirteenth and sixteenth centuries. Although Native American populations are geographically dispersed and culturally diverse, they have maintained a strong tendency for hypertension and diabetes mellitus and a less prominent tendency for hypercholesterolemia.\textsuperscript{3,5,4}

Native American populations appear to be susceptible to the effects of risk factors in the same way as white populations. Arizona Native Americans, for example, have a higher prevalence of hypertension and diabetes than Dakota Native Americans, but Dakota Native Americans have a higher rate of CHD.\textsuperscript{3,5,4} The explanation for more CHD in Dakota Native Americans is a higher prevalence of hypercholesterolemia and smoking. Hypercholesterolemia and smoking are the same risk factors for CHD as in the white population.

Our Arizona Native American patients’ tendency for lacunar stroke in association with hypertension and diabetes is similar to what is known for white populations.\textsuperscript{59} The tendency for lacunar stroke would likely be applicable to all Native American populations to the extent that they share the tendency for hypertension and diabetes. Our data on risk factors and stroke types for Native Americans and similar data for CHD in Native Americans imply that specific risk factors predispose Native Americans to the same types of vascular events as they do for whites.

In summary, our white, Hispanic, and Native American stroke patients have different risk factor profiles and different proportions of stroke types. Nonetheless, the three races appear to respond to risk factors similarly. Because our hospital-based data are subject to referral bias, it will be important to corroborate these observations and conclusions with data from community studies. For now, it appears that efforts to prevent stroke in Hispanics and Native Americans should emphasize control of risk factors in the same way as is suggested for whites.

References

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Stroke. 1998;29:29-33
doi: 10.1161/01.STR.29.1.29

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