Higher Risk Factor Burden and Worse Outcomes in Urban Carotid Endarterectomy Patients

Seemant Chaturvedi, MD; Ramesh Madhavan, MD; Sunitha Santhakumar, MD; Maysaa Mehri-Basha, MD; Nikita Raje, MD

Background and Purpose—Previous multicenter carotid endarterectomy (CEA) studies had screening criteria for patient comorbidities and very few blacks. We assessed the hypothesis that CEA results from two urban hospitals would approximate those of the previous multicenter trials.

Methods—A retrospective chart review was completed at two urban hospitals for CEA procedures done in 2003 and 2004. Demographic information and past medical history was recorded. In hospital perioperative complications (stroke or myocardial infarction [MI]) were noted. We calculated an expected perioperative stroke rate based on trial figures and our proportion of symptomatic and asymptomatic patients.

Results—Patients in our cohort had significantly higher rates of hypertension, diabetes, smoking, black race, and elderly status compared to previous trials. The expected perioperative stroke was 3.1%, and the observed stroke rate was 4.7% (P=0.36). Observed rates of MI (6.7%, P<0.001) and stroke or MI (11.3%, P<0.0001) were higher than expected based on the previous trials. The stroke or MI rate in black subjects was higher (15.4% versus 5.6%, P=0.065) and this was significant at the hospital with lower CEA volume.

Conclusions—In two urban hospitals, CEA results were significantly worse than previous trials. Patient selection is likely to play a role because our cohort had higher numbers of hypertensives, diabetics, smokers, blacks, and elderly patients. Clinicians need to carefully consider the risk/benefit ratio of CEA in urban patients because our study shows that these patients have a large number of medical comorbidities and worse outcomes after CEA.

Key Words: carotid endarterectomy ■ carotid stenosis ■ blacks

Extracranial carotid stenosis accounts for 10% to 15% of ischemic strokes. Carotid endarterectomy (CEA) has been found to be useful for stroke prevention in select patients with either recent symptoms or patients who are asymptomatic.1–4 Although several clinical trials have been performed to establish the efficacy of CEA, these studies have included relatively few blacks. Blacks have a differing vascular profile compared to whites. For example, they have increased frequency of hypertension, diabetes, and intracranial occlusive disease.5,6 These factors could increase the perioperative complication rate for blacks undergoing CEA.7

We sought to evaluate the results of CEA from two urban hospitals with a predominantly black population. The hypothesis was that the perioperative results would approximate those seen in the major multicenter trials.

Methods

We conducted a retrospective chart review of all CEA cases performed at two urban hospitals during the 2003 to 2004 time period. Data abstraction was done by two trained physicians, and information was collected pertaining to demographic information, past medical history, clinical symptoms before the CEA, degree of stenosis, in-hospital complications, use of postoperative neuroimaging, length of stay, and discharge status.

For comparison purposes, we calculated an expected rate of perioperative stroke based on the case mix of symptomatic and asymptomatic patients and rates documented in the North American Symptomatic Carotid Endarterectomy Trial (NASCET) and the Asymptomatic Carotid Atherosclerosis Study (ACAS). We also calculated an expected perioperative myocardial infarction (MI) rate based on figure from ACAS and NASCET.8 Expected perioperative death rate was calculated on the basis of these two studies. The calculated figure for our two hospitals evaluated in-hospital complications only.

Postoperative stroke was diagnosed as a vascular neurological syndrome lasting for 24 hours or more. Postoperative MI was diagnosed on the basis of either troponin or creatine kinase enzyme elevations along with clinical symptoms. These enzymes were not checked routinely in patients without symptoms. Patients were not routinely seen by neurologists after surgery.

Patient demographics from our cohort were compared with those from NASCET and ACAS. Statistical comparisons were done using pairwise comparisons. An adjusted probability value and Hommel adjusted probability value were calculated for baseline characteristics. Chi square testing was done to examine the outcome of individual risk factors with perioperative events and to compare the expected and observed complication rates. The study was approved by the local investigation review board.
Results

During the study period, hospital A had 99 procedures and hospital B had 51 cases. In the two hospitals combined, 69% of patients were asymptomatic. Black patients represented 52% of our series, and 42% of patients were age 75 years or over. A comparison of patient characteristics from NASCET, ACAS, and our two hospitals combined is provided in Table 1.

Based on having a mixed cohort of symptomatic and asymptomatic patients with 69% being asymptomatic, the expected perioperative stroke rate was 3.1% and the observed stroke rate was 4.7% ($P=0.36$). The expected perioperative MI rate was 0.6%, and it was 6.7% in our hospitals ($P<0.0001$). The expected rate of combined perioperative stroke or MI was 3.7%, and it was 11.3% in our series ($P<0.0001$). The expected death rate was 0.4%, and the observed death rate was 2.0% ($P=0.04$).

Based on figure from NASCET, we expected a stroke or MI rate of 7.5% in symptomatic subjects and we found an event rate of 4.3% ($P=0.55$). For comparison with ACAS, we expected a stroke or MI rate of 2.7% in asymptomatic patients and the observed rate was 14.4% ($P<0.0001$).

There were a total of 17 stroke and MI events. Data regarding the combined rate of stroke or MI and baseline variables are presented in Table 2. Seventeen stroke or MI events occurred in 16 patients, and 13 of these events occurred in black patients ($P=0.065$). Ten events occurred in patients age 75 years or over ($P=0.11$).

Among black asymptomatic patients, the stroke rate was 6.6%, compared to 2.0% in whites ($P=0.37$). For black patients who were operated on at the lower volume hospital (hospital B), the risk of a stroke or MI was 20.5%. For patients operated on at the higher volume hospital and whites operated on at the lower volume hospital (n=111), the risk of stroke or MI was 7.2% (2-tailed $\chi^2$ probability value=0.03).

Eight of the 10 patients with perioperative MI had a prior history of ischemic heart disease. All 10 patients were operated on for asymptomatic carotid stenosis. Five of the 7 patients with perioperative stroke were asymptomatic. The median length of stay in patients with a perioperative MI was 8.5 days (range 6 to 14 days), and the median length of stay in patients with a perioperative stroke was 13 days (range 3 to 24 days). The mean length of stay for all patients was 3.7 days.

In addition to the stroke and MI events, there were 4 instances of neck hematoma, 4 cases of perioperative atrial fibrillation, 2 cases of reoperation for stroke, and 1 case of intubation attributable to stridor. One patient required a tracheostomy in the postoperative period. Cranial nerve palsies were not well documented in the records.

Discussion

This study compared the baseline characteristics and perioperative outcomes among CEA patients from two urban hospitals and the landmark CEA trials of the past two decades. We found that our cohort, in which slightly more than 50% of the patients were black, had higher rates of hypertension, diabetes, and smoking compared to the NASCET and ACAS studies. In addition, our cohort had higher rates of women and elderly patients.

The other major finding in our study is that urban patients had higher rates of perioperative MI, a combined rate of perioperative MI or stroke, and perioperative death compared to the previous clinical trials. Asymptomatic urban patients in particular had a high rate of stroke or MI (14.4% in-hospital rate). Although the study was not powered to examine individual risk factors as predictors of perioperative complications, we found a trend for blacks to have a higher rate of stroke or MI in the postoperative period (15.4% versus 5.6% in whites). In black patients who were operated on in the hospital with lower CEA volume, 1 in 5 patients (20.5%) experienced an in-hospital stroke or MI. Low CEA volume itself is likely not an explanation for the operative results, however, because both hospitals in our study would be classified as "moderate volume" facilities (21 to 100 operations per year) based on an earlier classification scheme.9

Previous studies have also found that black patients undergoing CEA have differing risk factor profiles compared to whites. A 10-year analysis of CEA results in a large urban

### TABLE 1. CEA Patient Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>NASCET</th>
<th>ACAS</th>
<th>Our Hospitals</th>
<th>Hommel Adjusted P Value vs NASCET</th>
<th>Hommel Adjusted P Value vs ACAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>66</td>
<td>67</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age &gt;75 years</td>
<td>15.5%</td>
<td>Not available (N/A)</td>
<td>42%</td>
<td>0.0004</td>
<td>N/A</td>
</tr>
<tr>
<td>HTN, %</td>
<td>61%</td>
<td>64%</td>
<td>88%</td>
<td>0.0004</td>
<td>0.0004</td>
</tr>
<tr>
<td>Diabetes, %</td>
<td>22%</td>
<td>23%</td>
<td>33%</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Smoker, %</td>
<td>31%</td>
<td>26%</td>
<td>44%</td>
<td>0.006</td>
<td>0.0004</td>
</tr>
<tr>
<td>Women, %</td>
<td>30%</td>
<td>34%</td>
<td>50%</td>
<td>0.0004</td>
<td>0.0004</td>
</tr>
<tr>
<td>Black, %</td>
<td>3.5%</td>
<td>3%</td>
<td>52%</td>
<td>0.0004</td>
<td>0.0004</td>
</tr>
</tbody>
</table>

### TABLE 2. In-Hospital Stroke or MI and Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Event Rate With</th>
<th>Event Rate Without</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt;75 years</td>
<td>15.9%</td>
<td>6.9%</td>
<td>0.11</td>
</tr>
<tr>
<td>Male sex</td>
<td>13.2%</td>
<td>8.1%</td>
<td>0.43</td>
</tr>
<tr>
<td>Diabetes</td>
<td>12.2%</td>
<td>9.9%</td>
<td>0.78</td>
</tr>
<tr>
<td>Black</td>
<td>15.4%</td>
<td>5.6%</td>
<td>0.005</td>
</tr>
<tr>
<td>Smoking</td>
<td>10.6%</td>
<td>10.7%</td>
<td>1.00</td>
</tr>
<tr>
<td>HTN</td>
<td>11.4%</td>
<td>5.6%</td>
<td>0.69</td>
</tr>
</tbody>
</table>
A higher complication rate for black CEA patients has been seen in administrative database studies. Matsen et al conducted a large review of 23,237 CEA operations over a 10-year period in Maryland. In this large cohort, 7.2% of the operations were done in blacks. They found that blacks had a higher perioperative stroke rate, comprising 16.1% of the patients with postoperative stroke versus 7.3% of the patients without strokes (P < 0.001).

The relatively high number of asymptomatic patients (69%) and elderly patients (42% age 75 years and over) in our cohort has been observed in other CEA studies. Wennberg and colleagues found a steadily increasing perioperative death rate according to increasing age group in their analysis of more than 100,000 CEA operations. Because the benefit of CEA in asymptomatic patients age 75 years or higher is uncertain, this indicates that surgeons in the “real world” are not adhering to the patient profiles enrolled in the multicenter studies.

Our study has limitations. First, the number of patients in this review was relatively small. Second, patients were not seen by neurologists on a routine basis postoperatively, and this may have underestimated the rate of documented strokes. Also, we were able to evaluate in-hospital stroke and MI only, whereas the multicenter studies included events up to 30 days as the perioperative period. This variance also could have lowered the observed rate of perioperative complications.

In summary, we found that in a CEA cohort with more than 50% black patients, there was a significantly higher risk factor burden compared to patients enrolled in NASCET and ACAS. Operative results were also worse, especially for blacks operated on in the lower volume hospital and for asymptomatic subjects as a whole. Our study raises questions about the value of CEA in blacks with asymptomatic carotid stenosis and emphasizes the necessity for careful patient selection.

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Disclosures
None.

References
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