Effects of Public and Professional Education on Reducing the Delay in Presentation and Referral of Stroke Patients

Mark J. Alberts, MD; April Perry, RN; Deborah V. Dawson, PhD; and Christina Bertels, PA-C

Background and Purpose: Several emerging stroke therapies require patients to be treated within several hours of symptom onset. Past studies have documented a significant delay between symptom onset and hospital presentation. As part of an experimental treatment study using tissue-type plasminogen activator, we began a multifaceted program of public and professional education to reduce the delay in presentation and referral of acute stroke patients.

Methods: The educational efforts focused on improving the recognition of stroke symptoms, the study enrollment criteria, and the need for rapid treatment of stroke patients. This program included 1) interviews on television and radio, 2) newspaper articles, 3) lectures to local and regional primary care and emergency department physicians, 4) mailings to several thousand local physicians, 5) having neurologists on-call for referrals 24 hrs/day, and 6) use of the Duke Life-Flight helicopter.

Results: Since starting our program, 139 of 159 (86%) patients with cerebral infarction presented primarily to or were referred to our facility within 24 hours of symptom onset, compared with 70 of 187 (37%) before our educational efforts (p<0.00001). No significant change was seen in patients with intracerebral hemorrhage (23 of 30 [77%] within 24 hours after program, compared with 25 of 40 [63%] before educational efforts; p=0.30).

Conclusions: These findings suggest that educational efforts aimed at the public and health professionals may increase recognition of stroke symptoms and reduce the delay in presentation and referral of stroke patients. (Stroke 1992;23:352-356)

KEY WORDS • cerebrovascular disorders • stroke management • epidemiology

Studies in the United States have documented an excessive delay in the time of presentation for patients with an acute stroke.1,2 In the past, this delay was of little concern because some physicians and the public perceived that little could be done to treat acute stroke patients. However, ongoing studies of several new therapies for stroke, such as calcium channel blockers3 and tissue plasminogen activator (t-PA),4 suggest the need for early intervention if brain reperfusion and neuronal protection is to be successful. A recent study showed that the calcium channel blocker nimodipine had efficacy only if administered to stroke patients within 12 hours of symptom onset.5 It seems clear that the testing of new stroke therapies will require large numbers of patients being seen within hours of stroke onset.6

In an attempt to reduce the excessive delay in presentation after stroke, we conducted a concentrated program of public and professional education. Our hypothesis was that through improved public and professional education, we could significantly shorten the time period between the onset of stroke symptoms and presentation at our facility.

Subjects and Methods

Details of the Duke University/Durham, N.C., Veterans Administration Hospital computerized stroke registry have been published previously.1 For the present study, time of presentation data from November 1985 to January 1987 (preeducational period) were compared with data from December 1988 to December 1989 (posteducational period). The more recent dates were chosen because they coincided with the beginning of a study at Duke Hospital investigating the use of t-PA in acute stroke patients. The recruitment of patients for the t-PA study was a primary factor in initiating this program.

The preeducational period had data on four types of cerebrovascular events: cerebral infarction, stroke-in-evolution, intracerebral hemorrhage (ICH), and subarachnoid hemorrhage (SAH). Data were obtained from Duke Hospital and the Durham Veterans Administration Hospital. However, because the t-PA study was conducted solely at Duke and educational efforts were aimed at the Duke referral network, only data from...
Duke Hospital admissions were compared for each period. During the posteducational period, the stroke-in-evolution category was omitted because all patients were classified into a specific stroke category. The vast majority of patients classified as stroke-in-evolution had cerebral infarction. For comparisons between the two study periods, analyses were performed both including and excluding the stroke-in-evolution group from the cerebral infarction group.

The stroke registry for the posteducational period classified patients with cerebral infarction into specific subtypes (i.e., embolic, thrombotic, lacunar, or unknown) based on the following criteria. Classification as embolic stroke required presence of three or more of the following criteria: sudden onset, cardiac source for embolus, angiographic evidence for cerebral embolus, symptomatology for shower of emboli, and known carotid disease; for thrombotic stroke, three or more of the following criteria: history of hypertension, sporadic or gradual onset of symptoms, known carotid disease, history of transient ischemic attacks (TIAs), fluctuating deficit; for lacunar stroke, one or more of the following criteria: clinical evidence of small-vessel disease, lacunar syndrome, small-vessel infarct by computed tomographic (CT) or magnetic resonance imaging (MRI) scan; and for unknown stroke cause, may fit some criteria for above categories but not easily distinguishable, even given the patient's clinical course. The diagnosis of ICH required confirmation by brain CT or MRI.

Because the preeducational registry did not have data on cerebral infarction subtypes, specific comparisons between categories could not be made; however, descriptive data for these subtypes from the posteducational registry were analyzed. Analysis of SAH patients was omitted because there was an insufficient number of patients for a meaningful comparison. Patients with in-hospital strokes or TIAs were excluded from this analysis.

The preeducational registry had time data divided into large blocks (from 24 hours to days), whereas the posteducational registry had more specific hourly data. Details of the assignment of presentation times have been published previously.1 For a clear comparison, the descriptive data for these subtypes from the posteducational registry were analyzed. Analysis of SAH patients was omitted because there was an insufficient number of patients for a meaningful comparison. Patients with in-hospital strokes or TIAs were excluded from this analysis.

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For the posteducational period, 254 patients were registered. Time data were not available (chart missing, no times recorded, etc.) for 32 patients, and 27 patients had TIAs. Five patients with SAH were excluded, and one patient with an in-hospital stroke was excluded. The remaining 189 patients were used for this analysis.

The educational programs began in September 1988 with the opening of the Duke Stroke Acute Care Unit. These efforts were increased significantly in December 1988 to coincide with the beginning of the t-PA study. Public education was undertaken using a multimedia approach. Several local and regional television and radio stations presented features dealing with the use of t-PA for acute stroke and the need for early (within 8 hours) treatment. These stories featured interviews with patients and physicians and highlighted the symptoms of stroke and transient ischemic attacks. Regional radio stations conducted interviews and call-in talk shows that emphasized the need for rapid recognition and evaluation of stroke patients. Articles appeared in local newspapers describing stroke symptoms, the t-PA study, and the time limitations for treatment.

Education of physicians and other health providers was performed using several approaches. A team of neurologists with special training and interest in cerebrovascular disease spoke at Duke Hospital, local and regional hospitals, emergency rooms, and other medical group meetings. The study was explained to local ambulance personnel and paramedics. Letters accompanied by printed cards describing the protocol and its inclusion/exclusion criteria were mailed to Duke physicians and more than 3,000 local and regional physicians who refer patients to Duke Hospital. These educational efforts were repeated on a rotating basis to keep referring physicians up to date on the progress of the t-PA study and other ongoing protocols.

A system was developed to enable outside physicians to speak directly with a neurologist who was involved in the study. A study neurologist was on call 24 hours a day, 7 days a week to expedite referrals. A toll-free number was publicized through lectures and mailings. Rapid referrals were facilitated by equipping the on-call physician with a cellular phone so he could be reached at all times. The need for instant communications was important in cases where patients were transported by the Life-Flight helicopter. All referring physicians received feedback on the patients' evaluation, inclusion into the study, and outcome. Patients were sent back to their referring physicians and hospitals if desired.

Ordinal grading of presentation times used in the initial study was applied as the finest level of detail available in both initial and follow-up data. The information provided by the ordinal nature of the data was incorporated into these analyses using ridit procedures7 to compare the distribution of presentation-time intervals for the initial and follow-up periods. Comparisons of 24-hour status for pairs of groups was made using two-tailed Fisher's exact tests. Because presentation times associated with cerebral infarction and ICH were found to differ significantly in the initial study, these comparisons were made separately for these subgroups. The nonparametric Wilcoxon rank sum test was used in conjunction with individual presentation times to compare the distribution of presentation time for cerebral infarction and ICH in the follow-up study.

As individual presentation times were available for the follow-up study, descriptors were calculated for each stroke subtype. Possible heterogeneity among the subtypes of cerebral infarction was evaluated using the nonparametric Kruskal-Wallis procedure because of the marked nonnormality of the presentation times.

Results

There were 290 patients in the preeducational period with a diagnosis of cerebral infarction, stroke-in-evolution, or ICH, compared with 189 in the posteducational period (Table 1). In the initial study there were 187 patients with cerebral infarction, compared with 159 in
the follow-up study. The differences in patient accrual may reflect different ascertainment periods (15 months versus 13 months) for the two studies and a decline in stroke incidence.

The presentation times for cerebral infarction showed a marked shift toward earlier presentation, with a twofold increase in the number of patients presenting within 24 hours (Table 2). This appeared to result from a shift of patients from the 24–48 hour and 3–7 day delay groups into the ≤24 group (Table 2). This finding was statistically significant whether stroke-in-evolution was combined with or omitted from the cerebral infarction group in the initial study (p=0.0001 in both cases).

When analyzed with respect to a 24-hour presentation delay, the follow-up study showed a highly significant improvement in presentation times for cerebral infarction patients. Following educational efforts, >85% of cerebral infarction patients presented within 24 hours of symptom onset, compared with <40% prior to our efforts (p<0.00001; Table 3). This improvement was independent of whether stroke-in-evolution was classified with cerebral infarction or omitted from the analysis.

Stroke subtype analysis (Table 4) from the posteducational period indicates that patients with strokes of unknown etiology present most rapidly (mean time 12.46 hours), whereas thrombotic strokes were the most delayed (mean time 31.24 hours). When the distribution of presentation times for the four cerebral infarction subtypes were analyzed using the Kruskal-Wallis test, the results were somewhat suggestive (p=0.0794) of a subtype difference.

Patients with ICH had a similar time profile in both studies. Analysis using graded time intervals (Table 5) failed to demonstrate a significant improvement in time of presentation. In the follow-up study, 23 of 30 (77%) patients presented within 24 hours, compared with 25 of 40 (63%) in the initial study (p=0.30 by Fisher’s exact test). However, in both studies the vast majority of ICH patients (63–77%) presented within 24 hours of symptom onset.

We also compared the distribution of presentation times for cerebral infarction and ICH in the follow-up study. No significant differences were found between the distributions of presentation times between the two groups, whether individual presentation times (p=0.726 by Kruskal-Wallis test), or 24-hour status (p=0.274 by Fisher’s exact test) were considered. Because the follow-up study did not show a significant change in the ICH presentation times, this suggests that the cerebral infarction presentation pattern has become shorter, with a profile similar to that of ICH.

**Discussion**

We undertook this analysis to determine if an intensive, focused program of public and professional education reduced the time delay in presentation and referral of stroke patients to our facility. We found that after educational efforts, >85% of patients with cerebral infarction presented to our facility within 24 hours of symptom onset, compared with <40% before our program.

Among patients with cerebral infarction, there was a suggestion that presentation times differed with stroke subtype. The rapidity with which embolic stroke patients presented (mean time 15.21 hours) may be explained by the sudden onset of maximum symptoms and altered mentation that accompany many embolic strokes. Another factor may be the early onset of seizures that occurs in up to 10–20% of embolic strokes. The relative prolongation of presentation times for thrombotic strokes (31.24 hours) may relate to the gradual or fluctuating course that often occurs with these syndromes.

The lack of a significant change in the presentation times for ICH patients is not unexpected. Because ICH often presents with the relatively sudden onset of focal deficits, often accompanied by altered mental status, we would anticipate that patients (and their families) would tend to seek more immediate medical care. This urgency is probably maximized by the severity of symptoms and would not be changed significantly by educational efforts. However, the consistency of these responses between the two registry periods serves as an internal control and indicates that the other changes were not due to flaws in ascertainment or data collection.

The presentation times recorded in this study reflect the time a patient was seen at our facility. Some patients would have been seen in their local emergency room or

**Table 1. Descriptive Data for Initial and Follow-up Studies**

<table>
<thead>
<tr>
<th>Stroke type</th>
<th>Initial study</th>
<th>Follow-up study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebral infarction</td>
<td>187</td>
<td>159</td>
</tr>
<tr>
<td>Stroke-in-evolution</td>
<td>63</td>
<td>0</td>
</tr>
<tr>
<td>Intracerebral hemorrhage</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>290</td>
<td>189</td>
</tr>
</tbody>
</table>

**Table 2. Time of Poststroke Presentation for Patients With Cerebral Infarcts**

<table>
<thead>
<tr>
<th>Study</th>
<th>≤24 hr</th>
<th>24–48 hr</th>
<th>3–7 days</th>
<th>8–14 days</th>
<th>&gt;14 days</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial*</td>
<td>98 (70)</td>
<td>66 (48)</td>
<td>71 (56)</td>
<td>5 (5)</td>
<td>10 (8)</td>
<td>250 (187)</td>
</tr>
<tr>
<td>Follow-up*</td>
<td>136</td>
<td>6</td>
<td>14</td>
<td>3</td>
<td>0</td>
<td>159</td>
</tr>
</tbody>
</table>

Numbers in parentheses are for cerebral infarction patients excluding those with stroke-in-evolution.

*Significance probability from ridit analysis, p=0.0001. Significance was the same whether stroke-in-evolution was included or excluded from cerebral infarction data.

**Table 3. Presentation Within 24 Hours for Patients With Cerebral Infarction**

<table>
<thead>
<tr>
<th>Study</th>
<th>≤24 hours</th>
<th>&gt;24 hours</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial*</td>
<td>98 (39.2)</td>
<td>152 (60.8)</td>
<td>250</td>
</tr>
<tr>
<td>Follow-up†</td>
<td>136 (85.5)</td>
<td>23 (14.5)</td>
<td>159</td>
</tr>
</tbody>
</table>

Values in parentheses are percent.

*Includes stroke-in-evolution from initial study, results similar if stroke-in-evolution excluded.

†Significant difference by Fisher’s exact test, p<0.00001
physician's office before referral. Because detailed data about where patients presented initially was not collected, it is not possible for us to determine exactly those areas of delay that were most affected. As noted below, stroke presentation delays are multifactorial, but physician delay has been shown to be a major factor. In some cases, our efforts probably hastened patient referrals from outlying hospitals. However, the fact that there was no net increase in the total number of stroke patients seen during the study period suggests that we were accelerating the referral of patients who otherwise would have been seen much later. Since many drug trials are being conducted predominantly at specialized medical centers, the rapid presentation or referral of stroke patients, whether due to patient or physician initiative, is a desirable result.

Several other studies have examined time of presentation profiles for stroke. The Stroke Data Bank\(^9\) reported that half of stroke patients were not admitted within 12 hours of onset. However, the study excluded patients who presented >7 days after stroke onset, and it provided no details of whether stroke onset was equivalent to first symptom onset or how admission time was determined. The Stroke Data Bank studied patients primarily from large cities and, therefore, may not reflect admission patterns in small urban or rural areas. By contrast, a Scandinavian study\(^11\) found an average time of presentation of only 4.8 hours in a population-based study. The reasons for such early stroke presentation times in Scandinavia are unclear.

A study from Melbourne, Australia,\(^12\) examined several facets of delayed presentation. They found that 68% of patients presented within 12 hours and 85% within 24 hours of symptom onset. The two factors that contributed most to a delayed presentation were patient indecision (3 hours) and physician delay (10 hours). This emphasizes the need for continued physician education about the importance of rapid evaluation and treatment of stroke patients.

The involvement and cooperation of local and regional emergency department physicians were critical for the rapid recognition of stroke patients. Because Duke's catchment area includes most of North Carolina and parts of Virginia and South Carolina, the inclusion of these regional hospitals was important for the rapid ascertainment of appropriate study patients. A program involving local community hospitals has been successful in the identification and enrollment of many patients in the Cincinnati area within 90 minutes of stroke onset (T. Brott, personal communication).

Although our educational program was multifaceted, there were several areas that appeared to have a more significant impact. For example, we found that after each publicly oriented effort (e.g., radio, television, newspaper) several dozen telephone calls would be received by the stroke center or one of the study physicians. These calls usually dealt with a family member who recently had a stroke, but on several occasions calls concerned patients currently hospitalized elsewhere with a stroke. The mailing of study cards to physicians and lectures at individual hospitals aided in educating physicians and increasing rapid referrals.

Several limitations of this study should be mentioned. It could be argued that the improvements in presentation times were due solely to a change in the type of stroke patients seen, with a shift toward embolic strokes resulting from the study criteria. However, many patients in the follow-up study were self-referred, thereby excluding any bias of physician screening. Other patients were referred based on clinical data relayed by telephone, which does not allow for careful clinical screening. Even if all embolic stroke patients were assumed to present within 24 hours and were excluded from the analysis, the overall profile would still show a dramatic improvement in presentation times. Also, it is unlikely that a significant change in our referral pattern accounted for the change in presentation times because we specifically targeted the hospitals that had previously referred the most patients to Duke.

Some of the specific efforts we found useful may not be as successful in all areas depending upon the referral patterns, admitting privileges, and patient/hospital densities. Educational efforts may have to be individualized according to the specific environment and protocol parameters of a study.

We were concerned that referring physicians not be isolated from our study or feel that they would not see their patients again. However, in most cases local physicians were quite willing to refer patients, especially because we were offering a potential treatment that was not widely available. We kept the referring physicians well informed about the patient's status and our willingness to transfer the patient back whenever possible.

In summary, we found that a program of public and professional education was successful in raising awareness about stroke and significantly reducing the time delay seen in the presentation and referral of stroke patients to our facility. These efforts will be important for the testing of acute stroke therapies and for the overall improvement in the care received by stroke patients.

### Table 4. Time Data for Stroke Subtypes in Follow-up Study

<table>
<thead>
<tr>
<th>Stroke type</th>
<th>n</th>
<th>Median</th>
<th>Mean time (hr)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebral infarction</td>
<td>159</td>
<td>5.47</td>
<td>16.96</td>
<td>35.68</td>
</tr>
<tr>
<td>Infarction subtypes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embolic</td>
<td>52</td>
<td>4.48</td>
<td>15.21</td>
<td>48.73</td>
</tr>
<tr>
<td>Lacunar</td>
<td>29</td>
<td>7.60</td>
<td>15.36</td>
<td>19.26</td>
</tr>
<tr>
<td>Thrombotic</td>
<td>26</td>
<td>6.92</td>
<td>31.24</td>
<td>44.66</td>
</tr>
<tr>
<td>Unknown</td>
<td>52</td>
<td>5.27</td>
<td>12.46</td>
<td>16.09</td>
</tr>
<tr>
<td>Intracerebral hemorrhage</td>
<td>30</td>
<td>5.77</td>
<td>17.62</td>
<td>27.16</td>
</tr>
<tr>
<td>Total</td>
<td>189</td>
<td>5.47</td>
<td>17.06</td>
<td>34.41</td>
</tr>
</tbody>
</table>

### Table 5. Time of Poststroke Presentation for Patients With Intracerebral Hemorrhage

<table>
<thead>
<tr>
<th>Study</th>
<th>≤24 hr</th>
<th>24–48 hr</th>
<th>3–7 days</th>
<th>8–14 days</th>
<th>&gt;14 days</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial*</td>
<td>25</td>
<td>5</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Follow-up*</td>
<td>23</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>30</td>
</tr>
</tbody>
</table>

\(p=0.1344\) by ridit analysis.
Acknowledgments
The authors wish to thank Dr. James Davis and Dr. Larry Goldstein for their efforts in educating physicians as part of the t-PA study, and Ms. Janet Solomon for technical assistance. We also wish to thank Burroughs Wellcome Co. for its support in providing some of the funds used for these educational efforts.

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