Predictors of Emotional Distress After Stroke

Shirley A. Thomas, PhD; Nadina B. Lincoln, PhD

Background and Purpose—The aim of this prospective longitudinal study was to identify factors relating to emotional distress in the first 6 months after stroke in a sample including patients with aphasia.

Methods—One hundred patients who were in hospital at 1 month after stroke were recruited and assessed on measures of communication impairment (Sheffield Screening Test), personal activities of daily living (Barthel Index), and emotional distress (Visual Analogue Self-Esteem Scale). Demographic and stroke characteristics were recorded. Patients (n=92) were reassessed on the same measures 6 months after stroke, in addition to assessing extended activities of daily living (Nottingham Extended Activities of Daily Living Scale).

Results—Patients were aged 44 to 86 years (51 men), and 21 were classified as having aphasia. Multiple linear regression showed that expressive communication impairment and dependence in personal activities of daily living were significant predictors of emotional distress at 1 month after stroke ($R^2=24\%$). Expressive communication impairment, emotional distress at 1 month after stroke, and having a more severe stroke were significant predictors of emotional distress at 6 months after stroke ($R^2=55\%$). Distress levels were similar at 1 month and 6 months after stroke. Demographic characteristics and side of lesion were unrelated to distress.

Conclusions—Expressive communication impairment and level of disability in personal activities of daily living were related to distress. Distress was persistent in the first 6 months after stroke. Appropriate treatment strategies need to be developed and evaluated for patients who have communication impairments. (Stroke. 2008;39:000-000.)

Key Words: mood disorder ■ depression ■ stroke ■ aphasia ■ rehabilitation

Emotional distress is common after stroke. The prevalence of depression after stroke has been reported to be between 25% to 79%, with a pooled estimate of 33%. Depression after stroke is associated with poorer rehabilitation outcome, lower quality of life, suicide, and mortality. Anxiety disorders also occur after stroke, although this has received less attention than depression. Hospital-based studies have reported a prevalence of between 25% and 28%. There is high comorbidity in anxiety and depression after stroke.

It is important to identify risk factors for emotional distress after stroke to improve the detection of distress and provide appropriate interventions for distress to improve outcomes. Several studies have been conducted to ascertain which factors are related to depression after stroke, yet findings are often inconsistent and the synthesis of results is precluded by methodological heterogeneity. Studies vary in the location where they are conducted, the time after stroke that patients are assessed, participant inclusion and exclusion criteria, and mood assessments.

Early studies proposed that patients with a left hemisphere lesion were more likely to be depressed, but a subsequent review and meta-analysis found no consistent evidence that a particular lesion characteristic was associated with depression. Therefore, research has assessed whether personal characteristics and consequences of stroke are relevant. Other factors found to be associated with depression include older age, male gender, female gender, personal history of depression, living alone, level of physical disability, and cognitive impairment. A systematic review of predictors of depression after stroke concluded that physical disability and cognitive impairment were consistently associated with depression, however the authors identified that conclusions were limited by the variation in methodology and the quality of studies.

Aphasia is common after stroke and results in a sudden inability to function in many activities of daily life, such as leisure, occupational, and social activities, and may be an important risk factor for depression. However, most studies of depression after stroke exclude people with aphasia. In a systematic review of studies that diagnosed depression after stroke, 71% of studies reported some exclusion of patients with aphasia, and only 3 of the 20 studies reviewed by Hackett and Anderson included aphasia as a potential risk factor for depression. Patients with aphasia are usually excluded because they are unable to complete self-report measures of mood or psychiatric interviews. Studies that include people with aphasia do not always explain how mood

Received July 4, 2007; final revision received August 22, 2007; accepted September 7, 2007.

From the Division of Rehabilitation & Ageing (S.A.T.) and the Institute of Work, Health, & Organizations (N.B.L.), University of Nottingham, UK. Correspondence to Shirley Thomas, Division of Rehabilitation & Ageing, University of Nottingham, B Floor Medical School, Queens Medical Centre, Nottingham NG7 2UH, UK. E-mail shirley.thomas@nottingham.ac.uk

© 2008 American Heart Association, Inc.

Stroke is available at http://stroke.ahajournals.org

DOI: 10.1161/STROKEAHA.107.498279
assessments were completed and whether adaptations were required. Visual analogue scales such as the Visual Analog Mood Scales (VAMS)\textsuperscript{22} and the Visual Analogue Self-Esteem Scale (VASES)\textsuperscript{23} and observer rated measures such as the Stroke Aphasic Depression Questionnaire\textsuperscript{24,25} have been developed to assess mood in people with aphasia and allow people with communication problems to be included in research.

Kauhanen et al\textsuperscript{26} found that that two-thirds of patients with aphasia met DSM-III-R criteria for depression in the first year after stroke, and this was significantly greater than those without aphasia. The severity of depression in those with aphasia increased between 3 months and 12 months after stroke. Depression was diagnosed using a psychiatric interview, supplemented by information from family and friends. There is some evidence that aphasia\textsuperscript{27} and the severity of communication impairment\textsuperscript{28} are risk factors for depression after stroke, therefore further systematic studies are required that include this group of patients.

The aim of the present prospective study was to identify factors associated with emotional distress at 1 month and 6 months after stroke, in a sample that included patients with aphasia.

Subjects and Methods

Ethical approval was granted by Nottingham Research Ethics Committee. Patients were recruited from stroke wards at Nottinghamshire hospitals. All patients admitted to the stroke wards were considered for the study. Patients admitted to the stroke wards had rehabilitation potential, and those who remained in hospital at 1 month after stroke would have persisting physical or cognitive symptoms, such as arm or leg weakness. Patients were excluded if they were blind or deaf, had dementia documented in their medical notes, were unable to understand and speak English before stroke, or were too unwell to assess. Patients were recruited and assessed in hospital at approximately 1 month after stroke and were reassessed 6 months post-stroke. Consent was obtained from patients, and for those patients who had severe aphasia and were unable to consent a relative or carer was asked to give assent.

The Visual Analogue Self-Esteem Scale (VASES)\textsuperscript{23} was used as a measure of emotional distress as it could be completed with all patients. The VASES was chosen as it has higher internal consistency than the VAMS, it correlates with the Hospital Anxiety and Depression Scale total and subscale scores in healthy older adults and stroke patients\textsuperscript{29} and the Geriatric Depression Scale and Adult Manifest Anxiety Scale.\textsuperscript{30} It has been recommended to assess mood in people with communication problems\textsuperscript{29} and identifying patients at risk of emotional dysfunction.\textsuperscript{30} Performance on the VASES was found to be unrelated to visual acuity, cognitive functioning, or demographic variables in stroke patients.\textsuperscript{30} The VASES is a 10 item scale, each item consisting of 2 pictures presented horizontally with a verbal label (eg, “optimistic” and “not optimistic”) and a 5 point response scale. The internal consistency of the VASES is improved when the depression item (the practice item) is included in the total score,\textsuperscript{29} and this was included in the present study. Each item is scored from 1 to 5, the scores range between 11 and 55 (including the depression item), with a higher score indicating a lower level of distress.

Stroke characteristics were recorded using the Oxford stroke classification,\textsuperscript{31} side of lesion from the CT report, and side of weakness. The Sheffield Screening Test for Acquired Language Disorders\textsuperscript{32} was completed with the patient as a measure of receptive and expressive language impairment. The Sheffield Screening Test is a brief bedside measure that can be completed by someone who is not a speech and language therapist and has been recommended to screen for language difficulties after stroke.\textsuperscript{31} A lower score indicates greater language impairment. Personal activities of daily living (ADL) were assessed using the Barthel Index,\textsuperscript{33} and at 6 months the Nottingham Extended Activities of Daily Living Scale (NEADL)\textsuperscript{35} was also completed. Demographic information was recorded, whether the patient had had a previous stroke and whether a prestroke history of depression was documented in hospital medical notes.

Descriptive statistics (mean and standard deviation) were used to summarize data. The VASES total score did not significantly differ from the normal distribution using the Kolmogorov-Smirnov test (z=0.08, P=0.08), therefore parametric statistics were used. Independent samples t tests were used to compare means for continuous variables with 2 groups, 1-way ANOVAs for continuous variables with more than 2 groups and \(\chi^2\) test for categorical variables. Pearson correlation was used to assess univariate associations with distress. Multiple linear regression was used to evaluate cross-sectional and longitudinal models for predicting distress.

Results

Characteristics of Patients

During the time frame of the study 270 patients were identified for the study. Of the 270 patients, 113 (42%) were not invited to take part as they did not meet the inclusion criteria (32 discharged before 1 month, 46 too ill, 4 blind, 4 deaf, 14 had dementia, 3 were unable to speak English before stroke, and 10 died before they were invited to participate) and 157 (58%) met the inclusion criteria and were invited to take part. Fifty-seven (36%) of the 157 patients did not consent to take part or assent was not obtained, therefore 100 patients were included in the study. Of the 100 patients, 51 were men and the mean age was 70.15 years (SD=9.38). Patients who did not consent to take part were significantly older (84.11 years compared with 70.15 years, P<0.001). Assessments took place at a mean of 30.87 days poststroke (SD=8.29). Most patients were married (n=57) or widowed (n=35), the remainder were divorced (n=3) or single (n=5). Eighty-four patients were retired at the time of stroke. Fourteen patients had had a previous stroke. A history of depression was documented for 4 patients.

Stroke characteristics of the sample are shown in Table 1. The majority of patients had a PACS stroke, whereas POCS was least common. Right hemisphere lesions were slightly more common than left hemisphere lesions.

Table 1. Stroke Characteristics

<table>
<thead>
<tr>
<th>Stroke Characteristics</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>TACS</td>
<td>17</td>
</tr>
<tr>
<td>PACS</td>
<td>45</td>
</tr>
<tr>
<td>POCS</td>
<td>11</td>
</tr>
<tr>
<td>LACS</td>
<td>22</td>
</tr>
<tr>
<td>Missing</td>
<td>5</td>
</tr>
<tr>
<td>Side of lesion</td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>42</td>
</tr>
<tr>
<td>Right</td>
<td>51</td>
</tr>
<tr>
<td>Missing</td>
<td>7</td>
</tr>
</tbody>
</table>

Description of Baseline Assessment Scores

Descriptive statistics for the baseline assessments are shown in Table 2. There was a wide range of scores on the Sheffield
Table 2. Baseline Assessment Scores

<table>
<thead>
<tr>
<th>Measure (n=100)</th>
<th>Possible Scores</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheffield Screening Test</td>
<td>Total</td>
<td>0–20</td>
<td>4–20</td>
<td>17.11</td>
</tr>
<tr>
<td></td>
<td>Receptive subscale</td>
<td>0–9</td>
<td>2–9</td>
<td>7.55</td>
</tr>
<tr>
<td></td>
<td>Expressive subscale</td>
<td>0–11</td>
<td>0–11</td>
<td>9.56</td>
</tr>
<tr>
<td></td>
<td>Barthel Index</td>
<td>0–20</td>
<td>2–20</td>
<td>11.62</td>
</tr>
<tr>
<td></td>
<td>VASES</td>
<td>11–55</td>
<td>21–55</td>
<td>42.77</td>
</tr>
</tbody>
</table>

SD indicates standard deviation.

Screening Test, and 21 patients were classified as having aphasia. Patients had moderate levels of disability on the Barthel Index. The mean score on the VASES was 42.77, with wide variation in scores.

 Associates of Emotional Distress
Three sets of analysis were conducted. Two cross-sectional analyses were conducted to identify factors associated with distress at 1 month poststroke and at 6 months poststroke. The third analysis identified which factors measured at 1 month poststroke were associated with distress at 6 months poststroke. The analyses were conducted to identify factors associated with baseline VASES scores.

Associates of Distress at 1 Month After Stroke
Distress scores at 1 month were not significantly related to gender (P=0.23), marital status (P=0.07), employment status (P=0.62), previous depression (P=0.78), previous stroke (P=0.96), side of lesion (P=0.32), or stroke classification (P=0.16). Age was not significantly correlated with distress (r=0.12, P=0.23). There was a significant correlation between Barthel Index scores and distress (r=0.37, P<0.001), with lower independence in personal ADL associated with greater distress. Distress was significantly correlated with greater levels of receptive language impairment (r=0.33, P=0.001), expressive language impairment (r=0.37, P<0.001), and the Sheffield Screening Test total score (r=0.44, P<0.001).

The regression model is summarized in Table 3. Expressive language and Barthel Index scores were significant predictors of VASES scores at 1 month poststroke, whereas receptive language scores were not significant. The overall model was significant (F2,97=14.83, P<0.001) with a R² of 0.24, which means it accounted for 24% of the variance in VASES scores.

Table 3. Regression Model for Baseline VASES Scores

<table>
<thead>
<tr>
<th>Measure</th>
<th>B</th>
<th>95% CI</th>
<th>Standardized B</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheffield expressive language</td>
<td>0.88</td>
<td>0.42–1.49</td>
<td>0.34</td>
<td>3.52</td>
<td>&lt;0.001†</td>
</tr>
<tr>
<td>Barthel Index</td>
<td>0.38</td>
<td>0.15–0.74</td>
<td>0.26</td>
<td>2.84</td>
<td>0.006†</td>
</tr>
<tr>
<td>Sheffield receptive language</td>
<td>0.13</td>
<td>1.28</td>
<td>0.204</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CI indicates confidence interval.

†P<0.01, ‡P<0.001.

Associates of Distress at 6 Months After Stroke
Ninety-two of the original sample were reassessed at 6 months after stroke; 4 declined, 2 were too ill, and 2 had died. Nineteen of the 92 patients had aphasia at 6 months. At 6 months 28 patients (30%) were living alone, 55 (60%) with a spouse, 3 (3%) with a son or daughter, and 6 (7%) in a nursing or residential home. VASES scores at 1 month and 6 months after stroke were compared using a paired samples t test and were not significantly different (P=0.063).

At 6 months after stroke, distress was unrelated to gender (P=0.21) or marital status (P=0.63). Living arrangements were significantly related to distress (F3,88=2.79, P=0.045). Tukey post hoc test showed that those living in a nursing or residential home were significantly more distressed than those living alone (P=0.05). Only 6 patients were living in a nursing or residential home, and these patients had significantly lower scores on the Barthel Index than those living alone, with a son or daughter or with a spouse (F3,88=45.97, P<0.001). Age was not significantly correlated with distress at 6 months (r=0.05, P=0.67). Distress was significantly correlated with receptive language impairment (r=0.34, P=0.001), expressive language impairment (r=0.49, P<0.001), and the Sheffield Screening Test total score (r=0.51, P<0.001). Distress was also significantly correlated with the Barthel Index (r=0.36, P=0.001) and the NEADL (r=0.38, P=0.001). The Barthel Index had a ceiling effect at 6 months, with 55 (60%) patients scoring the maximum of 20. Therefore at 6 months the scores on the Barthel Index were dichotomised into dependent (0 to 16) and independent (17 to 20). VASES scores were significantly higher for those classified as independent compared with those who were dependent (t90=−2.86, P=0.005).

Expressive and receptive language scores on the Sheffield Screening Test, NEADL scores, and dependence on the Barthel Index were entered into the regression model. Living arrangements were not entered as only 6 patients were living in a nursing or residential home, and these patients were significantly more dependent on the Barthel Index. The regression model is summarized in Table 4. Expressive language scores and NEADL scores at 6 months after stroke were significant predictors of VASES scores at 6 months after stroke, whereas receptive language scores and dependence on the Barthel index at 6 months were not significant. The overall model was significant (F2,89=20.18, P<0.001) with a R² of 0.31 which means the model of factors assessed at 6 months after stroke accounted for 31% of the variance in VASES scores at 6 months. The Barthel Index was not significant in the regression model as scores on the NEADL mediated the relationship between the Barthel Index and the VASES.
Factors at 1 Month Associated With Distress at 6 Months
The third analysis examined the association between factors measured at baseline and distress at 6 months after stroke. Living arrangements at the time of stroke ($P = 0.60$), having a previous stroke ($P = 0.86$), and side of lesion ($P = 0.89$) were not significantly related to distress at 6 months. There was a significant relationship between stroke classification and distress at 6 months ($P = 0.006$). Tukey post hoc test showed that patients who had a TACS stroke were more distressed on the VASES than those who had a FACS ($P = 0.004$), POCS ($P = 0.045$), or LACS ($P = 0.014$). Baseline scores on the Barthel Index ($r = 0.46$, $P < 0.001$), receptive language scores ($r = 0.29$, $P = 0.005$), expressive language scores ($r = 0.35$, $P = 0.001$), and the Sheffield Screening Test total score ($r = 0.42$, $P < 0.001$) were significantly correlated with distress at 6 months. Lower levels of distress on the VASES at 1 month poststroke were significantly correlated with lower levels of distress at 6 months ($r = 0.62$, $P < 0.001$).

Baseline expressive and receptive language scores on the Sheffield Screening Test, Barthel Index scores, and having a TACS stroke were entered into the regression analysis. Baseline scores on the VASES were entered in the first step of the analysis as they were significantly correlated with VASES scores at 6 months. This approach was used in a previous study which used multiple linear regression for predicting depression after stroke. The results are summarized in Table 5. VASES scores and expressive language scores at baseline and having a TACS stroke were significant predictors of distress at 6 months. Receptive language impairment and Barthel Index scores at baseline were not significant in the model. The regression model was significant ($F = 5.80$, $P < 0.001$) and the $R^2$ was 0.55, and so the model accounted for 55% of the variance in VASES scores at 6 months.

Discussion
Previous studies of emotional distress after stroke have been limited by the exclusion of patients with aphasia and for not assessing distress over time. In the present study expressive communication impairment and dependence in personal ADL were predictors of levels of distress at 1 month poststroke. At 6 months after stroke expressive communication impairment and dependence in extended activities were predictors of distress. Receptive communication may not have been significant as those with poorer receptive abilities may have less understanding of the impact of stroke, with receptive language impairments having a protective effect. This is supported by evidence that depression is more severe in patients with nonfluent aphasia and the suggestion that patients with nonfluent aphasia had greater awareness of their impairments.

Severity of aphasia has been found to be related to the amount of time spent in social activity, and patients with expressive communication problems may have been less able to interact with others and participate in activities, leading to distress. Communication impairment remained a significant predictor of distress at 6 months after stroke, and this concords with research that found depression to be common in patients with acute and chronic aphasia.

Activity level assessed by personal ADL at 1 month and extended ADL at 6 months were predictive of distress. Those living in a nursing or residential home were more distressed, although this group also had greater impairment in personal ADL which may account for this finding. Previous studies have also found dependence on the Barthel Index to be related to mood within the first month of stroke. Most studies only assess personal ADL, although performance on the Functional Independence Measure and Frenchay Activities Index have been found to correlate with mood 6 months after stroke. At 6 months after stroke the relationship between the Barthel Index and distress was mediated by the NEADL which is comparable to Wade et al. These findings support the activity restriction framework, whereby major disruption in normal activities can result in poorer mental health outcomes.

Table 4. Regression Model for VASES Scores at Six Months

<table>
<thead>
<tr>
<th>(n=92)</th>
<th>B</th>
<th>95% CI</th>
<th>Standardized B</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheffield expressive language</td>
<td>1.38</td>
<td>0.80–1.97</td>
<td>0.42</td>
<td>4.69</td>
<td>&lt;0.001†</td>
</tr>
<tr>
<td>NEADL total</td>
<td>0.16</td>
<td>0.05–0.29</td>
<td>0.27</td>
<td>3.05</td>
<td>0.003†</td>
</tr>
<tr>
<td>Sheffield receptive language</td>
<td>0.01</td>
<td>0.07</td>
<td>0.941</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barthel Index</td>
<td>0.06</td>
<td>0.35</td>
<td>0.729</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Regression Model of Baseline Factors Predicting VASES Scores at Six Months

<table>
<thead>
<tr>
<th>(n=92)</th>
<th>B</th>
<th>95% CI</th>
<th>Standardized B</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>VASES</td>
<td>0.49</td>
<td>0.31–0.67</td>
<td>0.49</td>
<td>5.41</td>
<td>&lt;0.001‡</td>
</tr>
<tr>
<td>Sheffield expressive language</td>
<td>0.73</td>
<td>0.21–1.25</td>
<td>0.27</td>
<td>2.78</td>
<td>0.007‡</td>
</tr>
<tr>
<td>TACS</td>
<td>3.17</td>
<td>0.36–5.99</td>
<td>0.17</td>
<td>2.24</td>
<td>0.028*</td>
</tr>
<tr>
<td>Barthel Index</td>
<td>0.14</td>
<td>1.65</td>
<td>0.102</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheffield receptive language</td>
<td>−0.04</td>
<td>−0.48</td>
<td>0.634</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cl indicates confidence interval.

* $P < 0.05$, † $P < 0.01$, ‡ $P < 0.001$. 
Levels of distress were not significantly different on the VASES between 1 month and 6 months after stroke, supporting previous research which has found distress to be persistent after stroke. Distress at 1 month poststroke was the most important predictor of distress at 6 months and previous studies have also found depression early after stroke to be a predictor of later depression.

The regression model at baseline accounted for about one quarter of the variance in distress and at 6 months accounted for almost one third of the variance in distress scores. This is within the range reported in the literature. However, this suggests that other factors may also be important. Cognitive impairments related to right hemisphere lesions were not assessed. This is a potential confounding variable which would have provided additional descriptors of the patients’ impairments. There are practical limitations to the number of assessments that can be completed with stroke patients, particularly in hospital, and the sample size limits the number of variables that can be included in the analysis.

Demographic factors were not significantly associated with distress. Findings regarding age and gender in the literature are inconclusive, and comparisons across studies are difficult because of the age distribution of samples. Lesion laterality was unrelated to distress and this concords with reviews. However, as patients were recruited in hospital at 1 month poststroke, few had no limb weakness.

The most important strength of the present study was the inclusion of patients with aphasia, as this subgroup is usually excluded from studies of mood after stroke. Patients with a spread of communication abilities were included; therefore the sample was also reflective of a broader range of patients with stroke, not just those without communication problems. One-fifth of the sample were classified as having aphasia, and further investigation of emotional distress is needed using a larger sample of patients with aphasia. A brief measure was included to assess the severity of expressive and receptive language impairment and the mood assessment used was developed for people with acquired communication problems. A detailed language battery would be required to assess other language abilities (eg, reading and writing) and to investigate whether specific areas of language impairment are related to distress. The gold standard would have been to administer a standardized diagnostic interview for depression, but this may not be appropriate for patients with moderate or severe language impairment. The VASES was found to be acceptable by participants, although few had very severe aphasia. This may be because of the method of recruitment whereby consent from a carer or relative was obtained for those with severe aphasia and in some cases a carer or relative could not be contacted to give consent to assess the patient by about 1 month poststroke.

The sample in the present study was selected as patients who remained in hospital at one month after stroke were recruited, and as a result of this most patients had motor weakness. One third of patients who were invited to take part declined to participate in the study, and these patients were significantly older than those who agreed to take part. It is possible that patients who did not consent were those with higher levels of distress. It has been suggested that older adults with depression or psychological distress are more likely to decline research invitations. However, this is unlikely to have biased the results as the mean VASES score in the present study was similar to that of stroke patients recruited from an inpatient rehabilitation unit.

In conclusion, emotional distress was persistent after stroke, therefore efforts to monitor and treat mood problems should continue beyond the acute stages after stroke. Dependence in personal ADL and extended ADL were predictive of distress at 1 month and 6 months after stroke, respectively, suggesting that interventions to increase activity levels and social interaction may be appropriate. The finding that expressive communication impairment was related to distress supports the importance of including patients with aphasia when screening for mood problems after stroke and also that interventions are needed that are appropriate for patients with communication impairments.

Sources of Funding

We thank the Stroke Association, UK for financial support.

Disclosures

None.

References


Predictors of Emotional Distress After Stroke
Shirley A. Thomas and Nadina B. Lincoln

Stroke. published online February 21, 2008;
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2008 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/early/2008/02/21/STROKEAHA.107.498279.citation

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org/subscriptions/