Telestroke-Guided Intravenous Tissue-Type Plasminogen Activator Treatment Achieves a Similar Clinical Outcome as Thrombolysis at a Comprehensive Stroke Center

Syed F. Zaidi, MD; Mouhammad A. Jumma, MD; Xabier N. Urra, MD; Maxim Hammer, MD; Lori Massaro, CRNP; Vivek Reddy, MD; Tudor Jovin, MD; Ridwan Lin, MD, PhD; Lawrence R. Wechsler, MD

Background and Purpose—Telestroke networks offer an opportunity to increase tissue-type plasminogen activator use in community hospitals.

Methods—We compared 83 patients treated with intravenous tissue-type plasminogen activator by telestroke to 59 patients treated after in-person evaluation by the same neurologists at a tertiary care stroke center. Onset and door-to-treatment times and functional outcome at 90 days were obtained prospectively. Favorable outcome was defined as modified Rankin Scale score ≤2.

Results—Favorable outcome rates were comparable between the groups (42.1% versus 37.5%, \( P = 0.7 \)). There was no significant difference in the rate of symptomatic hemorrhage.

Conclusions—Telestroke is a viable alternative to in-person evaluation when stroke expertise is not readily available. (Stroke. 2011;42:3291-3293.)

Key Words: acute stroke • telemedicine • thrombolysis

Although tissue-type plasminogen activator (tPA) remains the only Food and Drug Administration-approved therapy for ischemic stroke within 3 hours of symptom onset, it is underused. Many patients eligible for intravenous tPA present to community hospitals with limited experience using thrombolysis. Telestroke networks offer an opportunity to bridge the gap between small community hospitals and tertiary stroke centers and prior studies demonstrate that tPA can be safely administered for acute stroke treatment through a telestroke evaluation.1,2

Methods

Telestroke Network

The University of Pittsburgh Medical Center telestroke network is composed of 12 spoke facilities and University of Pittsburgh Medical Center Presbyterian Hospital that serves as the telestroke hub. Presbyterian Hospital is a 625-bed, tertiary care comprehensive stroke center with established acute stroke treatment protocols and a 20-bed neurointensive care unit. Six neurologists with training in vascular neurology provide 24/7 coverage. All decisions regarding treatment with intravenous tPA at both the hub and spoke sites are made by the same neurologists. The network uses commercially available audio and video conferencing equipment to connect the hub with the spoke facilities. Stroke physicians have access to the different hospital Picture Archiving and Communication Systems.

Patients

Telestroke consults were initiated by the spoke hospitals on identification of possible intravenous tPA candidates. The vascular neurologist at the hub site activated the telemedicine connection, performed a National Institutes of Health Stroke Scale examination, and reviewed the CT scan and laboratory studies. If tPA was indicated, he obtained consent and ordered the treatment. Information on time of symptom onset, time at arrival, risk factors, initial National Institutes of Health Stroke Scale, radiological findings, and time to treatment was collected by the treating physician. Starting in June 2008, all patients treated with tPA by telestroke were contacted by telephone 90 days later by a nurse practitioner (L.M.) with extensive experience in stroke and certified in the modified Rankin Scale. Outcome was considered favorable if modified Rankin Scale was ≤2. For patients treated with tPA in person at the stroke center, the same information was charted prospectively and 90-day follow-up was obtained on all patients. Symptomatic hemorrhage was defined as any blood on 24-hour CT and a ≥4-point increase in the National Institutes of Health Stroke Scale score. This study was conducted with Institutional Review Board approval.

Statistical Analysis

Statistical analysis was performed using Stata 10 (Statacorp, College Station, TX). We used Fisher exact and \( \chi^2 \) test for categorical and
Table 1. Baseline Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Stroke Center (N=59)</th>
<th>Telesroke (N=83)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean y (SD)</td>
<td>71.9 (14.1)</td>
<td>71.9 (14.4)</td>
<td>0.9</td>
</tr>
<tr>
<td>Male, %</td>
<td>43.6</td>
<td>53.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Hypertension, %</td>
<td>77.9</td>
<td>66.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Diabetes mellitus, %</td>
<td>30.5</td>
<td>40.9</td>
<td>0.2</td>
</tr>
<tr>
<td>Atrial fibrillation, %</td>
<td>28.8</td>
<td>23.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Systolic blood pressure, mean mm Hg (SD)</td>
<td>161.6 (18.1)</td>
<td>153.6 (17.3)</td>
<td>0.1</td>
</tr>
<tr>
<td>Admission glucose, mean (SD)</td>
<td>145.5 (67.7)</td>
<td>158.5 (76.2)</td>
<td>0.5</td>
</tr>
<tr>
<td>NIHSS, median (range)</td>
<td>10.5 (2–38)</td>
<td>12 (4–33)</td>
<td>0.5</td>
</tr>
<tr>
<td>Onset-to-treatment time, mean min (SD)</td>
<td>156.7 (31.6)</td>
<td>145.5 (42.8)</td>
<td>0.09</td>
</tr>
<tr>
<td>Arrival-to-treatment time, mean min (SD)</td>
<td>67.8 (26.1)</td>
<td>89.9 (36.3)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

NIHSS indicates National Institutes of Health Stroke Scale; SD, standard deviation.

Student t test for continuous variables with a significance level of <0.05. Stepwise logistic regression model was used to identify predictors for favorable outcomes at 3 months.

Results

Between July 2008 and December 2009, 351 telemedicine evaluations were performed. Eighty-three patients were treated with intravenous tPA at spoke sites and 59 in person at the stroke hub. Baseline characteristics are outlined in Table 1. The groups were well matched except for longer mean arrival to treatment time in the telestroke (TS) group. However, overall mean time to treatment was comparable between the groups.

Functional outcomes at 90 days were obtained in 94.9% of the stroke center subjects and 91.5% of the TS group. The rate of favorable outcome was similar (Table 2) and the rate of complete or near complete recovery (modified Rankin Scale ≤1) was nonsignificantly higher in the TS group (Figure). There was no difference in mortality at 90 days. Overall mortality was significantly higher in octogenarians (age ≥80 years) at both stroke center and TS sites compared with the younger cohort (48.4% versus 26.2%, P<0.05). Symptomatic hemorrhage occurred in 3 patients in the stroke center group and 1 patient in the TS group (Table 2) and the rate of asymptomatic hemorrhage was also similar. Multivariate analysis showed no statistically significant predictors for 90-day functional independence or symptomatic hemorrhage.

Discussion

The study showed that outcomes at 90 days were no different between patients treated with tPA by telemedicine compared with patients treated by the same neurologists over the same time interval at the stroke center hub hospital, reinforcing similar findings of previous reports. Ninety-day mortality rate was higher than in other thrombolysis studies due to a significantly higher percentage of octogenarians in our cohort (Supplemental Table I, http://stroke.ahajournals.org).

Like others, we found no difference in time from stroke onset to treatment, but there was an increase in time from hospital arrival to treatment at the TS sites. Because door-to-treatment times at telemedicine sites were shorter than in previous reports, this difference may be explained by greater efficiency of the stroke center or by delays in initiating the consult at the spoke hospital.

Strengths of the study include that outcomes were assessed prospectively in all patients and that the same stroke neurologists evaluated all patients during the same time interval, leaving the remote versus in-person variable to account for any significant differences. Limitations include that outcome assessments were done by telephone and not blinded, the relatively small sample size, and the nonrandomized design. Despite these shortcomings, the study suggests that outcomes after intravenous tPA are similar when patients are treated by the same stroke physicians in person and at remote sites using telemedicine. Treatment of patients with tPA after assessment by stroke specialists using telemedicine is a viable alternative for community hospitals without on-site availability of stroke expertise.

Table 2. Clinical Outcomes at Day 90 and Hemorrhagic Complications

<table>
<thead>
<tr>
<th></th>
<th>Stroke Center</th>
<th>Telesroke</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>mRS ≤1, %</td>
<td>22.0</td>
<td>34.9</td>
<td>0.09</td>
</tr>
<tr>
<td>mRS ≤2, %</td>
<td>37.5</td>
<td>42.1</td>
<td>0.7</td>
</tr>
<tr>
<td>Mortality, %</td>
<td>30.4</td>
<td>31.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Asymptomatic ICH, %</td>
<td>16.8</td>
<td>16.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Symptomatic ICH, %</td>
<td>5.1</td>
<td>1.2</td>
<td>0.1</td>
</tr>
</tbody>
</table>

mRS indicates modified Rankin Scale; ICH, intracerebral hemorrhage.

Figure. Modified Rankin Scale distribution at 90 days for both treatment groups. mRS indicates modified Rankin Scale.
Disclosures

None.

References


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Data Supplement (unedited) at:
http://stroke.ahajournals.org/content/suppl/2011/09/02/STROKEAHA.111.625046.DC1

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Supplemental material

Supplemental Table: Comparison to the Telemedical Pilot Project for Integrative Stroke Care (TEMPiS) and National Institute of Neurological Disorders and Stroke (NINDS)

<table>
<thead>
<tr>
<th></th>
<th>UPMC TS*</th>
<th>UPMC SC†</th>
<th>TEMPis TS (1)</th>
<th>TEMPis SC (1)</th>
<th>NINDS (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Median), Y</td>
<td>76</td>
<td>74</td>
<td>71</td>
<td>70</td>
<td>67</td>
</tr>
<tr>
<td>% Above 80 Y</td>
<td>43.4</td>
<td>32.2</td>
<td>10</td>
<td>13.6</td>
<td></td>
</tr>
<tr>
<td>90 Day mRS 0-1, %</td>
<td>34.9</td>
<td>22.0</td>
<td>38.2</td>
<td>33.7</td>
<td>39</td>
</tr>
<tr>
<td>90 Day Mortality, %</td>
<td>31.6</td>
<td>30.4</td>
<td>11.2</td>
<td>11.5</td>
<td>17</td>
</tr>
</tbody>
</table>

* TS: Telestroke; † SC: Stroke Center

Supplemental references:
