The Importance of Size
Successful Recanalization by Intravenous Thrombolysis in Acute Anterior Stroke Depends on Thrombus Length

Christian H. Riedel, MD; Philip Zimmermann, MD; Ulf Jensen-Kondering, MD; Robert Stingele, MD; Günther Deuschl, MD; Olav Jansen, MD

Background and Purpose—We hypothesize that in acute middle cerebral artery stroke, thrombus lengths measured in thin-slice nonenhanced CT images define a limit beyond which systemic thrombolysis will fail to recanalize occluded arteries.

Methods—In 138 patients who presented with acute middle cerebral artery stroke and who were treated with intravenous thrombolysis (IVT), we measured lengths of thrombotic clots depicted as arterial hyperdensities in admission nonenhanced CT images with 2.5-mm slice width. Vascular recanalization was investigated after thrombolysis and recanalization results were related to thrombus lengths by logistic regression.

Results—In 62 patients, IVT resulted in recanalization; among these patients, no thrombus length exceeded 8 mm. The median modified Rankin scale score at hospital discharge was 2. In the remaining 76 patients, thrombus lengths mostly exceeded 8 mm and IVT failed in recanalization. These patients were discharged with a median modified Rankin scale score of 5.

Conclusions—This study shows that in acute middle cerebral artery stroke, IVT has nearly no potential to recanalize occluded vessels if thrombus length exceeds 8 mm. (Stroke. 2011;42:1775-1777.)

Key Words: cerebral ischemia ■ computed tomography ■ ischemic stroke
In 15 patients (10.9%), no hyperdense middle cerebral artery sign was detected. Subsequently, a vascular obliteration was found on the follow-up assessments after intravenous thrombolysis in none of these patients. In 62 patients, the occluded artery could be recanalized by IVT, whereas 76 patients showed vessel occlusion after IVT in the follow-up studies.

According to the logistic regression (Figure 1), short clots (length < 5 mm) are highly likely to be dissolved completely, but recanalization can be expected in <1% of cases if the thrombotic clot extends further than 8 mm. The predictive power of thrombus length measurement for successful recanalization after IVT proved to be highly significant ($P<0.001$).

The median value of the modified Rankin scale score at hospital discharge was 2 in patients with recanalization and 5 for those without recanalization (Figure 2). Modified Rankin scale score differed significantly between patients with and without recanalization ($P<0.001$).

**Discussion**

Our study shows that IVT has nearly no potential to recanalize occluded vessels with a thrombus length exceeding 8 mm. This is in line with other studies demonstrating the strong dependency of clinical outcome on recanalization rate.8,9 Loss of the hyperdense middle cerebral artery sign during follow-up was found to be an indicator of favorable outcome after IVT.10 Two recent studies related the success of recanalization by IVT and patient outcome to scores that were derived from CTA studies.1,8 These results compare to ours with respect to outcome. However, our measurement of thrombus length is easier to apply and unambiguous.

Our results can help to identify patients in whom IVT will most likely fail in open occluded arteries. In these patients, immediate intra-arterial therapy might be the treatment of choice.

The results of our study must be interpreted with caution because the data were analyzed retrospectively, although blind for the clinical and thrombus length outcome. Second, the sample size is limited for a stroke study. However, the threshold for the thrombus length indicating a favorable outcome was found to be so well-defined that a major quantitative deviation of future studies with larger sample sizes is unlikely.

We conclude that the present results justify a prospective study that should address the question of whether IVT should be replaced by intra-arterial thrombolysis when the thrombus length measured with our protocol exceeds 8 mm.

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**Table. Demographic Characteristics**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>All Patients (N=138)</th>
<th>Recanalized (N=62; 44.9%)</th>
<th>Not Recanalized (N=76; 55.1%)</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female, n/total n (%)</td>
<td>63/138 (45.7)</td>
<td>28/62 (45.2)</td>
<td>35/76 (46.1)</td>
<td>0.61</td>
</tr>
<tr>
<td>Age, years</td>
<td>67.9±12.8</td>
<td>66.8±14.2</td>
<td>68.5±11.1</td>
<td>0.03</td>
</tr>
<tr>
<td>NIHSS score (admission)</td>
<td>11.2±4.2</td>
<td>9.3±3.3</td>
<td>12.6±4.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Duration of hospital stay (days)</td>
<td>11.0±5.3</td>
<td>10.8±5.5</td>
<td>4.2±0.8</td>
<td>0.39</td>
</tr>
<tr>
<td>Modified Rankin scale score (discharge)</td>
<td>3.4±1.9</td>
<td>1.9±1.0</td>
<td>4.4±1.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Recanalization control (N), TCD/MRA/CTA</td>
<td>127/9/2</td>
<td>58/3/1</td>
<td>69/6/1</td>
<td></td>
</tr>
<tr>
<td>Time to recanalization control (hours)</td>
<td>20.7±6.0</td>
<td>20.9±5.8</td>
<td>20.5±6.3</td>
<td>0.42</td>
</tr>
</tbody>
</table>

CTA indicates computed tomography angiography; MRA, magnetic resonance angiography; NIHSS, National Institutes of Health Stroke Scale; TCD, transcranial Doppler.

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**Figure 1.** Logistic regression curve representing an estimate of the probability for successful recanalization of occluded vessels by intravenous thrombolysis (IVT) depending on thrombus length.
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Disclosures
None.

References
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