In-Hospital Stroke Treated With Intravenous Tissue Plasminogen Activator

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Background and Purpose—In-hospital strokes (IHSs) are potential candidates for thrombolysis. We analyzed the treatment procedures, safety, and efficacy of intravenous tissue plasminogen activator (IV-tPA) in IHSs compared with out-of-hospital strokes (OHSs).

Methods—This study was based on a multicenter prospective registry of patients treated with IV-tPA divided into IHSs and OHSs. We recorded intrahospital delays and stroke outcomes.

Results—Among 367 patients treated with IV-tPA, 30 were IHSs. Baseline characteristics were similar except for a greater proportion of diabetes (36.7% vs 17.5%, \( P=0.01 \)), cardiac failure (16.7% vs 5.3%, \( P=0.014 \)), and atrial fibrillation (33.3% vs 17.5%, \( P=0.034 \)) in IHSs than OHSs. In-hospital delays were significantly longer in IHSs for door-to-computed tomography time (39.5 ± 18.7 vs 22.6 ± 19.7 minutes, \( P<0.0001 \)) and computed tomography-to-treatment time (92.0 ± 26.1 vs 65.4 ± 25.8 minutes, \( P<0.0001 \)). No differences were observed in safety or efficacy.

Conclusions—In-hospital procedures for thrombolysis proceed more slowly in IHSs than in OHSs. Thrombolysis is safe and efficient in IHS. (Stroke. 2008;39:2614-2616.)

Key Words: intravenous tissue plasminogen activator • in-hospital stroke • stroke code • thrombolysis • stroke

Information on stroke occurrence in hospitalized patients is limited. Some studies found that in-hospital strokes (IHSs) represent 6.5% to 15% of all first strokes.1,2 Thrombolysis could be performed earlier in IHSs because prehospital delays are avoided. However, delays in recognition and assessment are common. Different causes might explain these delays, such as associated comorbidities, absence of specific training in the recognition of stroke, treatment options among referring physicians, and the complexities of hospital practice.3 Risk factors for IHS include specific procedures, previous medical disorders, especially cardiac diseases, previous stroke or transient ischemic attack, and withdrawal of antithrombotic drugs during hospitalization.3 Information on thrombolysis in IHSs is limited. We performed a prospective study to assess the procedures, safety, and efficacy of thrombolysis in IHS compared with out-of-hospital stroke (OHS).

Patients and Methods

Consecutive acute stroke patients treated with intravenous tissue plasminogen activator (IV-tPA) at 4 stroke units (SUs) that share a common extrahospital stroke code from January 2004 to July 2007 were prospectively registered. IHSs were those occurring in hospital. OHSs were those occurring outside the hospital. Patients received IV-tPA as a standard 0.9-mg/kg dose within 3 hours of stroke onset.

Stroke onset was defined as the last time the patient was known to be without neurologic deficit. On admission for OHS or as soon as the neurologist was advised for IHS, a neurologic examination and efficient in IHS.

Statistical Analysis

Analyses were performed with SPSS 11.5. Comparisons were made with \( \chi^2 \) tests for categorical variables and the Mann–Whitney \( U \) test for continuous measures, as appropriate.
Results

Among 367 patients, 30 (8.2%) had IHS. Stroke severity was similar in both groups. IHS patients more frequently had diabetes (36.7% vs 17.5%, \( P = 0.01 \)), cardiac failure (16.7% vs 5.3%, \( P = 0.014 \)), and atrial fibrillation (33.3% vs 17.5%, \( P = 0.034 \)). IHS patients were more frequently receiving anticoagulant (23.3% vs 2.4%, \( P = 0.001 \)) or antithrombotic (56.7% vs 28.8%, \( P = 0.002 \)) treatments before thrombolysis. Other risk factors and stroke etiology were similar (Table 1). Reasons for hospitalization previous to stroke in IHS were prior transient ischemic attack (11 patients), cardiac disease (8 patients), peripheral arterial disease (5 patients), programmed surgery with withdrawal of antithrombotic treatment (4 patients), hemodialysis (1 patient), and digestive tract endoscopy (1 patient).

Stroke-onset-to-CT (39.5±18.7 vs 97.8±30.2 minutes, \( P<0.0001 \)) and onset-to-treatment (92.0±26.1 vs 141.7±26.9 minutes, \( P<0.0001 \)) times were significantly lower in IHS. However, in-hospital delays were significantly longer: door to CT scan (39.5±18.7 vs 22.6±19.7 minutes, \( P<0.0001 \)), CT to treatment (53.9±23.07 vs 44.9±27.0 minutes, \( P=0.0231 \)), and door to treatment (92.0±26.1 vs 65.4±25.8 minutes, \( P<0.0001 \); Table 2). Fifty percent of IHSs and only 3.3% of OHSs were treated within 90 minutes (\( P<0.0001 \)). In IHS, stroke onset was actually seen by a witness in 25 patients, and in these patients, the mean time in contacting the neurologist was 17.6±19.4 minutes.

Patients were treated at the SU (IHS 43.4%, OHS 47.7%), Emergency Department (IHS 23.3%, OHS 45.2%), or in-

![Table 1. Baseline and Demographic Data, Stroke Risk Factors, and Etiology](image)

![Table 2. Delays in Management of Stroke Patients](image)
tensive care unit (IHS = 33.3%, OHS = 7.1%). Patients were treated in the intensive care unit only when no bed was available in the SU or the Emergency Department. Favorable outcome was similar in both groups (IHS = 55.6%, OHS = 55%). There was no difference in significant neurologic improvement, symptomatic intracerebral hemorrhage rate, and mortality (Table 3).

**Discussion**

A narrow time window is the major factor in restricting thrombolysis to 2% to 15% of all strokes. Extrahospital stroke codes have reduced prehospital and in-hospital delays. Specific stroke code protocols have improved the efficiency of in-hospital care, but these protocols include only Emergency Department procedures for OHS.

This study compared patient characteristics, delays, efficacy, and safety of IV-tPA in both groups. Baseline characteristics were similar except for a greater proportion of diabetes, atrial fibrillation, and cardiac failure in IHS. This fact is not surprising, because they were actually in the hospital owing to different diseases. However, stroke etiology was similar in both groups. Cardioembolic stroke was strikingly high, specially in IHS.

Time management was different. Stroke-onset-to-CT and onset-to-treatment times were significantly lower in IHS because they avoid prehospital delays. Fifty percent of patients were treated within 90 minutes, a large proportion in comparison with OHS (3.3%) or findings from the SITS-MOST study (10.6%).

Patients with NIHSS decrease ≥4 points at 24 h, n (%)

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<th>IHS</th>
<th>OHS</th>
<th>Group Comparison</th>
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<td>18 (60)</td>
<td>176 (53.7)</td>
<td>NS</td>
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Table 3. Stroke Outcomes and Hemorrhagic Complications

NIHSS indicates National Institutes of Health Stroke Scale; IQR, interquartile range; and mRS, Modified Rankin Scale.

In summary, thrombolysis in IHS is safe and effective. Efforts should be made to improve in-hospital management to minimize avoidable delays and obtain better results.

**Disclosures**

None.

**References**

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