

Efficacy of New Measures Saving Time in Acute Stroke Management: A Quantified Analysis

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Background: Time to treatment remains the most important factor in acute ischemic stroke prognosis. We quantified the effect of new interventions reducing in-hospital delays in acute stroke management and assessed its repercussion on door-to-imaging (DTI), imaging-to-needle (ITN), and door-to-needle (DTN) times. *Methods:* Prospective registry of consecutive stroke patients who were candidates for reperfusion therapy attended in a tertiary care hospital from February 1 to December 31, 2014. A series of measures aimed at reducing in-hospital delays were implemented. We compared DTI, ITN, and DTN times between patients who underwent the interventions and those who did not. *Results:* 231 patients. DTI time was lower when personal history was reviewed and tests were ordered before patient arrival (2.5 minutes saved, $P = .016$) and when electrocardiogram was not made (5.4 minutes saved, $P < .001$). Not performing a computed tomography angiography and not waiting for coagulation results from laboratory before intravenous thrombolysis (25.5%) reduced ITN time significantly (14 and 12 minutes saved, respectively, $P < .001$). These interventions remained as independent predictors of a shorter ITN and DTN time. Completing all steps resulted in the lowest DTI and ITN times (13 and 19 minutes, respectively). *Conclusions:* Every measure is an important part of a chain focused on saving time in acute stroke: the lowest DTI and ITN times were obtained when all steps were completed. Measures shortening ITN time produced a greater impact on DTN time reduction; therefore, ITN interventions should be considered a critical part of new protocols and guidelines. **Key Words:** Door-to-needle time—intravenous thrombolysis—ischemic stroke treatment—door-to-imaging—imaging-to-needle.

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Introduction

Guidelines on acute stroke management recommend an organized protocol for the emergency evaluation of patients with suspected stroke in order to reduce delays in administering treatment.^{1,2}

In the case of intravenous thrombolysis (IVT) with tissue plasminogen activator (t-PA), the benefit increases proportionally with earlier treatment.^{3,4} Every minute lost from symptom onset to treatment could prove critical for the functional prognosis.⁵

Several studies in recent years have focused on developing protocols and strategies to shorten door-to-needle (DTN) time.⁶⁻⁸ Some of these ultrafast protocols have reduced the median DTN time to 20 minutes, with multiple concurrent interventions, although it is not possible to associate this improvement with any single strategy. Therefore, we do not know which specific interventions are more effective at reducing in-hospital delays or how door-to-imaging (DTI), imaging-to-needle (ITN), and DTN times are affected.

The latest clinical trials of endovascular treatment in acute stroke have shown that reducing time from onset to therapy is also a priority.^{9,10} Thus, interventions aimed at reducing DTN time should also be geared toward shortening time to femoral puncture, considering both therapies as a whole.

Our objective was to quantify the effect of the new interventions designed to avoid in-hospital delays in a population of acute stroke patients who were potentially candidates for reperfusion therapies. We also aimed to assess which of these new interventions were predictors of rapid brain imaging in the patients attended and which were finally predictors of rapid IVT.

Methods

Study Design and Population

We created a prospective registry of all consecutive patients diagnosed with acute stroke who were attended in the emergency department of a tertiary hospital from February 1 to December 31, 2014. We included consecutive patients attended within 6 hours from onset of symptoms and patients with unknown onset who were considered candidates for recanalization therapies. Intrahospital strokes and patients transferred from other hospitals with part of their workup complete were excluded. We included cases with and without hospital prenotification.

Hospital General Universitario Gregorio Marañón is located in the city of Madrid, Spain, and its Stroke Unit provides tertiary care to a catchment population of about 1 million people. An acute stroke care program was established in the Madrid region in 2006 and includes a prehospital stroke protocol, according to which the Emergency Medical Service makes a prenotification call directly to the mobile phone of the on-call stroke physician.¹¹

In a previous retrospective analysis performed at our center, we obtained the following median in-hospital times in minutes (interquartile range, IQR): onset-to-door (OTD) 84 (60-120); DTI 17 (13-24.7); ITN 34 (26-47); DTN 52 (43-70); onset-to-needle (OTN) 145 (120-180). Several factors were identified to affect in-hospital delays.¹² As a consequence of these results, a series of consecutive interventions aimed at reducing the in-hospital delays detected were implemented from February 2014.

Interventions to Reduce In-Hospital Delays

Interventions for DTI Time

In cases of prenotification, the neurologist searched the electronic patient record in the hospital database and/or the Madrid region data registry for the previous medical history, medications, and previous functional status. If the electronic patient record was available, tests were ordered before arrival. At arrival, vital signs, glucose level, and a blood sample were obtained by nursing staff at the emergency room. If the patient was taking oral anticoagulants or coagulopathy was suspected, a point-of-care international normalized ratio (INR) determination was obtained. An electrocardiogram (EKG) was obtained only if not previously performed by the emergency medical services or if an acute cardiac condition was suspected. The neurologist performed a neurological assessment using the National Institutes of Health Stroke Scale (NIHSS). The patient was then transferred immediately to the computed tomography (CT) room.

Interventions for ITN Time

A simple CT scan was performed and interpreted by the neurologist or the radiologist when they were immediately available. Computed tomography angiography (CTA) was only performed before IVT if the diagnosis was uncertain, basilar artery thrombosis was suspected, or IVT was contraindicated. After the CT scan, the patient was transferred to the Stroke Unit, which is located on the sixth floor of the hospital. IVT was administered there. If a coagulation disorder was not suspected, we did not wait for coagulation results before initiating IVT. When IVT was initiated, a transcranial duplex study was performed immediately in order to detect candidates for endovascular treatment. If a major vessel occlusion was detected, thrombectomy could be performed in our center during office hours (8 AM-3 PM, Monday to Friday). Out of hours, the patient is transferred to the on-call center.

Feedback

We held a series of meetings focused on operational feedback for all neurologists implicated in the care of stroke patients and for regular reporting of DTN times.

Variables Analyzed

Data from consecutive stroke patients were collected prospectively. These included demographic variables, personal history, and stroke severity, as measured using the NIHSS. We also recorded if hospital prenotification was performed.

In all consecutive patients, the time from onset to arrival at hospital (OTD time) and time from arrival at hospital to neuroimaging (DTI time) were documented.

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