Factors Influencing Door-to-Imaging Time: Analysis of the Safe Implementation of Treatments in Stroke–EAST Registry

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Background: Brain imaging is logistically the most difficult step before thrombolysis. To improve door-to-needle time (DNT), it is important to understand if (1) longer door-to-imaging time (DIT) results in longer DNT, (2) hospitals have different DIT performances, and (3) patient and hospital characteristics predict DIT. *Methods:* Prospectively collected data in the Safe Implementation of Treatments in Stroke–EAST (SITS-EAST) registry from Central/Eastern European countries between 2008 and 2011 were analyzed. Hospital characteristics were obtained by questionnaire from each center. Patient- and hospital-level predictors of DIT of 25 minutes or less were identified by the method of generalized estimating equations. *Results:* Altogether 6 of 9 SITS-EAST countries participated with 4212 patients entered into the database of which 3631 (86%) had all required variables. DIT of 25 minutes or less was achieved in 2464 (68%) patients (range, 3%-93%; median, 65%; and interquartile range, 50%-80% between centers). Patients with DIT of 25 minutes or less had shorter DNT (median, 60 minutes) than patients with DIT of more than 25 minutes (median, 86 minutes; $P < .001$). Four variables independently predicted DIT of 25 minutes or less: longer time from stroke onset to admission (91-180 versus 0-90 minutes; odds ratio [OR], 1.6; 95% confidence interval [CI], 1.3-1.8), transport time of 5 minutes or less (OR, 2.9; 95% CI, 1.7-4.7) between the place of admission and a computed tomography (CT) scanner, no or minimal neurologic deficit before stroke (OR, 1.3; 95% CI, 1.02-1.5), and diabetes mellitus (OR, .8; 95% CI, .7-.97). *Conclusions:* DIT should be improved in patients arriving early and late. Place of admission should allow transport time to a CT scanner under

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5 minutes. **Key Words:** Door-to-imaging time—door-to-needle time—acute stroke—ischemic stroke—imaging—thrombolysis.

Introduction

Earlier thrombolytic treatment for stroke with tissue plasminogen activator is associated with better clinical outcomes.[1-5] In order to treat a patient with thrombolysis, several steps must be taken after the admission of a patient. After clinical examination, the most important step is brain imaging that requires patient transport. The National Institute of Neurological Disorders and Stroke (NINDS) guidelines recommend that brain imaging should be initiated within 25 minutes of hospital arrival.[6] This recommendation is based on practical considerations rather than scientific evidence because the role of door-to-imaging time (DIT) has not been thoroughly studied.[6] Specifically, we do not completely understand how many centers meet recommended time frame of 25 minutes, if DIT influences outcome and what circumstances need to be changed do shorten DIT.

Therefore, the goal of our study was to analyze the extent as to which delayed brain imaging contributes to delays in treatment with thrombolysis and to determine the reasons for delayed imaging. Specifically, we hypothesized that (1) longer DIT results in longer door-to-needle time (DNT), (2) hospitals have different performance with respect to DIT, and (3) certain patient and hospital characteristics predict DIT.

Subjects and Methods

This analysis included 2 complementary sources of information:

1. Patients characteristics were obtained from prospectively collected data in the Safe Implementation of Treatments in Stroke (SITS) registry. For this analysis, a subset of the registry, from Central/Eastern European countries (SITS-EAST), was used. Details of the SITS-EAST registry have been described elsewhere in detail.[7] Briefly, SITS-EAST represents the geopolitical region of Central and Eastern Europe and 9 countries contributed: Croatia, Czech Republic, Estonia, Hungary, Lithuania, Poland, Slovakia, Slovenia, and Turkey. For this research project, 3 countries (Hungary, Poland, and Slovakia) decided not to participate because of additional effort to obtain hospital characteristics data as described subsequently. The SITS-EAST registry contains data dating back to 2003, but for the purpose of the analysis, only data between January 2008 and December 2011 were used to ensure that the patient characteristics would be relevant to hospital characteristics obtained in 2012. The following variables were collected from the SITS-EAST registry: basic demographic data, acute medical records, National Institutes of Health Stroke Scale and modified Rankin Scale scores before stroke and 3 months after stroke, symptomatic intracerebral hemorrhage (SICH)-SITS, SICH-NINDS, SICH-European Cooperative Acute Stroke Study (ECASS) II, current medication, medical history, onset-to-treatment time (OTT), onset-to-door time (ODT), DIT and DNT, treatment after October 1, 2008, treatment at working hours (Monday–Friday 8 AM-4 PM), and the academic status of the hospital.
2. Hospital characteristics had to be obtained separately because hospital characteristics relevant to imaging time are not included in the SITS registry. A separate questionnaire was sent to the National Coordinators of the SITS-EAST countries. Of these countries, 6 (Croatia, Czech Republic, Estonia, Lithuania, Slovenia, and Turkey) participated. A 7-item questionnaire included the place of admission to hospital of stroke patients brought by an ambulance, total number of thrombolytic treatments annually, existence of prehospital notifications, priority access of thrombolytic candidates to computed tomography (CT), transport time (minutes) between the place of admission to hospital and a CT scanner, regular assessment of DIT, and the number of CT scanners in the hospital. The National Coordinators were asked to obtain data from each stroke center in their country. If a center did not respond for 3 months, the center was asked again. If there was still no response, the center was classified as a nonresponder.

The Ethics Committee of the Karolinska Institute in Stockholm approved the Safe Implementation of Treatments in Stroke–Monitoring Study. Ethical approvals were obtained in countries where approval was required.[7]

Statistical Analysis

The outcome for our analysis was DIT of 25 minutes or less. DIT was defined as the time from hospital arrival to the initiation of brain imaging. The 25 minutes cutoff was chosen in accordance with NINDS recommendation and previous reports.[6,8,9] Associations between DIT of 25 minutes or less and all variables were analyzed using the Mann–Whitney test for numerical parameters and the χ^2 test for binomial and categorical parameters. The relationship between each numerical variable and our outcome was graphically analyzed. If a nonlinear response was detected, then these variables were dichotomized.