Improvement in Door-to-Needle Time in Patients with Acute Ischemic Stroke via a Simple Stroke Activation Protocol

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Background: In acute ischemic stroke (AIS), treatment with intravenous tissue-type plasminogen activator (IV-tPA) is time-sensitive. All stroke centers make continual efforts to reduce door-to-needle time (DNT) with varying success. We present the impact of modifications to our stroke activation protocol on DNT. *Methods:* We included 404 consecutive patients with AIS receiving IV-tPA between January 2014 and December 2016. First changes in stroke activation protocol were made in March 2015 in the form of prenotification by paramedics, direct transfer from ambulance to computed tomography (CT) scanner, and rapid en route neurological assessment by an emergency physician and neurologist. In March 2016, a second amendment was made where a stroke nurse accompanied the patient to expedite various steps in the treatment pathway, including endovascular treatment in eligible cases. *Results:* Both protocol amendments resulted in improvement in DNT and door-to-CT time from 84 ± 47 minutes before intervention to 69 ± 33 minutes after protocol amendment 1 to 59 ± 37 minutes after protocol amendment 2. In particular, the second amendment (144 patients) showed significant shortening of DNT compared with the 137 patients before (59 ± 37 minutes versus 69 ± 33 minutes, $P = .020$), with a higher percentage achieving the target of 60 minutes (68.1% versus 48.2%, $P < .001$). This finding was attributed to a reduction in both door-to-CT time and CT-to-needle time. This improvement remained consistent over subsequent months. *Conclusions:* The application of a simple systems-based, multidisciplinary stroke activation protocol may help in significant reduction in DNT. Encouraging increased patient ownership by stroke nurses appeared to be a promising approach for timely administration of definitive acute therapies. **Key Words:** Acute ischaemic stroke—door-to-needle time—stroke activation protocol—clinical outcomes.

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Received November 10, 2017; revision received November 30, 2017; accepted January 1, 2018.

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1052-3057/$ - see front matter

https://doi.org/10.1016/j.jstrokecerebrovasdis.2018.01.005

Introduction

In acute ischemic stroke (AIS), the effectiveness of intravenously administered tissue-type plasminogen activator (IV-tPA) is time dependent. Pooled data from major IV-tPA trials suggest that the therapeutic benefit is maximal when thrombolysis is initiated rapidly and worsens rapidly with the passing of time.[1-4] Accordingly, the number needed to treat to achieve a good functional outcome (modified Rankin scale 0-1) is only 4.5 when IV-tPA is initiated within 90 minutes.[2] Furthermore, early initiation of the treatment translated into improved patient outcomes.[5]

The door-to-needle time (DNT) is an acceptable measurable standard of acute stroke care. The reduction of the DNT is a complex process, which requires a close coordination across several departments to provide a rapid administration of acute revascularization therapy in AIS.[6,7] Many protocols, including the Toyota system, have been implemented to good effect.[5,6] Nonetheless, these improvements need to be individualized for each center to be effective. For example, the Helsinki protocol and the value stream analysis, proven effective at the Washington University in reducing DNT, failed to show any effect on the "after-hours" DNT when applied at the Royal Melbourne Hospital in Australia.[7-9]

At our tertiary center, we launched protocol amendments in March 2015 and March 2016. We present the impact of these initiatives in reducing DNT and functional outcome.

Methods

Before March 2015 at our center, paramedics evaluated patients with AIS and performed a point-of-care glucose test. Upon arrival to our emergency department, patients were further evaluated by emergency physicians. An urgent computed tomography (CT) scan of the brain was performed if the patient was considered potentially eligible for acute revascularization treatment. Stroke neurologist was simultaneously alerted. An intravenous line was set and blood was sent to the laboratory while waiting for the CT. Neurologist would review the patient and CT scan, as well as perform the National Institutes Health Stroke Scale (NIHSS). The patient was transferred to the neurology high-dependency ward for IV-tPA treatment. The decision for further endovascular therapy was made during the tPA infusion.

In an attempt to improve the delivery of acute revascularization measures, we evaluated the existing workflow in February 2015 and identified steps that could be shortened or modified. As a result, the first protocol amendments were made in March 2015 (Fig 1) and the second amendment in March 2016. In the first protocol amendment, we introduced a prenotification sent to the emergency physician by the paramedics from patients' home if AIS was suspected. Paramedics would also perform point-of-care glucose test on the site and insert an intravenous line. The radiographer, radiologist, and stroke neurologist were simultaneously alerted. Patients with AIS were

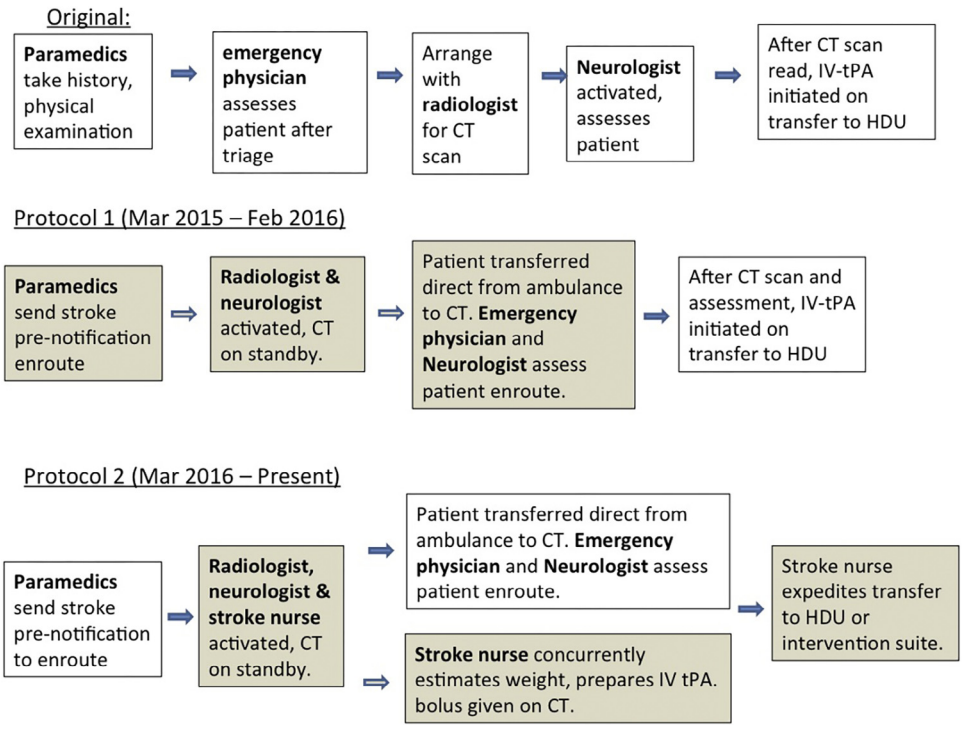

Figure 1. *Change in workflow with implementation of a simple multidisciplinary stroke activation protocol. Abbreviations: CT, computed tomography; HDU, high-dependency unit; IV-tPA, intravenous tissue-type plasminogen activator.*