Telestroke in an Urban Setting

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Abstract

Background: Telestroke is a viable alternative in rural areas where neurologists or stroke expertise is unavailable. Urban applications of telestroke have not been previously described. **Materials and Methods:** All patients evaluated using remote telestroke technology at four urban spoke hospitals between March 2011 and March 2013 were included in this analysis. Telestroke services were provided by vascular fellowship-trained neurologists at one academic stroke center. Patient characteristics, time to initiation of consult, and treatment decisions were prospectively recorded. Stroke triage protocols and thrombolysis rates prior to initiation of telestroke were also obtained. **Results:** Four hundred ninety-eight patients were evaluated during the study period; mean age was 64.5 years, and 60.4% were female. Median time from initial emergency room call to start of teleconsult was 5 (range, 1–51) minutes. Average length of teleconsult was 30 minutes. Technical difficulties occurred in 80 (16.0%) teleconsults, but only 1 was major. Daytime calls (8 a.m.–5 p.m. Monday–Friday) accounted for 38.2% of teleconsults. Two hundred eighty-one patients (56.4%) were determined by teleconsult to have an acute ischemic stroke or transient ischemic attack (TIA). In 72 patients (14.5% overall; 25.6% of all ischemic stroke/TIA patients), intravenous alteplase (tissue plasminogen activator) was recommended. Transfer to the hub hospital occurred in 75 patients (15.1%). **Conclusions:** Telestroke is a rapid and effective way to assess patients with suspected acute stroke in an urban setting. Its use may increase access to stroke neurologists and improve thrombolysis rates where competing responsibilities may delay, prevent, and even dissuade on-site evaluation by neurologists.

Key words: teleneurology, telemedicine, emergency medicine/teletrauma, telecommunications

Introduction

Access to stroke thrombolysis has improved with the proliferation of primary stroke centers (PSCs) in many large metropolitan areas of the United States. These advances have materialized largely despite not having financial incentives to compensate neurologists for call responsibilities.¹ Telemedicine use for stroke evaluation (telestroke) delivers high-quality neurologic assessment and increases rates of thrombolysis^{2,3}; for this

reason, telestroke has been implemented in nonurban areas where neurologists and stroke expertise are not available.^{4,5} Urban applications of telestroke, including within PSCs, have not been reported. We describe a novel urban experience in which implementation of telestroke was done in order to provide outreach and services to patients in a large metropolitan area. By providing telestroke services in a rapid manner, we hoped to increase the number of patients receiving thrombolysis.

Materials and Methods

Patients treated between March 2011 and March 2013 using remote telemedicine technology (InTouch Health, Santa Barbara, CA) (www.intouchhealth.com/products-and-services/products/rp-lite) at four urban spoke hospitals were included; details of a hub-and-spoke system are described elsewhere.⁶ Emergency department (ED) protocols and rate of alteplase (tissue plasminogen activator [tPA]) administration prior to telestroke initiation were reviewed with an administrator at each hospital. We interviewed neurologists practicing at these spoke hospitals prior to telestroke initiation to ascertain practice patterns and thrombolysis protocols. Multiple orientations occurred at each spoke site prior to implementation to ensure that the ED staff were familiar with the activation protocol. When suspected acute ischemic stroke patients presented to a spoke, the ED physician caring for the patient called a central number, which was linked to the phone of the neurologist on-call. Telestroke services were provided by vascular fellowship-trained neurologists. After video patient evaluation and review of imaging, recommendations regarding tPA were communicated to the ED and followed American Heart Association/American Stroke Association guidelines.⁷ Patient characteristics, time to initiation of consult, and treatment decisions were prospectively recorded. This study was conducted with Institutional Review Board approval.

Results

Characteristics of our spoke hospitals are listed in Table 1. Prior to telestroke implementation, spoke hospitals did not have a dedicated neurohospitalist, requiring interruption of neurologists' workflow for patients with suspected acute stroke. Hospital 1 required neurologists to be physically present to give tPA (with rare exceptions). Hospital 2 required discussion with a neurologist prior to tPA administration. Neurologists were not required to be present but were less likely to recommend tPA without reviewing the computed tomography scan or seeing the patient. Hospitals 3 and 4 required neurologists to be physically present for tPA administration. Hospitals 2–4 did not use tPA in the 3–4.5-h window prior to telestroke. tPA usage was generally low. Following implementation of telestroke, spoke hospitals generally contacted the telestroke neurologist on-call prior to contacting their local neurologist in cases of suspected acute stroke.

Table 1. Characteristics of Spoke Hospitals

	HOSPITAL 1	HOSPITAL 2	HOSPITAL 3	HOSPITAL 4
Number of beds ^a	165	330	282	164
Annual admissions ^a	4,000	10,000	12,000	9,000
Annual ER visits ^a	25,000	45,000	43,000	36,000
Primary stroke center certification	February 2012	July 2012	NA	NA
Neurologists on staff (<i>n</i>)	2	2	5	5
Number of patients treated with tPA in 2010	2	2	6	2
tPA rate per month in 2010	0.16	0.16	0.5	0.16
Telestroke initiated	March 2011	May 2011	September 2011	September 2011
Length of study period (months)	25	23	18	18
Telestroke consults (<i>n</i>)	117	222	82	77
Number of telestrokes/week	0.85	2.42	1.13	1.07
tPA advised (all teleconsults)	16/117 (13.7%)	24/222 (10.8%)	21/82 (25.6%)	12/26 (15.6%)
tPA advised (any stroke/TIA patient)	16/56 (28.6%)	23/127 (18.1%) ^b	21/52 (40.4%)	12/46 (26.1%)
tPA rate per month	0.64	1	1.16	0.67

^aData for 2011, collected by the Illinois Department of Public Health. Admissions are rounded to the nearest thousand.

^bOne patient was offered tissue plasminogen activator (tPA), although ultimately not diagnosed with stroke (malingering).

ER, emergency room; NA, not applicable; TIA, transient ischemic attack.

Four hundred ninety-eight patients were evaluated by telestroke during the study period; the mean age was 64.5 (range, 19–96) years, and 60.4% were female. Median time from initial ED call to start of teleconsult was 5 (mean, 7; range, 1–51) min; average consult length was 30 (range, 7–115) min. Technical difficulties occurred in 80 consults (16.0%), but only 1 was major, leading to incomplete assessment because of absent wireless connectivity. Minor difficulties consisted of intermittent poor connection quality (*n* = 25), technical difficulties pertaining to the robot (*n* = 18) or laptop (*n* = 8), inability to personally review imaging (*n* = 8), difficulty creating the electronic consult note (*n* = 6), protocol violations relating to computed tomography scan acquisition prior to consult (*n* = 10), and poor phone reception during the initial call (*n* = 4). Daytime calls (8 a.m.–5 p.m. Monday–Friday) and weekend calls (5 p.m. Friday–8 a.m. Monday) accounted for 38.2% and 34.9% of teleconsults, respectively.

Two hundred eighty-one telestroke patients (56.4%) were determined to have an acute ischemic stroke or transient ischemic attack (TIA). Median NIH Stroke Scale score was 4 (interquartile range, 2–10). tPA was recommended for 72 patients (14.4% overall; 25.6% of ischemic stroke/TIA patients). Twenty-six tPA-eligible patients (36.1% of eligible patients) presented during typical clinic hours. The remaining 209 telestroke patients with acute ischemic stroke were not considered eligible for tPA, with the most frequent reason for exclusion being presentation outside the time window (43.8% of telestroke consults with acute stroke). *Table 2* lists all reasons for tPA exclusion.

Table 2. Exclusion Criteria for Intravenous Tissue Plasminogen Activator

EXCLUSION REASON	NUMBER
Outside of time window	123
Mild symptoms, NIHSS 1–3	35
Complete symptom resolution or NIHSS of 0	22
Elevated INR	10
Inability to bolus tPA within time window	3
Refractory hypertension	3
Use of heparin, dalteparin, or enoxaparin	3
Use of a novel oral anticoagulant	2
Recent surgery	2
Platelets <100,000	2
Seizure at onset	1
Recent myocardial infarction	1
Concomitant aortic dissection	1
Recent gastrointestinal bleed	1
Total	209

INR, international normalized ratio; NIHSS, NIH Stroke Scale; tPA, tissue plasminogen activator.

Transfer to the hub hospital occurred in 75 patients (15.1%); 38 patients received tPA prior to transfer ("drip and ship"). Twenty-three transfers were for possible interventional therapy, 18 for routine post-tPA care (12 from hospitals without PSC certification at the time), 34 for other stroke-related reasons (size of stroke, fluctuation in neurologic examination), and 10 for other neurologic reasons.

Discussion

Telestroke can be a rapid and effective way to assess stroke patients in an urban setting, including at PSCs. Our goal in implementing telestroke was to provide stroke specialized care to patients early in the course of their symptoms who may not have had access to such services. Suspected stroke patients were assessed in 5 min on average from the time of call, even during clinic hours (when over one-third of our consults occurred). Through telestroke, one-quarter of stroke patients received tPA; this rate meets or exceeds prior studies demonstrating administration of tPA in 22–36% of telestroke patients.^{8,9} No patient received tPA outside of telestroke at spoke hospitals during the study period. The rate of tPA use at each hospital increased between two- and sixfold over the rate prior to telestroke.

The spoke hospitals varied dramatically in terms of their use of telestroke. One hospital (Hospital 2) called frequently with patients who were not eligible or ultimately not determined to have a stroke; another hospital with approximately the same number of annual emergency room visits (Hospital 3) was selective in use of telestroke and thus had a higher rate of tPA usage. Feedback was given to all spoke hospitals on a semiannual basis, and changes in recommendation for activation occurred to allow better use of resources.

Although occasional technical difficulties occurred, these were due to a variety of minor issues that did not alter management. Technical difficulties at the spoke hospital lessened over time through protocol re-education and wireless system upgrades within EDs.

This unique practice model may appeal to private practice neurologists, who have increasing pressure on productivity because of federal cuts in reimbursement. Although telestroke consultation averaged one per week per spoke, cumulative effects on practices and revenue are not trivial as many neurologists cover more than one hospital while on-call. Although hospitals receive compensation and recognition for successful thrombolysis in stroke patients, increased remuneration has not been routinely passed down to the consulting neurologists. Emergency call responsibilities demand interruptions and rescheduling clinic patients for many neurologists.¹⁰ A telestroke partnership with dedicated 24/7 staff improves stroke care (by increasing tPA utilization) and prevents fragmented or suboptimal outpatient care. Costs related to this model, in our system shouldered by the hub hospital, need to be carefully weighed but appear cost-effective at a societal level.¹¹

In summary, telestroke can be successfully applied to an urban practice setting. In hospitals with limited resources, including neurologists who may be occupied with other clinical responsibilities away from the ED, this model allows for rapid evaluation of stroke patients and improved thrombolysis rates.

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Disclosure Statement

No competing financial interests exist.

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