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Epidemiology of a large telestroke cohort in the Delaware valley

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ABSTRACT

Background: The American Heart Association/American Stroke Association has recently endorsed telestroke. Telestroke has enhanced stroke diagnosis, increased tPA administration and improved long-term outcomes. However, many of the publication on telemedicine so far have been review articles.
Objectives: We investigated the epidemiological features of telestroke patients and evaluated the difference between the transferred and non-transferred cohorts.
Methods: We collected data on telestroke consultation, between January 2012 and June 2013, regarding patient's age, gender, diagnosis, NIHSS, onset-to-spoke time (OTS), tPA administration and transfer status. Further data was obtained on transferred patients regarding discharge and endovascular interventions.
Results: The means of age, NIHSS and OTS time were the following: 67.59 years, 7.65 and 11.28 h respectively. The proportion of transferred patients was 12.04% (280/2324); lower than what was previously reported. The overall rate of IV tPA administration was 11.98%. Transferred patients had a significantly higher NIHSS mean (10.93 vs. 6.73; $P<0.001$), and were more likely to have received IV-tPA at onset (25.57 vs. 9.67; $P<0.001$). The age, gender proportion, stroke mimic proportion, and the mean of OTS did not differ between the two-groups (0.49 vs. 0.31; $P=0.38$). A logistic regression showed that NIHSS (OR = 1.06, $P<0.001$) and tPA administration at onset (OR = 2.78, $P<0.001$) predict the transfer. Of the transferred patients, 4.5% received endovascular intervention. The mortality rate of transferred patients was 12.9%. Other outcomes were the following: 52% discharge to rehabilitation facilities, 29% discharge to home, and 8% discharge to long-term nursing facilities.
Conclusion: Telestroke network is increasing the frequency of tPA usage in acute ischemic stroke and may decrease the need for transfer. Our aim was to optimize the stroke therapy to shorten the hospital stay and to increase the discharge home. This allows a better functional outcome and an additional benefit of cost-saving for the hospitals.

1. Introduction

Stroke remains a major burden to society in terms of health-costs, disabilities and mortality [1]. Even though the FDA-approved intravenous (IV) tissue-plasminogen activator (tPA) has been shown to improve symptoms and lower mortality [2], only 3–5% of stroke patients are actually treated [3], and 65% of physicians feels uncomfortable prescribing it without a consultation [4]. Currently, efforts are being made to overcome the obstacles that prevent the application of evidence-based medicine in the management of acute ischemic stroke (AIS), and to increase the proportion of stroke patients amenable to treatment. Telestroke so far has been a promising solution. It serves to battle the shortage of vascular neurosurgeons and neurologists, the long distance to primary stroke care centers, the physician's hesitations to prescribe IV tPA and the rural-to-urban asymmetry [5–8] (the lack of stroke experts and stroke dedicated centers in the rural areas when compared to rural settings). Telestroke was proven to be safe and feasible [9,10]. It has enhanced stroke diagnosis, increased tPA usage and improved long-term outcomes [8,11]. In a recent study, the tPA administration rate was increased to 55%, and was used for the first time in a number of hospitals [11]. For all the previous reasons, the

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American Heart Association/American Stroke Association has endorsed the use of telestroke networking in the treatment of AIS [2]. Given that as much as half of the articles on telestroke are review articles [8], we decided to design a study that investigates the epidemiological features of telestroke patients and evaluates the difference between the transferred and non-transferred cohorts.

2. Methods

2.1. Study design, settings and participants

The University Institutional Review Board approved the study protocol. The Department of Neurosciences at our institution set-up a telestroke network of 29 spoke and 1 hub hospital. Robots were placed in the emergency departments (EDs) of all spokes hospitals. The telestroke network is focused on consultation and diagnosis with the following aims:

- Timely delivery of appropriate stroke care to patients presenting to local hospitals.
- Elimination of inappropriate patient transfers to primary stroke centers.
- Stroke training for medical staff members regarding the National Institutes of Health Stroke Scale (NIHSS) and implementation of a thrombolysis algorithm.
- Development of stroke awareness and education programs.

The consultants include five vascular dual-trained neurosurgeons and seven stroke neurologists from our institution. Telemedicine consults are delivered through Remote Presence (RP) robotic technology (In Touch Health, Santa Barbara, CA, USA), which allows patient's evaluation through synchronous bidirectional video and audio communications. Briefly, anytime a patient suspected of AIS presents to the ED of a spoke hospital, the ED physician calls a "stroke alert" and an operator immediately pages the physician on call. The exact date of when the patient arrives to the E.R is registered as "arrival time". The patient is then questioned about the onset of symptoms, which is then registered as "onset time". The onset time is further classified to three types of categories:

- Observed onset: meaning that the patient is sure of the symptoms onset as it has been observed and noted
- Last known well: the last time the patient recalls having no symptoms or last seen normal by someone else
- Unknown: when the patient cannot recall accurate information.

The onset-to-spoke time (OTS) is derived from the subtraction of the "onset time" from the "arrival time". After receiving the stroke alert, the consultant logs on a remote laptop/Ipad and establishes a wireless connection with the RP robot in the ED. This allows the physician to maneuver the robot in the patient's room, assess the patient's neurologic status, review vital signs/laboratory values/CT and interact with the patient, family, and ED staff. We defined a stroke mimic, every time our consultants were notified of a stroke alert and the patient turned out to have a diagnosis other than stroke. If treatment with IV-tPA was recommended, based on the guidelines of the Stroke Council of the American Heart Association/American Stroke Association [2], IV-tPA is carried out at the spoke hospital according to a standardized protocol. Patients might get transferred to a primary stroke center for further evaluation, endovascular intervention, or any additional treatment that might benefit the patient and could not be offered at the spokes hospital. The transportation modality was categorized into: JeffSTAT helicopter, JeffSTAT ambulance, STAT (Kennedy Health), EMStar ambulance, Transcare ambulance, other ambulance service, and other air service.

2.2. Data collection

Data on patient's gender, age, NIHSS, thrombolysis eligibility, tPA administration, and patient transfer status, were prospectively recorded by the spoke hospitals. We reviewed retrospectively the variables needed on all the patients that were evaluated by videoconferencing between January 2012 and June 2013. Regarding the transferred patients, additional data on endovascular intervention, final diagnosis, and discharge status were collected.

2.3. Statistical analysis

Data is presented as mean and range for continuous variables, and as frequency for categorical variables. Analysis was carried out using unpaired *t*-test and Chi-square. Univariate analysis was used to test covariates predictive of the patient transfer. Interaction and confounding was assessed through stratification and relevant expansion covariates. Factors predictive in univariate analysis ($P < 0.15$) were entered into a multivariate logistic regression analysis. *P*-values of ≤ 0.05 were considered statistically significant. Statistical analysis was carried out with Stata 10.0 (College Station, TX).

3. Results

3.1. Participants

We managed to collect data on 2324 patients. No major technological issue occurred. One spoke hospital was added in 2013 increasing the number of peripheral hospitals in the network to 29. Of the 2324 patients, 280 (12.04%) were transferred to a primary stroke center. The remaining 2044 patients were hospitalized in the peripheral hospital or discharge home in the case of a false diagnosis that did not require hospitalization.

3.2. Outcome results

The mean age was 67.59 years (±32.96 years) among all telestroke consultation, with 55.55% of patients being older than 65 years. The proportion of females was higher than that of males (53.45% vs. 46.55%). The mean NHISS score was 7.65, and 60.0% of patients had a NHISS < 7. The NHISS of almost 92% of patients was less than 21. The mean of OTS time was 11.28 h, a value higher than expected. As high as 32.56% of our patients had an "observed onset" in contrast to 45.55% who presented with an "unknown onset". The proportion of stroke mimics was 10.80%. The overall rate of IV tPA administration was 11.98%, slightly similar to that of the past 2 years (13.58%). The most frequently encountered contraindications to tPA administration were: false diagnosis, hemorrhagic stroke, labile hypertension, low NIHSS (<4), very high NIHSS (>22), history of surgery, history of head trauma, history of intracerebral hemorrhage, rapid improvements of symptoms, and patient/family preferences.

3.3. Transferred vs. non-transferred (Tables 1 and 2)

The proportion of patients who were transferred to a primary stroke care center was 12.04% (280/2324), lower than the rate of transfer reported in 2011 (44%) and that of 2012 (19%) in our telestroke community [11]. This confirms the finding of our previous study that shows a linear decline in transfer rate over the years [11].