

ORIGINAL RESEARCH CONTRIBUTION

Observational Study of Telephone Consults by Stroke Experts Supporting Community Tissue Plasminogen Activator Delivery

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Abstract

Objectives: Barriers to intravenous (IV) tissue plasminogen activator (tPA) use in ischemic stroke include limited treatment experience of community physicians. Models of acute stroke care have been designed to address these limitations by providing community support. These include support by telephone or televideo, with or without subsequent transport to tertiary care centers. The authors describe the frequency, characteristics, and effect of community phone consultations to a 24/7 stroke “hotline” staffed by stroke physicians at an academic stroke center using such a model.

Methods: Twelve intervention hospitals participating in the INcreasing Stroke Treatment through Interventional behavior Change Tactics (INSTINCT) trial were provided a single-access number (“hotline”) for expert consultation on tPA use. Experts consisted of stroke-trained physicians at an academic medical center. Hotline use was not mandated by the study protocol, nor was patient transfer required. Consultants were required to record all treatment questions in a Web-based log. All patients discussed over the hotline and/or treated with tPA in an INSTINCT hospital underwent multilevel chart review by trained nurse coordinators. Cases were linked to logged hotline calls, based on the time of treatment and the initial treating hospital. Physician adjudicators assessed appropriateness of tPA treatment, presence of deviation from standard guidelines, and treatment complications (intracranial hemorrhage [ICH], systemic hemorrhage, or death).

Results: Over 27 months, there were a total of 204 hotline calls regarding 116 patients. Ninety-one percent of calls were between 8 a.m. and midnight, and 77% of questions explored issues of eligibility for IV tPA, particularly for minor stroke or improving stroke (26%). A total of 243 patients were treated with IV tPA at the 12 intervention hospitals, 54 of which were following hotline consult. Seventy-six percent of hotline patients in whom tPA was recommended actually received tPA, while 2% of those in whom tPA was not recommended received the medication. There were no differences in protocol deviations (27.8% hotline group vs. 23.8% nonhotline group), incidence of symptomatic ICH (5.6% vs. 7.3%), or in-hospital mortality (5.6% vs. 13.2%). No medico-legal issues have been reported for any case in the study.

Conclusions: Providing tPA decision-making support via telephone consult to community physicians is feasible and safe. Consultants may play a more prominent role in determining tPA ineligibility than acceptance. Future work should include a real-time survey of physician providers to ascertain such potential qualitative benefits of a stroke hotline.

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Estudio Observacional de las Consultas Telefónicas a Expertos en Ictus Para Favorecer la Administración de Activador de Plasminógeno Tisular en Hospitales Comunitarios

Resumen

Objetivos: Las barreras para la utilización del activador de plasminógeno tisular (APT) intravenoso (IV) en el ictus isquémico incluyen la limitada experiencia en dicho tratamiento por parte de los médicos de hospitales comunitarios. Se han diseñado modelos de atención al ictus para reconducir estas limitaciones a través de darles soporte. Este soporte incluye ayudas por teléfono o videoconferencia, con o sin el transporte posterior a los centros de atención terciaria. Se describe la frecuencia, características y efecto de las consultas telefónicas de los médicos de hospitales comunitarios a la línea telefónica directa permanentemente de ictus supervisada por médicos especialistas en patología cerebrovascular en un centro de ictus universitario utilizando dicho modelo.

Métodos: La intervención se realizó en doce hospitales que participaron en el estudio *INcreasing Stroke Treatment through Interventional behavior Change Tactics* (INSTINCT). Los hospitales estaban provistos de un número de acceso único (línea de acceso directo) para consultas a expertos en el uso de APT. Los expertos eran médicos formados en ictus en un centro médico universitario. El uso de la línea de acceso directo no era obligado por el protocolo del estudio ni por la necesidad de traslado del paciente. Se requirió a los especialistas grabar todas las preguntas sobre el tratamiento en un registro electrónico. Todos los pacientes consultados en la línea directa de teléfono y/o tratados con APT en un hospital del estudio INSTINCT fueron revisados por los coordinadores de enfermería con formación específica. Los casos fueron posteriormente vinculados a las llamadas registradas, en base al tiempo de tratamiento y al tratamiento inicial en el hospital. Los médicos revisores valoraron si el tratamiento APT era apropiado o se desviaba de las guías clínicas establecidas, así como sus complicaciones (hemorragia intracraneal, hemorragia sistémica o muerte).

Resultados: Durante los 27 meses, hubo un total de 204 llamadas telefónicas de 116 pacientes. Un 91% de las llamadas fueron entre las 8 y las 24 horas, un 77% de las preguntas era sobre cuestiones de indicación para el uso del APT IV, especialmente para ictus menores o ictus en mejoría (26%). Un total de 243 pacientes se trataron con APT IV en los 12 hospitales donde se realizó la intervención, 54 de los cuales fueron tras la consulta telefónica. Un 76% de los pacientes consultados telefónicamente en los que el APT fue recomendado lo recibió, mientras que esto sucedió en el 2% de aquéllos en los que el APT no estaba recomendado. No hubo diferencias en las desviaciones del protocolo (27,8% del grupo con línea telefónica vs. 23,8% del grupo sin línea telefónica), en la incidencia de hemorragia intracraneal sintomática (5,6% vs. 7,3%) o en la mortalidad intrahospitalaria (5,6% vs. 13,2%). No se documentó ningún problema médico-legal.

Conclusiones: El proporcionar ayuda telefónica a los médicos de hospitales comunitarios para la toma de decisión de administrar el APT es viable y seguro. Los médicos especialistas pueden jugar un papel más destacado en determinar la no elegibilidad de pacientes para el uso de APT que para asentar su indicación. Futuros trabajos deberían incluir una encuesta a tiempo real a los médicos de hospitales comunitarios para determinar el potencial beneficio cualitativo de una línea telefónica de directa ictus.

I schemic stroke carries a substantial public health burden. Although multiple studies have demonstrated the efficacy of recombinant tissue plasminogen activator (tPA) in improving outcomes following stroke, its use remains limited to less than 3% of ischemic stroke patients.¹ Patient-, physician-, and hospital-level barriers have all been identified as contributing to this low utilization rate.²⁻⁴ Among physician- and hospital-level barriers, the lack of neurology support, particularly from stroke specialists, is a major limitation. Lack of stroke specialists has been shown to inversely correlate with intravenous (IV) tPA administration in Japan.⁵ While it is unknown precisely how many U.S. neurologists treat

acute stroke, an estimate can be gleaned from those who seek subspecialty training and remain apprised of current stroke issues. By 2008, 704 neurologists had been certified in vascular neurology by the American Board of Psychiatry and Neurology,⁶ and by 2010, there were 1,181 active members in the Stroke Section of the American Academy of Neurology (personal communication, Stroke and Vascular Neurology Section Staff Liaison, American Academy of Neurology, March 2010). Even for neurologists who are comfortable treating acute stroke, it is often impractical to leave a busy clinic to attend to a stroke patient in the emergency department (ED). This leaves non-neurologists, particularly emergency

physicians (EPs), often responsible for the initial acute care of acute stroke patients. The neurologic training within emergency medicine (EM) residency programs has previously been described as highly variable; therefore, some EPs and non-EM residency-trained physicians may have limited experience or specific education with acute stroke protocols.^{7,8} They are also concerned about potential complications of tPA treatment, particularly intracranial hemorrhage (ICH),⁴ and the medico legal risk associated with either inappropriate treatment or failure to treat.⁹

Several models of acute stroke care have evolved to address these limitations and to provide enhanced treatment support in the community setting. These models may broadly be classified by 1) the technology used to provide the support and 2) the destination of the patient following treatment. Telemedicine evaluation, or “telestroke,” is a live, two-way, audio and video transmission allowing real-time patient examination by a remote stroke expert. It has demonstrated feasibility and reliability in measuring neurologic deficits using the National Institutes of Health Stroke Scale (NIHSS)^{10,11} and offers increased accuracy in decision-making compared to telephone-only support for thrombolytic decisions.¹² Although it has been shown to be cost-effective compared to usual care,¹³ telestroke is expensive to establish and maintain and is associated with increased consultation time compared to telephone alone.¹² It has not demonstrated improvement in patient outcomes or reduced complications compared to a structured telephone consultation provided by stroke experts.¹² An alternate method of extending the expertise of stroke specialists to both community neurologists and EDs is through the use of telephone-only support from a comprehensive stroke center. This method has demonstrated ability to increase tPA treatment and has advantages of simplicity and speed.¹⁴ Limitations include reduced content of information provided to the consultant, which may be particularly important in cases of diagnostic uncertainty.

Both telestroke and telephone-only consult methods have demonstrated safety with respect to ICH and mortality when used within the context of systems where, after consultation, the patient is transferred to the regional stroke center providing direction (i.e. the “drip and ship” model).^{12,14-18} Our goal is to describe the characteristics of a telephone support model to community hospitals treating patients with tPA, the questions asked by community physicians, patient characteristics, consultant recommendations, incidence of deviations from tPA treatment guidelines, and in-hospital clinical outcomes.

METHODS

Study Design

This was a consecutive case series of telephone-only consults provided from November 2007 to January 2010 in the INcreasing Stroke Treatment through INterventional behavior Change Tactics (INSTINCT) trial (NIH R01 NS050372). The INSTINCT trial is a cluster-randomized trial designed to test methods to increase appropriate use of IV tPA in community hospitals. Institutional

review board approval was obtained prior to the start of the study for all hospitals.

Study Setting and Population

The methods of the INSTINCT trial have previously been described.¹⁹ Briefly, 24 hospitals were randomly selected from the pool of 61 acute care hospitals located in the lower peninsula of Michigan, excluding academic stroke centers and those with more than 100 stroke discharges in 2003. Once the first of the pair was chosen, the second hospital was drawn from the remaining hospitals that were greater than 15 miles away from and within 20% of the first hospital’s discharge volume. This process was repeated until 12 matched pairs were obtained, each time excluding remaining hospitals within 15 miles of previously selected hospitals. Adaptive randomization via a biased coin approach was used to ensure overall balance between intervention and control groups for hospital-level variables: percentage of African Americans, percentage of population over 65 years of age, and the number of hospitals in northern and southern Michigan (reflecting urban and rural areas).

Twelve hospitals were randomized to the intervention group and were 25% urban, with an overall total annual ED volume of 397,193 patients for 2007. Four were Joint Commission–certified Primary Stroke Centers, five had specified inpatient stroke units, and the median number of hospital beds was 215 (interquartile range [IQR] = 138 to 356; range = 25 to 804). The median number of stroke hospitalizations at each hospital was 298 in 2007 (IQR = 132 to 476; range = 62 to 733). As part of the INSTINCT trial, each intervention hospital was required to have a written institutional protocol for the care of acute stroke patients, including off-hours interpretation of computed tomographies (CTs). Protocol specifics were not dictated by INSTINCT investigators. These hospitals were provided a single access number (a stroke “hot-line”) for 24/7 expert consultation on IV tPA use.

Study Protocol

Consults were provided by a nine-person academic stroke team consisting of neurologists and EPs, all stroke-trained and practicing in the University of Michigan Health System (UMHS). The standard procedure of the trial was that the advice provided be in accordance with the 2005 American Heart Association (AHA) acute stroke management guidelines.²⁰ Activation notified the entire team to provide backup call in case of a nonfunctioning pager by the team member on primary call. All study consults were logged by the consultant using a Web-based form, although the protocol did not require logging of follow-up calls.

Data collected included information on clinical presentation, specific treatment question(s) to be addressed, and consultant recommendation(s). Consultants were required to categorize their recommendations on the form as “definitely treat,” “potentially treat—with more information needed,” or “do not treat.” Reasons for “potentially treat” included patients for whom the EPs did not yet have complete information; for example, the head CT results were still pending or the blood pressure exceeded guidelines but antihypertensive treatment had

not yet been attempted. At the time of data analysis, each call was subsequently classified into 12 categories describing the consult question (e.g., eligibility of minor stroke, blood pressure management, tPA dosing). Up to three categories were classified for each call.

The study protocol did not require use of the telephone consult service prior to treatment with tPA by local hospitals. It was offered as an adjunct to assist treatment decisions when the local EP, neurologist, internist, or other personnel had an acute thrombolytic-related stroke question. The service was promoted through a series of on-site meetings, during which personnel at each hospital also received 4 hours of continuing education on stroke. The hotline was also promoted via monthly e-mails sent to the local EPs; neurologists; and nursing, pharmacy, radiology, and administrative staff.

As part of the overall INSTINCT trial, each patient treated with tPA for acute ischemic stroke (regardless of telephone consultation use) at each hospital (intervention and control) underwent a multilevel chart review. Hotline consultation alone, without tPA treatment, did not qualify a patient for chart review. Trained nurse coordinators, visiting each site on a quarterly basis, completed an extensive data collection form using all available medical records, with approximately 10% to 20% of cases undergoing dual data abstraction. We have previously demonstrated excellent interrater crude agreement of 96% to 99% for all data fields with this methodology.²¹ The NIHSS score was recorded; if it was not documented in the chart, it was abstracted using a validated method whereby the abstractor translates the documented neurologic exam into NIHSS subscores (e.g. documented "alert and oriented $\times 3$ " = 0 on level-of-consciousness questions).²² The medical records were then deidentified, copied (including neuroimaging reports), and forwarded for a second-level blinded review.

For this substudy on hotline utilization and safety, subjects were limited to those patients with acute stroke at an intervention hospital (since the hotline was

only offered to intervention hospitals) who received IV tPA and/or their physicians used the hotline to assist in their management. Cases were then linked to logged hotline calls, based on the time of treatment and the initial treating hospital. The coordinators also reviewed the records of patients in whom the UMHS consultant recommended treatment but tPA was not given, to establish the rationale.

The second-level review was completed by two, independent, blinded physician reviewers with expertise in acute stroke care and not involved in the study. They assessed appropriateness of treatment and presence of deviation from standard guidelines,²⁰ as well as any treatment complications (ICH, systemic hemorrhage, or death). Any disagreement between reviewers was adjudicated by a third, independent, blinded stroke expert. In-hospital mortality was assessed by chart review. Medicolegal issues for each site were ascertained by querying the hospitals at the final investigators meeting which occurred approximately 6 months after the end of data collection.

Data Analysis

Descriptive statistics for patients treated using local resources and remote hotline consultation were calculated with means and standard deviations (SDs) for normally distributed variables and medians and IQR for the skewed distribution, ordinal NIHSS. SAS Version 9.1.3 was used as the analysis software (SAS Institute, Cary, NC).

RESULTS

During the study period (November 2007 to January 2010), 243 total patients were treated with IV tPA at the 12 intervention hospitals, 189 by local physicians (predominantly EPs, internists, and local neurologists) without hotline consultation, and 54 following hotline consult. The clinical characteristics of patients treated with IV tPA, by consultation group, are given in Table 1. Overall, 77% were non-Hispanic white, 11%

Table 1
Demographic and Clinical Characteristics of Patients Treated With IV tPA

Characteristic	Overall (n = 243)	Hotline Patients (n = 54)	Nonhotline Patients (n = 189)
Age (yr)*	71 ± 14	74 ± 12	70 ± 15
Female (%)	51	41	53
History of prior stroke (%)	20	26	19
History of atrial fibrillation (%)	24	33	21
History of diabetes (%)	25	20	26
History of hypertension (%)	76	81	75
Pretreatment NIHSS score†	11 (7–16)	12 (8–18)	10 (6–16)
Pretreatment glucose (mg/dL)*	134 ± 50	129 ± 35	135 ± 53
Pretreatment sBP (mm Hg)*	148 ± 21	149 ± 19	148 ± 22
Pretreatment dBP (mm Hg)*	80 ± 17	82 ± 18	80 ± 16
Onset to arrival (minutes)†	60 (39–82)	58 (42–71)	60 (38–87)
Door to treatment (minutes)†	85 (65–108)	85 (63–106)	85 (66–108)
Transferred out of index ED (%)	15	20	13

dBP = diastolic blood pressure; IQR = interquartile range; NIHSS = National Institutes of Health Stroke Scale; sBP = systolic blood pressure; tPA = tissue plasminogen activator.

*Mean ± SD.

†Median (IQR).

were non-Hispanic African American, 3% were Hispanic white, and 9% had unknown race/ethnicity. The NIHSS was estimated in 31 patients (13%). A total of 36 patients were transferred out of the EDs at the INSTINCT hospitals to which they initially presented; only one of these transfers was to the University of Michigan.

With respect to hotline consultations, the University of Michigan stroke team received 204 calls regarding 166 patients from 13 hospitals (one call was received from a control hospital, one was received from an inpatient unit at an intervention hospital). Most calls (91%) occurred between 8 a.m. and midnight, with a mean call frequency of seven per month (8 a.m. to midnight) less than one per month (midnight to 8 a.m.). From the 204 calls, we identified 209 separate treatment

questions from local physicians. The nature of these questions and detail by treatment group are presented in Table 2. The majority of questions (77%) concerned tPA eligibility, particularly regarding issues of the definition of minor or improving stroke (26%).

In the 166 patients, the hotline consultant recommended the local physician “definitely treat” in 50, “potentially treat” in 52, and “do not treat” in 64. Ultimately, 54 IV tPA treatments occurred in the 166 patients: 76% ($n = 38$), 29% ($n = 15$), and 2% ($n = 1$) of patients in each group, respectively. The relative utilization of the hotline and tPA for each of the 12 sites is summarized in Figure 1.

Of the 12 patients in whom the recommendation to “definitely treat” was made, but tPA not given, five were due to symptomatic improvement, one was due to

Table 2
Nature of Hotline Questions Regarding Acute Stroke Patients

Reason for Call	All Hotline Calls, 209 Questions on 166 Patients	Treated Patients, 68 Questions on 54 Patients	Nontreated Patients, 141 Questions on 112 Patients
Minor/improving	55 (26.3)	13 (19.1)	42 (29.8)
Historical (i.e., seizure)	42 (20.1)	12 (17.6)	30 (30.3)
General eligibility	23 (11.0)	18 (26.5)	5 (7.2)
Timing/onset	20 (9.6)	0 (0)	20 (14.2)
Uncertain of stroke diagnosis	17 (8.1)	2 (2.9)	15 (10.6)
Laboratory values (e.g., INR)	15 (7.2)	5 (7.4)	10 (7.1)
Blood pressure (eligibility and management)	7 (3.3)	3 (4.4)	4 (2.8)
CT findings	7 (3.3)	3 (4.4)	4 (2.8)
Age	6 (2.9)	4 (5.9)	2 (1.4)
Eligibility of severe strokes	5 (2.4)	2 (2.9)	3 (2.1)
Consent	2 (1.0)	2 (2.9)	0 (0)
Other	10 (4.8)	4 (5.9)	6 (4.3)

Data are reported as n (%).

Up to three reasons for call could be documented for each patient. The denominator for percentages is the total number of questions.

INR = international normalized ratio; CT = computed tomography

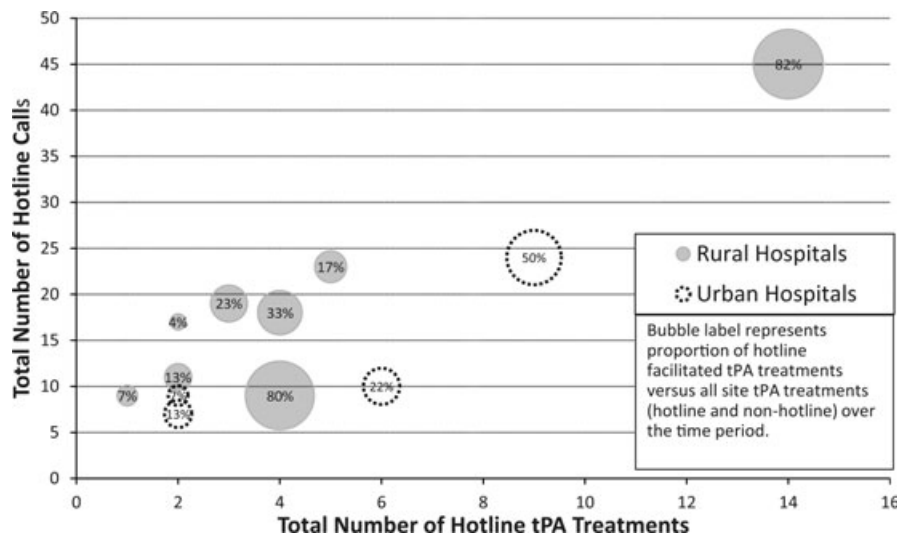


Figure 1. Hotline and tPA utilization by INSTINCT intervention hospital. The bubble label represents all tPA treatments (hotline and nonhotline) by site over the study time period. For example, the urban hospital in the middle of this chart had 18 total tPA treatments (number in circle), 24 total hotline calls, and nine tPA treatments associated with hotline calls. INSTINCT = INcreasing Stroke Treatment through Interventional behavior Change Tactics; tPA = tissue plasminogen activator.

Table 3
Clinical Outcomes and Protocol Deviations Stratified by Hotline Use

Variable	Nonhotline (n = 189)	Hotline (n = 54)
Clinical outcomes		
Treatment guideline deviation	45 (23.8)	15 (27.8)
Treatment guideline deviation (excluding timing)	18 (9.5)	7 (13)
Symptomatic ICH within 36 hours	13 (7.3)	3 (5.6)
Mortality	25 (13.2)	3 (5.6)
Protocol deviations		
Onset to treatment > 3 hours	27 (14.3)	9 (16.7)
BP at treatment > 185 systolic or > 110 diastolic	14 (7.4)	3 (5.6)
Prior stroke (3 months)	2 (1.1)	2 (3.7)
Recent myocardial infarction	2 (1.1)	0 (0)
Clearing symptoms	1 (0.5)	0 (0)
Recent major surgery (14 days)	1 (0.5)	0 (0)
Active bleeding or fracture	1 (0.5)	0 (0)
Platelet count < 100 × 10 ³	1 (0.5)	1 (1.9)
Minor symptoms	0 (0)	1 (1.9)

Data are reported as n (%).
The two groups were not statistically different on any outcome or deviation.
There were no protocol deviations for: not clinical diagnosis of stroke, symptoms suggestive of SAH, recent head trauma (3 months), recent GI/GU hemorrhage (21 days), recent noncompressible arterial puncture (1 week), prior ICH or SAH, on oral anticoagulants or INR > 1.7, on heparin or heparinoids or aPTT abnormal, glucose < 50 mg/dL, seizure at onset.
Note: Patient could have more than one documented protocol deviation.
aPTT = activated partial thromboplastin time; BP = blood pressure; ICH = intracranial hemorrhage; GI/GU = gastrointestinal/genitourinary; INR = international normalized ratio; SAH = subarachnoid hemorrhage.

patient/family declining treatment, one was due to a subsequent finding of ICH on head CT, and one was due to a finding that the time of onset was initially incorrect. A reason for nontreatment was unable to be determined in the other five patients.

Clinical outcomes and protocol deviations by use of the stroke consult hotline are presented in Table 3. There were no significant differences between the groups in protocol deviations (27.8% hotline group vs. 23.8% nonhotline group), incidence of symptomatic ICH (5.6% vs. 7.3%), or in-hospital mortality (5.6% vs. 13.2%). No medicolegal issues have been reported to date for any case in the study, although the time frame is short.

DISCUSSION

In this study, we found it feasible, safe, and minimally disruptive for consulting stroke experts to provide decision-making support via a free stroke hotline to local physicians, particularly EPs, who had limited on-site stroke treatment expertise. Our telephone advice model was different from those previously described in the literature, as generating transfers to the tertiary center was not our objective. As such, transfers to UMHS associated with calls to the hotline were rare, with “drip and keep” being the usual method of tPA delivery.

Nearly all of the questions to the hotline consultant surrounded the intricacies of tPA eligibility. EPs were particularly concerned about the issue of minor/improving stroke—an important subset of patients in whom tPA benefit may be greater than has been traditionally appreciated.^{23–25} Although telephone consultation does not allow for the consultant to conduct an independent history and neurologic examination, as is possible in telestroke consultations, consultants often were able to tease out the “minor” symptoms by asking the EP to

further define the deficits. For example, questions such as “Can the patient walk?” or “Would this weakness, if there were no further improvement, lead to disability?” allowed the consultant to help the EP determine whether the symptoms were severe enough to qualify for thrombolytic treatment. Future educational efforts aimed at increasing EP comfort levels in evaluating acute stroke patients for IV tPA eligibility should focus heavily on the relative versus absolute contraindications for the medication, including minor or resolving deficits.

Despite hotline consult recommendation to “definitely treat,” only 76% of patients in whom tPA was recommended received the medication; conversely, only one patient received tPA in whom treatment was not recommended. This reflects the complexity and evolving nature of acute stroke care, including improvement in the neurologic exam. It may also suggest that hotline consultants play a particularly prominent role in determining factors leading to tPA ineligibility but that the decision to provide (and accept) tPA treatment requires nuances only provided by bedside face-to-face encounters, which are difficult to capture in a brief phone consult. Due to EP efficiency and parallel processing (calling a consultant while data are still being finalized), nearly one-third of calls resulted in the consultant only being able to recommend to “potentially treat.” This reflects the real world of EM and the acute nature of stroke care.

Although rural hospitals used the hotline more frequently than urban hospitals, reliance on the hotline for tPA decision-making varied greatly. For example, a few hospitals used the hotline to discuss nearly every tPA treatment; however, the staff at many hospitals only rarely used the hotline for their treatment decisions. This points to the importance of understanding the

local strengths (such as preexisting consulting arrangements) and hindrances to acute stroke treatment within a hospital organization prior to designing a support system.

Protocol deviations and clinical outcomes did not differ in tPA-treated patients by hotline use. Over half of the protocol deviations involved timing of tPA administration, which was prospectively defined within the INSTINCT protocol as >3 hours since “last known well.” This may in part be due to the publishing of the ECASS 3 trial,²⁶ which occurred in the middle of the INSTINCT trial. Many of the decisions to treat with IV tPA may have been made with knowledge of the subsequent AHA advisory recommending treatment in the 3- to 4.5-hour window.²⁷ In addition, as part of the INSTINCT trial, the physicians at hospitals in which hotline use was advertised also received extensive education in acute stroke treatment, particularly on the appropriate use of tPA.¹⁹ Thus we cannot infer from these data the potential effect on protocol deviations or outcomes of providing telephone support in a drip-and-keep model without also providing additional education.

Stroke consultants may be concerned about legal liability and therefore hesitant to provide phone consultation without seeing a patient. Michigan case law (*Bank v Barry*, 223 Mich App 370, 1997) makes it clear that a phone consult between a treating physician and an outside nontreating expert does not create a treatment relationship. Since there is no relationship, there is no legal duty to the patient and so there cannot be any liability for the hotline physician. In contrast, telestroke, a billable service, does establish a treatment relationship between consultant and patient.

LIMITATIONS

Although a large proportion of calls were regarding minor or improving symptoms, only pretreatment NIHSS were abstracted in treated patients, limiting the inferences we could make regarding symptom improvement in treated or untreated patients. This study was also limited by lack of long-term outcome data, particularly in patients not treated with tPA, since these records were not collected by the INSTINCT study. In addition, we did not query EPs in real time to determine if they felt the hotline provided additional value to their practice, nor if use of the hotline increased appropriate tPA usage. This study lacked data on the appropriateness of nontreatment decisions, because the INSTINCT trial only collected patient-level data when there was treatment with tPA in the ED. In addition, this methodology was not compared to a formal, high-fidelity telemedicine strategy, such as is being increasingly adopted among EDs without acute stroke teams.

CONCLUSIONS

A stroke thrombolytic hotline was feasible and did not place undue burden on an academic acute stroke team. A cohort of community hospitals used the hotline with variable intensity. This model of providing hotline advice from an academic center as an adjunct to the local stroke protocols of community hospitals dispersed

throughout Michigan appeared safe, based on review of patient-level data. Future work that may be informative includes a real-time physician survey to ascertain such potential qualitative benefits of a stroke hotline, along with evaluation of long-term functional outcomes in all stroke patients in hospitals utilizing the service.

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