

Current TeleStroke systems enhance IV thrombolysis after acute stroke but may delay access to endovascular procedures

EJMINT Original Article, 2015: 1523000262 (4th June 2015)

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Abstract

INTRODUCTION: Telestroke systems as known today used currently recommend imply transfer of patients with acute strokes to Community Hospitals (CommH) that cannot offer endovascular procedures (EVT). The primary benefit of this policy relies on the fact that intravenous (tissue plasminogen activator (iv-tPA) one, may be offered earlier and two, unnecessary transfers to Comprehensive Stroke Centers (CSC) can be avoided. However, this strategy may generate time delays in potential EVT candidates. This study aimed to quantify the potential benefits and disadvantages of this strategy. **METHODS:** From March 2013 to March 2014, 533 teleconsults were centrally attended by stroke neurologists in the Catalan telestroke system that covers 105 CommH. We defined criteria to identify potential EVT candidates on the field or in the CommH after teleconsultation (clinical and radiological). **RESULTS:** Eighty-four patients (15.7 %) could have been identified on-in the field before arrival to CommH as potential EVT candidates. Once at the CommH, of these 84 patients, 60 (71 %) were still potential EVT candidates after CT-scan and teleconsultation. Of these 84 patients, only 27 (32 %) received iv-TPA in the CommH; however 68 (80 %) were still emergently transferred to CSC, where only 13(19 %) finally received EVT. The median time from CommH-door to groin puncture was 216 min vVs CSC-door to groin 152 min for primary CSC admissions ($p<0.01$). **CONCLUSIONS:** Present telestroke systems offer safe and timely iv-tPA treatment to eligible patients but may induce a considerable time loss in EVT candidates. Only a third 1/3 of the on-field potential EVT candidates benefit from admission in a CommH when being treated with iv-tPA, while more than three quarters 3/4 will still be transferred to the CSC.

Keywords: thrombectomy, endovascular treatment, Telestroke, acute stroke, stroke organization

Introduction

In the last decade, worldwide expansion of telestroke systems have improved stroke care in remote areas and reduced time to thrombolytic treatment allowing the use of intravenous tissue plasminogen activator (iv-tPA) in centers that otherwise cannot afford the presence of a stroke specialist in the emergency department [1-2]. A large number of publications have shown the safety and efficacy of telestroke for initiating iv-tPA treatment and triaging need for emergent transfer to a Comprehensive Stroke Center (CSC) [3-4]. However, in recent years, the proliferation of endovascular treatments (EVT) in selected centers and the fact that telestroke systems may delay access of severe stroke patients to these treatments has emerged.

As we know them today, telestroke systems imply transfer of acute stroke patients to the closest Telestroke Community Hospital (CommH) even if EVT cannot be offered at the site. The primary

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motivation for this policy relies on the fact that 1) iv-tPA may be offered earlier and 2) unnecessary transfers to CSCs can be avoided. However, this strategy generates a time delay in potential candidates for endovascular procedures [5]. This study aims to quantify the effects of a regional telestroke system on patients' access to EVT and to estimate the potential benefits of identifying EVT candidates in the field.

Methods

From March 2013 to March 2014, 533 teleconsults from CommH were centrally attended by a stroke neurologist in the Catalan Telestroke System that covers catchment areas of 10 Comm's (population covered: 1.23 million out of 7.5 million) with no endovascular facilities. Within these remote territories, pre-hospital protocols were established and the Emergency Medical System was instructed to transport all patients with acute stroke (<8 hours) with no major comorbidities to the closest Telestroke CommH. In the CommH, after initial examination and urgent CT-scan, attending Emergency Room physicians were instructed to teleconsult the vascular neurologist who reviewed all available data. The neurologist provided recommendations on optimal medical treatment including iv-tPA if indicated, and decided whether the patient should be transferred to a CSC for higher level of care including EVT, admission to a certified Stroke Unit / Intensive Care Unit or neurosurgery. Since each CommH has a referral CSC, patients from a specific CommH are preferentially transferred to its referral CSC even though incidences sometimes determine redirection to any of the three CSCs covering the telestroke catchment areas in Catalunya. Transfers were made by the fastest method, primarily by ambulance; however, depending on distance and availability, transfers could also involve helicopter. Mean distance from CommH to CSC was 58 km and mean transfer time 34 min. After each consult, the vascular neurologist recorded all data in a centralised web-based database. Data on all patients receiving iv-tPA or undergoing EVT were also recorded in a mandatory government centrally-audited web-based database [6].

We aimed to evaluate the possible benefits of applying predefined criteria to identify potential candidates for EVT in the field during initial evaluation by paramedics. To determine the ability of the system to identify potential EVT candidates at different levels, we defined a set of criteria according to available information collected in the field or at the CommH.

Potential candidates for EVT in the field were <81 years, with NIHSS>8 and <8 hours from symptom onset.

Potential candidates identified at the CommH were <81 years, NIHSS>8, <8 hours from symptom onset, absence of haemorrhage on CT-scan and ASPECTS > 6.

In order to measure the possible effects of applying these criteria to determine initial patient disposition, we studied the received treatments and transfers of these potential EVT candidates.

Results

From March 2013 to March 2014, 533 patients were consulted via telestroke with mean age 74+/-15 and 53.5 % were male. Median time from onset to videoconference was 165 min (IQR: 100-360) and total videoconference time 20 min (15-30). Final diagnoses after evaluation were: ischaemic stroke 78.9 %, haemorrhagic stroke 4.5 %, stroke mimic 8.3 %, others 8.3 %. Median NIHSS score was 4 (2-9) and median ASPECTS score on initial CT-scan was 10 (10-10). A total of 94 patients (17.6 % of teleconsults) received iv-

tPA via telestroke accounting for 8.7 % of all iv-tPA treatments in Catalunya during this time period. During teleconsultation, a decision to subsequently transfer to CSC was made in 226 cases (42.4 %) including 68 potential candidates for EVT. However, after transfer to and evaluation at CSC, only 13 of the 68 EVT candidates (19.1 %) finally received EVT accounting for only 4.3 % of all EVT procedures performed in Catalunya in the same time period (n=302). Additionally, the time from symptom-onset to groin puncture was considerably longer in patients initially evaluated by telestroke than in primary admissions at the CSC (216±82 min vs. 152±75 min; $p<0.01$) (Figure 1).

When we applied the pre-defined criteria of potential candidates for EVT, of the 533 patients, 84 (15.7 %) fulfilled the criteria to be identified as potential candidates for EVT on field before arrival to the CommH, and therefore could have been directly transferred to the CSC, which would considerably lower the number of time-consuming secondary transfers from CommH to CSC.

After CT-scan and telestroke evaluation at the CommH, of the initial 84 potential EVT candidates, 60 (71 %) were still eligible for EVT and emergently transferred as EVT candidates. Only 8 of 68 patients (11.7 %) emergently transferred for EVT were not initially identified in the field as potential candidates for EVT. On the other hand, only 27 (32 %) of the 84 EVT candidates received iv-TPA in the CommH before being transferred to the CSC; the rest did not receive any specific treatment at the CommH (Figure 2).

Discussion

Our study describes the clinical pathways of acute stroke patients transferred to a CommH for emergent telestroke evaluation. The study shows that a standard telestroke system with a design similar to systems around the world is highly effective in offering a timely specialised neurological evaluation and iv-tPA treatment. The system, however, leads to important delays and appears to preclude or delay access to EVT for potential candidates. According to current clinical guidelines, the only specific treatment for acute ischaemic stroke with the highest levels of evidence is iv-tPA treatment administered as early as possible within 4.5 h from symptoms onset [7]. Therefore, clinical pathways and strategies should prioritise access to iv-tPA treatment under these conditions. For this purpose, telestroke systems have been shown to be excellent tools, increasing the number of iv-tPA treated patients, reducing time to treatment and avoiding unnecessary long transfers to distant higher level of care centers [1].

Nonetheless, a number of disadvantages of telestroke systems must be considered. Patients sent for telestroke evaluation, especially close to or beyond the 4.5 h limit from onset or those currently on anticoagulants, may not be eligible for tPA treatment. Moreover, iv-tPA treatment alone will not be sufficient most of the time in a subgroup of stroke patients with proximal large vessel occlusions despite early thrombolytic treatment [8]. Therefore, in most cases, patients with these specific profiles will not clearly benefit from quick transfer to nearest telemedicine center, where after CT-scan and evaluation, a secondary transfer will be required leading to a considerable time delay [5,9]. For these patients, EVT appears to be a real therapeutic option, although extremely time dependent [10].

The proliferation of EVT programs and the possibility that in the near future ongoing clinical trials [11-12] will increase the evidence supporting these treatments, justifies reconsidering the present telestroke clinical pathways. Our study aimed to describe, quantify and confirm the perception that patients initially evaluated through telestroke in many cases arrive too late to the CSC for EVT. New triage algorithms to

determine which patients could be primarily transferred to a CSC bypassing the nearest telestroke CommH should be explored with the aim of minimising the number of time-consuming secondary transfers. These algorithms should include clinical information (such as stroke severity, prior medications) but also geographic information such as estimated time of arrival to different level of care centers. Clinical scales predicting the presence of a major vessel occlusion [13] have been proposed to help guide initial transfer destination. Similarly, several strategies are exploring the potential benefits of new technologies. CT scans can now be performed in the ambulance, and tPA treatment can be initiated even before patient transfer is initiated [14]. Mobile devices that allow videoconference and remote neurological assessment [15] can be used to offer onsite, instant consultation with expert vascular neurologists by the paramedic team to determine the best transfer option balancing in the decision: patient condition, therapeutic options and distance to different level of care centers. Several apps for mobile tablets or phones [16] are already in the market offering instant sharing of all relevant information such as neurological status, location or imaging files to the different members of the treating team in order to better coordinate the acute response and minimise the time frames.

Unfortunately, our study does not include data about the specific reasons for not receiving EVT in 55 out of 68 patients evaluated by telestroke who were sent for EVT to a CSC. Extensive brain damage on CT is probably the main cause; however, it is also true that several patients may improve during transfer due to recanalisation - either spontaneous or induced by iv-tPA treatment received at the CommH. Regardless, our results indicate that telestroke systems may interfere with access to EVT: telestroke patients represent 8.7 % of all iv-tPA treatments in Catalunya. A similar rate should be expected for EVT; however, telestroke patients represent only 4.3 % of all EVT in Catalunya. Moreover, the observed time from first admission to groin puncture was 64 min longer for telestroke patients. This considerable difference is likely minimised by the fact that those patients who experienced the longest inter-hospital transfers were ultimately not treated with EVT and are not accounted for in the time to groin puncture group. Finally, we did not compare the clinical outcome of EVT patients for both groups for different reasons: low number of EVT patients in telestroke group (n=13), probable imbalance between groups in time from symptoms-to-EVT, ASPECTS scores or collateral circulation. Future studies comparing the efficacy of direct transfer of acute stroke patients to EVT capable CSC versus closest CommH should help in the design of future clinical pathways, especially if there is growing evidence to support EVT treatment.

Conclusions

Telestroke systems as we know them today offer safe and timely iv-tPA treatment to eligible patients but may induce a considerable time delay in most EVT candidates. Only a third of in-field potential EVT candidates benefit from admission in a CommH by being treated with iv-tPA while more than three quarters will still be transferred to the CSC, with considerable delays in treatment.

Conflict of interest

We declare that we have no conflict of interest.

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Figures

Figure 1

Figure 1 shows actual flow of all patients evaluated through telestroke, transfers and received treatments at community hospitals or comprehensive stroke centers (absolute numbers and rates according to total treatments in Catalunya in the same period). The figure shows time from first hospital admission to groin puncture for patients that received endovascular treatment.

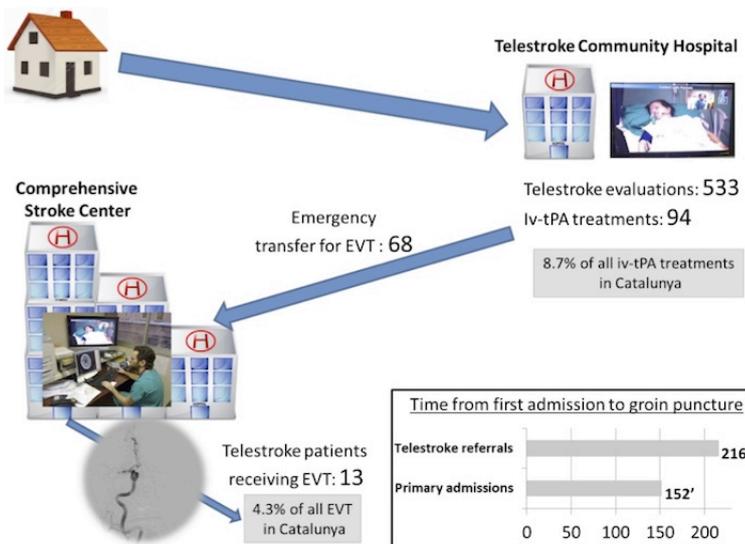


Figure 2

Figure 2 shows predicted detection of candidates for endovascular treatment candidates according to defined criteria in the field and after teleconsultation, treatment received treatments and suggested proposed novel circuits pathways bypassing community hospitals.

