# How to Improve Stroke Care in Your State and Region

Changing systems of care to optimize timely treatment for stroke.

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Mechanical thrombectomy is a revolutionary treatment that improves outcomes for patients with emergent large vessel occlusion (ELVO) in the anterior circulation, even up to 24 hours from symptom onset.[1-6] Although the time window for treatment is expanding, the effectiveness of intervention still decreases over time. We therefore have a unique problem in medicine—there is a highly effective treatment, among the most effective in all of medicine, but patients do not receive it due to inefficient organization of systems of care. This article focuses on what the neurointerventionalist can do to improve stroke care in his/her state or region. In many ways, we analogize the steps needed to those described by Goyal et al[7]; the goal is to eliminate as many bottlenecks as possible. We will start backwards, beginning in the angiography suite and ending in the field where emergency medical services (EMS) first makes contact with the patient.

## IN THE ANGIOGRAPHY SUITE

The angiography suite is where neurointerventionalists tend to focus on their contribution to stroke care. It is imperative to work toward decreasing times to recanalization. The use of a standardized technique by all neurointerventionalists at a single center has been shown to decrease treatment times.[8,9] This also functions to decrease the "cognitive load" on the entire team, including nurses and technologists, after hours. An analysis of multiple trials showed worse outcomes when general anesthesia was used as compared with moderate sedation.[10,11] However, some recent trials did not show a difference in outcome when patients were randomized to anesthesia or sedation.[12,13] As such, there does not appear to be a benefit to using anesthesia, and it is possible that the routine use of anesthesia may delay the procedure.[14] Whatever the protocol, as determined by the local site, it should be employed consistently in every case to facilitate rapid treatment.

## MAKING THE TREATMENT DECISION

Prior to patient arrival in the angiography suite, there is the issue of making the treatment decision. The neurointerventionalist should take an active role in determining what information is needed to mobilize the team. Is an exact National Institutes of Health Stroke Scale (NIHSS) score needed? Or, is it adequate to know that the patient has an occlusion of the middle cerebral artery with dense weakness on the appropriate side? Whether the final NIHSS score is 8 or 18, the patient will likely undergo thrombectomy. As such, we favor keeping the criteria for team activation simple. The presence of occlusion on CTA along with a moderate to severe clinical deficit is usually adequate to mobilize the team, along with an assessment of core infarct.

As no clinical score can adequately exclude ELVO, many suggest performing CTA on all suspected stroke patients regardless of severity.[15-17] Although diffusion-weighted MRI is the gold standard for assessing the extent of core infarct, we believe that adequate assessment can usually be made using a combination of noncontrast CT Alberta Stroke Program Early CT Score (ASPECTS) and an assessment of collateral flow on CTA. Multiphase CTA can aid in assessing collateral flow and can be acquired simply with no additional postprocessing.[18] In cases in which the ASPECTS and CTA collaterals suggest a small core infarct, MRI is concordant in most cases.[19] As such, even beyond 6 hours

from onset, performing additional imaging to confirm eligibility may come at the expense of a delay to treatment.

## INTERFACILITY TRANSFERS

Although optimizing in-hospital processes is important, the biggest delay in delivering timely access to thrombectomy occurs between the call to EMS and arrival to the endovascular-capable center. This is where the neurointerventional community has the greatest potential to make an impact, and we need to be actively involved. Mobile stroke treatment units (MSTUs), specialized ambulances with on-board CT scanners, are promising technologies that have the ability to administer tissue plasminogen activator and scan the patient on the scene. Although MSTUs are exciting, there are two more readily implemented methods to improve access to thrombectomy—improved interfacility transfer protocols and field triage for suspected ELVO.

Historically, interfacility transfers for ELVO have been inefficient and have resulted in a substantial percentage of futile transfers. In many of these cases, vessel imaging at the endovascular-capable center demonstrated no ELVO. One recent study showed that more than 50% of transferred patients with suspected ELVO did not undergo thrombectomy after transfer, with the most common reason being no ELVO shown on CTA.[20] For this reason, it is imperative that all facilities receiving stroke patients have the capability to perform CTA. This would ensure that all patients being transferred have a confirmed diagnosis of ELVO. The other reason that patients are not candidates for treatment is progression of infarct due to delays in the transfer process. One in three patients becomes ineligible for treatment due to a decline in the noncontrast CT ASPECTS score.[21] However, it is worth noting that in these series, the interfacility transfer times were extremely long, approaching 5 hours between initial CT scan and repeat imaging.

It is possible to develop a more streamlined transfer process for thrombectomy. One such successful protocol focuses on three key elements: (1) early vessel imaging at the initial hospital; (2) Health Insurance Portability and Accountability Act (HIPAA)–compliant, cloud-based imaging sharing with the stroke team at the receiving facility; and (3) mobilization of transport resources prior to confirming an ELVO.[22] With this protocol, McTaggart et al showed that the door-in to door-out time at the initial hospital could be reduced to a mean of just 64 minutes as compared with 104.5 minutes when this strategy was partially implemented (fewer than all three elements performed).[22] Because the vessel imaging has already been done at the initial hospital, patients can be directly transported to the angiography suite, rather than needing to stop in the emergency department for repeat assessment and imaging. This direct transport allowed for an arrival to angiography time of just 17 minutes in the fully implemented group. Others have described a similar paradigm for transferred patients, bypassing the emergency department and going directly to the angiography suite.[23] However, ensuring consistent compliance with such a protocol may be an ongoing challenge. This transfer protocol may be best for centers that are slightly more distant from the endovascular-capable stroke center.

## FIELD STROKE SEVERITY SCALES

Ultimately, the most effective way to ensure rapid access to thrombectomy is probably field triage for suspected ELVO based on an EMS assessment. Using data from the ESCAPE trial, mathematical models have shown that if a patient is within close proximity to the endovascular-capable stroke center, direct triage from the field will result in better outcomes than going to the closest hospital first.[24] The range for which direct transport is preferential to going to the closest hospital is a function of several factors, including the efficiency of care at the closest hospital (ie, door-to-needle time and door-in to door-out times), as well as at the treating thrombectomy center. Indeed, the model showed that if the endovascular-capable stroke center can achieve modified thrombolysis in cerebral ischemia 2b or greater in 90% of cases after thrombectomy, then direct transport is likely superior, even within a 90-minute transport radius. When modeling these data using real geographic data, for metropolitan regions, where both endovascular-capable and nonendovascular-capable centers are in close proximity, direct triage to the center where thrombectomy is performed is much more likely to result in better outcomes.[25] Real-world validation of these models is needed, but this will likely confirm the need for direct triage.

The next natural question is: How should EMS triage patients? Most field stroke protocols have initially asked EMS to simply screen for stroke on a binary level, but now, the crucial step is to use a field severity scale, with the idea being that patients with a positive field severity scale would be directly transported to an endovascular-capable stroke center. Several stroke scales have been developed, which mostly focus on the presence of motor weakness (typically involving the arm and face, sometimes the leg) and, in some cases, the presence of cortical signs (eg, gaze deviation, aphasia, hemineglect).[26-29] The optimal scale is unknown, but the performance of most of these scales, including the

physician-performed NIHSS, is similar for the presence of ELVO.[28,30] It is also important to note that a percentage of the "false positives" for these scales may actually be intracerebral hemorrhage (ICH), and those patients are often cared for at the same centers. As such, it is important to think of success of field triage as identifying both ELVO and ICH patients. Different jurisdictions may use different scales, and it is paramount to engage the local EMS community in the process of choosing a severity scale that they prefer. Smartphone-based tools such as the Stroke Scales for EMS app can assist first responders in performing stroke scales.

## CHANGING EMS PROTOCOLS: WHAT YOU CAN DO

Changing EMS protocols to directly triage suspected ELVO patients to endovascular-capable stroke centers is possible but will likely take time. Additionally, the logistic processes of EMS protocols vary by state or region. Neurointerventionalists who are active in the community should know how EMS policy is made and changed in their region. Many regions will have an advisory board, task force, or council for stroke. Identify where this group meets, and ensure neurointerventional representation on the task force. The Society of NeuroInterventional Surgery is actively involved with this process nationally through the Get Ahead of Stroke campaign (www.getaheadofstroke.org), which aims to change EMS protocols in all 50 states. At least one state (Rhode Island) has already changed the protocol and implemented a severity-based triage for ELVO, and others are close to following suit.[31]

# WHAT YOU CAN DO TO IMPROVE STROKE CARE IN YOUR REGION

### IN THE ANGIOGRAPHY SUITE

- Develop a single standardized technique for thrombectomy at your center
- Instruct all involved personnel on the preferred setup
- Decide whether anesthesia services will be used, and if so, partner with the anesthesia team to minimize related delays

### MAKING THE TREATMENT DECISION

- Simplify neurointerventional team activation criteria to only what is needed to mobilize the team
- Develop a center-specific, simplified imaging paradigm for all suspected stroke patients
- Perform continuous quality improvement on all treated patients to streamline times and rapidly identify roadblocks

### INTERFACILITY TRANSFERS

- Work with all referring centers in your region to standardize imaging protocols and perform CTA as initial imaging in all suspected stroke patients
- Instruct centers on the need to mobilize transport resources early, ideally before confirmation of ELVO on CTA
- Develop cloud-based, HIPAA-compliant solutions to securely share images from referring hospitals prior to arrival at the endovascular-capable stroke center
- Transport patients directly to the angiography suite without stopping in the emergency department or repeating imaging, unless there has been a clinical change or a prolonged transport time
- Provide near real-time feedback for transferred patients to improve the mechanism for next time

### FIELD STROKE SEVERITY SCALES

- Review and understand how to perform the most popular field stroke severity scales
- Engage local EMS leadership to educate them on the need for a field stroke severity assessment and gauge their preferences on a scale

### CHANGING EMS PROTOCOLS

- Identify and participate in the regional or state stroke council, task force, or committee
- Inquire how EMS protocols are developed for other acute care diseases (eg, trauma, myocardial infarction)
- Work to educate policymakers on the need for similar triage mechanisms for ELVO

### IMPLEMENTING EMS CHANGE

- Meet with local EMS leaders as field triage is implemented and review the local protocol with them
- Provide feedback to local and regional EMS leadership as patients are triaged, both appropriately and inappropriately
- Engage EMS with in-person educational sessions, reviewing your local stroke severity scale and the benefits of thrombectomy

## IMPLEMENTING EMS CHANGE

After EMS stroke triage policies are updated, there is the more daunting task of implementation. Educating EMS on the proper use of the field stroke severity scale and appropriate triage is a process that will likely take years. Direct, in-person educational sessions have the highest yield but will take substantial time. At your endovascular center, determine whether patients are taken to the closest hospital or directly triaged to the endovascular-capable stroke center. After the procedure, give feedback to the EMS unit that brought the patient in, both positive and negative. Feedback on appropriately triaged patients, especially when those patients are discharged home with minimal deficits, can have a tremendous effect for future patients.

## CONCLUSION

We are at an exciting time in stroke care. Patients with ELVO, the most devastating type of ischemic stroke, now have an incredibly effective treatment option. However, ensuring timely access to this treatment will require substantial work to change our systems of care. It is important to optimize in-hospital processes at individual endovascular-capable stroke centers, as well as processes for interfacility transfer.

Ultimately, direct triage in the field will likely yield the greatest benefit to our patients. As such, it is imperative that our neurointerventional community becomes actively involved with changing EMS protocols to ensure that suspected ELVO patients are taken directly from the field to endovascular-capable stroke centers. We must be actively involved in implementing these changes in order to improve outcomes for all ELVO patients in our region. ■

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