MAYO CLINIC

EDITORIAL

January 2009
Volume 84
Number 1

Mayo Clinic Proceedings

Camera in the Emergency Department: The Evolution of Stroke Telemedicine

Each minute that an acute ischemic stroke goes untreated, 1.9 million neurons die.[1] Multiple professional organizations have promoted the concept of *brain attack* (to correspond with the more widely recognized *heart attack*) ever since approval of tissue plasminogen activator (tPA) for treating acute ischemic stroke.[2] The health care system continues to adjust to the fact that tPA must be given within 3 hours of a stroke to increase the likelihood of a favorable neurological outcome. The most common reason patients who present with acute ischemic stroke do not qualify for tPA treatment is that they do not present to the care facility in time to receive it. Even if patients present within the therapeutic time window and have no obvious contraindication to tPA, they may not receive it because physicians may be reticent to give it.

Why the reticence to use a proven therapy? Some suggest that this attitude stems from the perception that tPA carries an unacceptably high risk of intracranial hemorrhage and an attendant risk of liability.[3] Vascular neurologists (and related subspecialists) who focus on the diagnosis and treatment of cerebrovascular diseases are more likely than other physicians to appreciate the favorable balance of risks and benefits when using thrombolytic therapy in properly selected patients.[4] Because it is not possible to bring a vascular neurologist to the bedside of all patients who are possible candidates for tPA, tPA use might instead be improved by bringing more of the patients to the specialists. Creating emergency management networks that preferentially transport patients to designated stroke centers is one option. This approach was proved effective in Brooklyn and Queens, NY, where designating stoke centers and instituting preferential triaging resulted in higher rates of tPA use and lower rates of tPA protocol violations.[5] Another approach is to bring more specialist expertise to the patients through novel means. In this issue of *Mayo Clinic Proceedings*, Demaerschalk et al[6] summarize progress that has been made to bring stroke specialty care to patients through telemedicine.

In what is referred to as *telestroke* patient assessment and management, brain attack cases present to a spoke hospital emergency department and undergo a remote stroke assessment by a vascular neurologist at a hub hospital. Special audiovisual equipment transmits information in real-time between spoke and hub. The vascular neurologist remotely interacts with patients, their families, and emergency department staff and is able to observe diagnostic head imaging, cardiac monitors, and patients' performance on a structured neurological examination (the National Institutes of Health Stroke Scale). The vascular neurologist, informed of all pertinent information, then advises the emergency department physician whether to administer tPA. Demaerschalk et al[6] describe their early experience with a hub center based in Phoenix, AZ, and 2 spoke centers—one in Yuma, AZ, and the other in Kingman, AZ. This Stroke Telemedicine for Arizona Rural Residents (STARR) network plans to add 7 more spoke hospitals soon. Developing such networks is becoming technologically more feasible. At least 3 devices for streaming audiovisual information to and from the patient's bedside are commercially available. Several stroke telemedicine networks have already been established among diverse groups of physicians in Germany, France, Canada, and the United States.

See also pages 43 and 53

Is this rapid adoption of telemedicine technology for assessing and treating brain attack justified? Stroke telemedicine compares favorably with the more traditional telephone consultation. A trial of 222 patients with acute ischemic stroke presenting to 1 of 4 spoke hospitals located within 30 to 350 miles of an academic stroke center in California randomized patients to telephone consultation

Dr Meschia receives support from the Siblings with Ischemic Stroke Study (R01 NS39987) and the Carotid Revascularization Endarterectomy vs. Stenting Trial (CREST) (R01 NS038384).

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vs telemedicine.[7] Making the correct decision about administering thrombolytic therapy occurred 16% more often in the telemedicine group than in the telephone consultation group. Nonetheless, investigators did not demonstrate that telemedicine improved hard end points, such as case fatality rate, intracranial hemorrhage rate, or functional outcomes. More research is needed to address whether telemedicine can improve these hard end points. Longitudinal studies of the effects of stroke telemedicine on a community would also be of interest. Long-term exposure to stroke telemedicine consultations may lead to emergency medicine physicians becoming more comfortable giving tPA independently. However, concern remains that, by removing decision making (and its legal consequences) from local physicians, a sense of *learned helplessness* may develop among staff members at spoke hospital emergency departments. Clearly, more experience is needed to determine how these issues will evolve.

Numerous financial, legal, and administrative challenges had to be overcome to develop the STARR telemedicine program.[6] These challenges would likely be encountered by others considering a similar program in their geographic region. Telestroke networks present complex health economics questions. Telestroke is a high-technology solution to bringing timely stroke expertise to underserved communities, but how sparsely populated and geographically isolated does an underserved community need to be to justify providing telestroke services over establishing a local primary stroke center? No single answer will apply to all communities.

The Demaerschalk et al review focuses on brain attack, that 0- to 3-hour window of care when the decision as to whether to give tPA must be made. However, telemedicine is also being tested in many other aspects of stroke care. Physical therapists are using telemedicine to enhance the rehabilitation of motor deficits after stroke.[8] Speech pathologists are using it to improve access to aphasia assessment services. A randomized trial of 24 patients who had had a stroke showed that assessment of functional communication by video conference had high levels of agreement with face-to-face assessments.[9] Telemedicine is also being used to improve utilization of neurosurgical services. A randomized trial of 710 patients with emergent neurosurgical conditions showed that video consultation combined with teleradiography achieved a higher diagnostic accuracy than telephone consultation.[10] It is unknown how widely telemedicine for stroke will be used. However, if it proves financially sustainable, its use in many aspects of stroke care will likely grow.

Although the decision to give tPA is seen as the end point of telestroke consultation, this decision is really just the beginning of caring for the patient. Postthrombolytic care requires intensive cardiovascular and neurological monitoring and neurosurgical backup. Many spoke centers would do well to adopt a "drip-and-ship" policy; that is, after initiation of tPA infusion, patients would be transported from spoke hospital emergency departments to a hub center experienced in neurointensive care.

After the immediate postthrombolytic period, care needs to focus on secondary prevention. Patients with acute ischemic stroke are at high risk of recurrent stroke. If successful reperfusion therapy is like dodging a bullet, successful secondary prevention is like avoiding being caught in the line of fire again. In this issue of *Mayo Clinic Proceedings*, Adams[11] gives evidence-based recommendations on optimizing secondary prevention. His review will be welcomed by clinicians seeking guidance beyond evidence-based guidelines. Results of the Carotid Revascularization Endarterectomy vs. Stenting Trial (CREST trial) (clinicaltrials.gov identifier: NCT00004732), which completed enrollment earlier this year, should provide clarity on the relative merits of carotid stenting vs endarterectomy in non–high-risk patients with symptomatic and asymptomatic carotid stenosis. Results of the Carotid Occlusion Surgery Study (COSS) (clinialtrials.gov identifier: NCT00029146) should determine whether patients with symptomatic carotid occlusion defined as high-risk on the basis of positron emission tomographic findings benefit from extracranial-intracranial bypass. These and many other trials call on clinicians to remain vigilant as the field of secondary stroke prevention continues to advance.

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