Public Health Urgency Created by the Success of Mechanical Thrombectomy Studies in Stroke

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Stroke is a major cause of death and disability.[1] Each year, >15 million strokes occur worldwide. In addition, ≈35% of strokes are caused by potentially reversible large-vessel occlusion. Until 2015, no scientifically proven interventional treatment strategies were available to address this type of stroke. In the early 1980s, reports of dramatic clinical improvement with reopening of large-vessel occlusions were published. However, patient volumes were small, tools were crude, and results were inconsistent. The first significant advance in the treatment of this condition was the US Food and Drug Administration's approval of intravenous tissue plasminogen activator in 1996. With tissue plasminogen activator, only a small subset was eligible for this therapy, and most people with major strokes fared poorly.[2] Subsequent development of the Merci device (Stryker) gave birth to the field of invasive clot retrieval for acute ischemic stroke (AIS). MR CLEAN (Multicenter Randomized Clinical Trial of Endovascular Treatment for Acute Ischemic Stroke in the Netherlands) first documented transformational beneficial results for clot retrieval.[3] This study was followed by 4 more positive trials reported in 2015 and began a new era in stroke care.[3]

The new data have resulted in a potentially cataclysmic gap between patient need and available expertise. Given the recent study results, the "gold standard" treatment is now rapid mechanical revascularization and mirrors the last 2 decades of acute myocardial infarction care. In contrast to acute myocardial infarction, however, we now face an overwhelming shortage of neurointerventionists to support the shift in AIS treatment. Therefore, we believe interventionists from other training backgrounds must now fill this gap in AIS, and a collaborative ST-segment elevation myocardial infarction (STEMI) model for care needs to be instituted to ensure rapid revascularization.

Brain cells appear to be even more sensitive to ischemia than is the myocardium. A subset analysis of recent trials shows that time to intervention is critical with patients revascularized ≤2 hours achieving ≈90% good functional neurological recovery, whereas the recovery associated with a delay of >6 hours was considerably less, yielding ≈20% good functional recovery.[4]

We envision a multidisciplinary approach that includes cardiologists for optimal results. "Time is Brain" must be the mantra, so immediate revascularization must be the goal. As reimbursement for revascularization improves, technology offerings will rapidly advance, making optimal intervention for AIS more widely available, efficient, and successful. Available interventional expertise to ensure rapid intervention will be key to good outcomes, with fast-track protocols in emergency rooms, prompt and accurate image-based diagnosis (ischemic occlusion versus hemorrhage), appropriate patient selection, and postoperative care necessary for best outcomes.

Although the concept of comprehensive stroke centers has been developed and implemented in selected areas of the country, the centers are usually located in major metropolitan areas. The composition of these centers includes neurora-

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diologists, neurosurgeons, neurologists, expert imaging capability, general medicine, and physical therapy, with an emphasis placed on team-based care. With the current data on the success of mechanical thrombectomy, a program to increase the number of these centers is imperative, particularly with expansion of the number of individuals with neurointerventional expertise. Several practical issues need to be addressed in this regard.

Demographics and time limit the ability to meet the mandate that stroke intervention takes place as close to onset as possible. Currently in the United States, ≈600[a] 24/7/365 stroke-ready neurointerventionists exist, and they are mostly concentrated at major medical centers in cities with a population >250 000. Nearly half the US population lives in more rural areas with nearby cardiac catheterization laboratories but no comprehensive stroke centers with neurointerventional capabilities. Moreover, in larger cities, many designated stroke centers are without interventional capabilities. In 2016, industry experts predict that 15 000 to 20 000 stroke interventions will be performed in the United States, which is still a relatively small number considering the ≈800 000 acute ischemic strokes that will occur. Time needed to transfer all stroke patients to comprehensive stroke centers will result in unacceptable delays and suboptimal outcomes.

Training many more neurointerventionists does not appear to be a practical solution. The volume of elective intracranial work simply does not provide enough cases to support the many more providers needed to treat acute strokes. We believe the only practical solution is to recruit and train other practicing interventionists, such as cardiologists and interventional radiologists, to perform the time-sensitive revascularization at the location closest to AIS onset. For this approach to work, these physicians will need cognitive preparation as well as hands-on experience, preferably at an established regional stroke center.

Interventional cardiologists appear well suited to take on this task. They are accustomed to 24/7 STEMI coverage and are highly skilled at reopening occluded arteries—something neurointerventionists rarely do outside of AIS treatment. Interventional cardiologists spend most of their working hours opening stenosed or occluded arteries in the heart with techniques and goals similar to those required for stroke intervention, whereas neurointerventionists spend most of their time coiling aneurysms, embolizing arteriovenous malformations, and treating other lesions in the brain. In addition, >6000[a] interventional cardiologists currently practice, and the cardiology/STEMI infrastructure is already in place, with >2000[a] cardiac catheterization laboratories in the United States to support the additional patient demand.

Training of interventional cardiologists should be individualized but meet a well-defined bar, and it should be based on the cardiologist's interest, experience, skill set, local multidisciplinary capabilities, and institutional commitment to collaboration. We envision stroke intervention performed successfully and efficiently by appropriately trained physicians from different specialties who are skilled in navigating and opening small arteries. Cardiologists and interested interventional radiologists must join in AIS treatment, and turf issues must not be allowed to interfere with the overarching public health benefits. Many barriers must be overcome beyond the creation of a new workforce, including physician and patient awareness, AIS system inertia, reimbursement for intervention, technology improvements, and systems of care. For the narrow interventional aspect of stroke care, the key to success will be to utilize the available 10:1 cardiology manpower advantage and widespread cardiac catheterization laboratory presence to focus on geographic areas underserved by neurointerventionists. Utilizing local expertise can fast-track clinical and imaging protocols fostering early intervention to reverse strokes, save lives, reduce the economic burden, and benefit the public health currently unavailable to a significant portion of the population. The STEMI model perfected by cardiologists over the last decades works well, saves lives, and is an excellent standard for successful AIS care.

A new and different paradigm is needed to optimize outcome for AIS caused by large-vessel occlusion. Patients should be treated at the nearest neuro angiographic suite or cardiac catheterization laboratory to minimize delay. Multidisciplinary stroke teams must be organized like STEMI teams. Clinical and imaging diagnostic criteria for intervention will become standardized and easy to follow and will reduce variation. Straightforward cases with good results in rural cardiac centers can be managed by local teams pairing cardiologists and neurologists. Complex cases can be transferred under standard protocol to comprehensive stroke centers for postprocedural management after revascularization is accomplished.

A final issue is assessment of quality of care at current and new centers taking care of these patients. Consideration should be given by the professional societies involved to develop a national registry of stroke centers with the development and implementation of standardized data forms and a data center to document outcome and identify ways to further improve the delivery of care.

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[a]Extrapolated from references 1, 3, and 4 and contacts at the Society of Neurointerventional Surgery and the Society for Cardiac Angiography and Interventions, October 2016.

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FOOTNOTES

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