Editorial

Workforce needs for endovascular acute ischemic stroke therapy: myth or reality?

HARRY CLOFT, M.D., PH.D.

Departments of Radiology and Neurosurgery, Mayo Clinic, Rochester, Minnesota

The acute ischemic strokes amenable to intraarterial therapy probably number no more than 20,000 per year in the United States. The future demand for intraarterial reperfusion techniques may change, but the fraction of patients who require intraarterial thrombolysis is currently rather low, and the number of neurointerventionists is adequate. Each hospital caring for patients with acute stroke will need to determine its own demand for intraarterial therapy and employ an adequate supply of qualified neurointerventionists available to meet demand. Comprehensive stroke centers are now being designated and hopefully will foster a rational, regionalized approach to the delivery of endovascular therapies for stroke.

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ACUTE ischemic stroke is a complex entity with many forms and many corresponding treatments that must be tailored to the individual patient. Consensus guidelines from the American Heart Association and American Stroke Association regarding acute ischemic stroke mention intraarterial therapy as one of many tools in the armamentarium for ischemic stroke.¹ The rapid evolution of intraarterial therapy for ischemic stroke has led to speculation regarding the availability of a sufficient number of operators to treat patients in the United States (US).^{14,15,37,38} Stroke is the fourth leading cause of death in the US, after heart disease, cancer, and lung disease,³² so it is tempting to speculate that the number of neurointerventions for stroke must be headed for rapid expansion.

The Demand for Intraarterial Stroke Therapy

A rejection of the need for expansion of neurointerventional services for stroke might be regarded as a callous disregard for the needs of more than 795,000 Americans³² who face death and disability from stroke each and every year. Based on the available relevant statistics, however, it is not. Intraarterial therapy is currently applicable to a small subset of patients with ischemic stroke. Hirsch et al.²² recently estimated 10,400–41,500 potential endovascular acute ischemic stroke intervention cases per year. In the Mayo Clinic analysis of demand

for endovascular intervention for acute ischemic stroke in the US, we found that the demand is quite likely to be less than 20,000 cases per year,¹¹ which fits nicely within the range estimated by Hirsch and colleagues.²² An additional factor not considered in previous estimates is that advanced stroke imaging has significant potential to reduce the number of endovascular treatments, because it could exclude many patients with completed infarctions from futile recanalization therapy.

A recent series of negative trial results for endovascular therapies is certainly not going to stimulate their use in acute ischemic stroke. The MR RESCUE (Mechanical Retrieval and Recanalization of Stroke Clots Using Embolectomy),²⁶ SYNTHESIS (Local Versus Systemic Thrombolysis for Acute Ischemic Stroke),⁹ and IMS III (Interventional Management of Stroke III)⁸ trials all found a lack of benefit from endovascular therapy for acute ischemic stroke. It is clear from these trials that the application of endovascular therapy to a broad clinical cohort of acute ischemic stroke patients is not efficacious. These trial results should cause all endovascular stroke therapists to realize that careful patient selection is essential to good outcomes. Improving selection boils down to avoiding the treatment of those for whom endovascular recanalization is futile.^{7,10,23,31} Patient selection may be improved by advanced imaging, such as MRI²⁷ or CT perfusion imaging,¹⁷ but this hypothesis remains to be conclusively evaluated.^{18,25,33,36,39,40} New technology such as stent-trievers cannot be expected

to inevitably stimulate very much growth of endovascular treatment. Rather, these new endovascular technologies are replacing old ones, with probably little net growth in case numbers.

The Supply of Intraarterial Stroke Therapy Providers

An optimal number of practitioners in any medical specialty maximizes patient access to care while providing enough patients for each specialist to maintain his or her clinical expertise. Analysis of the neurointerventional workforce has been conducted for more than a decade, with initial work on this subject estimating that the optimal number of neurointerventionalists might be 600 in the US.¹²

While several papers in the cardiology literature have claimed that a shortage of neurointerventionalists would require cardiologists to provide endovascular therapy for acute ischemic stroke,^{14,15,37} there is actually no evidence that such a shortage exists. The number of neurointerventionalists was noted to be approaching 800 in 2012,^{16,41} and with 80–100 fellows finishing training each year recently,¹⁶ the number continues to grow. The 800 practitioners now make neurointerventional services available within 50 miles of 95% of the population.⁴¹

The optimal way to serve patients in sparsely populated areas and at smaller community hospitals is not to expect that we can staff them with a neurointerventionalist who is inactive all year except for the 1 or 2 instances in which someone needs neurointerventional treatment, when he or she would spring into action as a rather unpracticed operator. It is also not in the best interest of patients to expect that a non-neurointerventionalist is going to be able to expertly offer neurointerventional services after attending a hands-on workshop or other minimal training. The most practical solution is to rapidly transfer patients to regional centers that have volumes of patients to justify employing a neurointerventionalist who handles enough cases to maintain a high skill level. Aside from the neurointerventionalist's skill, high-volume stroke centers have better clinical outcomes and lower mortality than low-volume centers.^{34,35}

Planning for the Future

The delivery of stroke care is analogous to that of trauma care in that a regional system is needed to provide prompt, skilled management to as much of the population as is practical. A regional care model has also been applied to myocardial infarctions but has not been implemented on a national level as in trauma.²⁴ Regional trauma centers have been designated throughout the US and have been shown to improve outcomes.¹³ The number of Level I trauma centers in the US is 190.²⁹ Comprehensive stroke centers are now being designated to serve a function analogous to trauma centers. If each of an estimated 200 comprehensive stroke centers treated 100 patients per year with intraarterial thrombolysis, 20,000 individuals would be treated annually in the US. That translates to 2.5% of the 795,000 patients hospitalized for acute is-

chemic stroke in the US each year who could be treated with intraarterial methods. If each comprehensive stroke center were staffed by 3 neurointerventionists, the total number of required neurointerventionists would be approximately 600.

Because stroke is a major health problem, it is essential that skilled care be available from qualified neurological experts. Qualification standards have already been published as agreed on by a multidisciplinary coalition consisting of the Society of NeuroInterventional Surgery (SNIS), American Academy of Neurology, American Association of Neurological Surgeons/Congress of Neurological Surgeons Cerebrovascular Section, and Society of Vascular and Interventional Neurology.³⁰ It is rather naive to assume that advanced stroke care can be delivered by physicians without expertise in the neurosciences. Each acute stroke center that offers intraarterial ischemic stroke therapy must ensure that qualified individuals are providing this therapy.

For patients with complex medical problems, studies have repeatedly and consistently shown that morbidity and mortality rates tend to be lower when treatment is provided at centers that care for large numbers of patients.^{3–5,20,21,28} This trend toward better outcomes with treatment at high-volume centers also holds true for patients who undergo endovascular therapy for acute ischemic stroke. Patients have been shown to be more likely to have successful reperfusion and a good clinical outcome if treated at a high-volume center.¹⁹

It might be argued that recanalization in acute ischemic stroke is such an urgent imperative that it is necessary to enlist the help of operators who are not specialized neurointerventionalists. There is often a misconception that endovascular treatment cannot possibly make things any worse than they already are. But misguided and unskilled intervention can certainly make the patient worse in many cases, and I remain skeptical that endovascular ischemic stroke intervention practiced outside of a specialized stroke center will help more patients than it harms. I find ischemic stroke cases to be among the most challenging neurointerventions, not just from a technical perspective but also from a cognitive decision-making perspective. While there may be anecdotal reports of patients recovering well after treatment by nonspecialized interventionists, overall outcomes will probably be optimized by sending as many patients as possible for treatment at specialized stroke centers. Until recently, the SNIS mission statement was as follows: “The mission of [SNIS] is to foster the growth of the discipline of neurointervention and support its multi-disciplinary physician members to provide the highest quality of neurointerventional patient care through research, education, standard-setting, and advocacy” (<http://www.snisonline.org/mission> [accessed August 16, 2013]). At some point, fostering the growth of the discipline starts to conflict with providing the highest quality of neurointerventional patient care. Providing the highest-quality care should be the fundamental mission, and fostering the growth of the discipline should only be implemented if and when it promotes the highest quality of patient care. The number of operators has grown beyond an optimal level, resulting in a decline in quality.¹⁶

Workforce for ischemic stroke intervention

For example, in 2010, cerebral aneurysm treatments began to shift toward low-volume centers, probably because of an excessive number of treating physicians entering practice.⁶ Safety is fostered by having skillful operators at experienced centers, so maintaining an appropriate number of qualified practitioners is imperative.

The neurointerventional field finds itself in a position similar to American medicine a century ago. In the 19th century, medical education was largely unregulated and there were too many medical schools in the US. Following the release of an influential report by Abraham Flexner in 1910, educational standards were established and the number of medical schools was substantially reduced.² These changes marked a turning point in the reputation of physicians among the general public. Like physicians in the early 20th century, neurointerventionalists are rather undefined and unregulated. There is no consensus standard of what qualifies a person to perform neurointerventional procedures. Board certification is the means by which fully mature specialties define qualified practitioners, and the neurointerventional field has not been able to reach this level of maturity for political reasons. While certification of fellowships was implemented by the Accreditation Council for Graduate Medical Education in 2006, such accreditation has not been sought by the majority of fellowships.

Conclusions

The number of acute ischemic strokes amenable to intraarterial therapy is probably no more than 20,000 per year in the US. The future demand for intraarterial reperfusion techniques may change, but the fraction of patients who require intraarterial thrombolysis is currently rather low, and the number of neurointerventionists is adequate. Each hospital caring for patients with acute stroke will need to determine its own demand for intraarterial therapy and employ an adequate supply of qualified neurointerventionists available to meet this demand. Comprehensive stroke centers are now being designated and hopefully will foster a rational, regionalized approach to the delivery of endovascular therapies for stroke.

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Address correspondence to: Harry Cloft, M.D., Ph.D., Department of Radiology, Mayo Clinic, 200 1st St. SW, Rochester, MN 55905. email: cloft.harry@mayo.edu.