Future of Subspecialty Training in Vascular Neurology
Harold P. Adams Jr, MD; José Biller, MD

In 2003, the American Board of Psychiatry and Neurology (ABPN) received approval from the American Board of Medical Specialties (ABMS) to recognize the expertise of board-certified neurologists who were providing specialized care of patients with a broad spectrum of cerebrovascular diseases (vascular neurology.) This designation reflected the growth in knowledge about stroke as reflected by dedicated meetings and focused journals. The expansion in knowledge in vascular diseases of the brain and spinal cord, which was the result of advances in experimental, epidemiological, and clinical research, also served as an impetus. In 2005, the ABPN started the process of awarding 10-year time-limited certificates in vascular neurology. Now, ≈10 years later, it is reasonable to review the progress in the field of vascular neurology and to look at the future of the subspecialty.

Because of their demonstrated special expertise and experience in the diagnosis and treatment of patients with a broad spectrum of vascular diseases of the central nervous system, vascular neurologists are and will continue to be at the forefront of stroke management. Patients, third-party payers, and colleagues will continue to seek the advice and care of vascular neurologists. With the advent of specialized training and resultant certification, many general neurologists now refer their problematic cases to vascular neurologists. This trend likely will continue and probably will accelerate. In addition, vascular neurologists are well-suited for leadership positions within hospital quality improvement programs and clinical initiatives. As of January 2013, the Centers for Medicare and Medicaid Services began mandatory hospital reporting of 7 stroke quality metrics known as core measures. Performance on these measures may become incorporated in determining reimbursement incentives and penalties in the future. The Joint Commission also is certifying primary and comprehensive stroke centers based on the recommendations of the Brain Attack Coalition. Certification standards include a well-defined leadership team that includes a medical director with expertise in cerebrovascular disease to help the program achieve its mission. Thus, vascular neurologists will continue to be the leaders of stroke-related research initiatives, professional and public educational programs, and advocacy efforts to the public and governmental bodies.1–5

The American Academy of Neurology (AAN) has emphasized the increasing shortage of neurologists in the United States, particularly in rural areas.5 As a surrogate, they have used increasing waiting times for an outpatient clinic visit. The situation is even more severe in vascular neurology, a situation in which delays are inherently life-threatening.6 From 2005 to 2012, 1169 physicians were certified by the ABPN. Of these, only 269 were graduates of training programs approved by the Accreditation Council for Graduate Medical Education (ACGME). This figure represents an average of 38 new physicians entering the specialty each year. More than one-half of the board-certified vascular neurologists trained before the creation of the ACGME-approved programs. Currently, the mean age of vascular neurologists is 48 (±9) years and ≈5% of vascular neurologists are older than 65 years. Attrition in the pool of board-certified vascular neurologists through death, retirement, or changes in practice likely will occur in the next few years.

ACGME-Approved Vascular Neurology Fellowships
At present, 84 institutions are sponsoring positions in ACGME-approved training programs in vascular neurology (Table 1). While there has been an increase in numbers of trainees, there is a need to further expand the number of trainees in vascular neurology fellowships. The average age of vascular neurology fellows is 35 years. Although stroke is especially prevalent in underserved populations, few African American or Latino physicians are entering training programs. In 2014, a system to match applicants with training programs was initiated. The goal was to expedite the process of application, recruitment, and selection and to give potential trainees a wide range of fellowship options. Although the success of this system was limited, it likely will be improved and continued. However, it is not clear if a matching program will have a positive impact by increasing the number of young physicians pursuing a career in vascular neurology.

Qualifications
Currently, only physicians who have successfully completed training in an ACGME-approved neurology program,
including those who are not US citizens, may be enrolled. Thus, a potential trainee who is a graduate of an ACGME-approved training program other than neurology or who has received training in a non–ACGME-approved program is not eligible. It may be time to change this restriction. The expansion of the opportunity for vascular neurology education to physicians who are graduates of programs outside the United States and Canada could increase the number of trainees and also would increase the international outreach of stroke education.

Stroke is the most common acute neurological disease, and its management generally has been in the purview of the profession of neurology. Stroke is a fundamental component of education in neurology. Still, the profession’s support of vascular neurology seems limited. Unless the number of neurologists focusing their careers on the diagnosis and treatment of patients with cerebrovascular diseases increases, a professional void will develop. The leaders in the AAN (in particular, its Stroke Section), the American Neurological Association (ANA), the Association of University Professors of Neurology, ABPN, and ACGME need to develop and vigorously support a broad range of initiatives to encourage residents to enter vascular neurology. These efforts need to be started immediately. Time is short.

Although we would prefer that stroke care continue to be directed by experts in brain disease (neurologists), if the neurology community does not meet the healthcare needs, alternative strategies to meet the future needs of stroke care are needed. One approach to increase the number of physicians with specialized training in stroke management is the recruitment of physicians from other specialties, such as emergency medicine, internal medicine, physical medicine and rehabilitation, and neurosurgery for additional training. Such additional training, which would add to the expertise of these physicians, would be superior to abdicating stroke care to a broad group of physicians who have not had any additional training. The nature of stroke already means that physicians from a broad range of specialties already collaborate in management and a change in the eligibility criteria for training would reflect the multidisciplinary nature of stroke care. Other fields of medicine and neurology, such as pain medicine and sleep medicine, do have trainees from multiple specialties and certification sponsored by multiple boards of the ABMS. It may be time for the same strategy to be considered for training in stroke. It may be time to change the name of the specialty and of the training programs to cerebrovascular medicine.

### Table 1. Vascular Neurology Programs and Numbers of Fellows

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Programs</th>
<th>No. of Fellows</th>
</tr>
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<tbody>
<tr>
<td>2008–2009</td>
<td>65</td>
<td>50</td>
</tr>
<tr>
<td>2009–2010</td>
<td>65</td>
<td>66</td>
</tr>
<tr>
<td>2010–2011</td>
<td>67</td>
<td>65</td>
</tr>
<tr>
<td>2011–2012</td>
<td>72</td>
<td>77</td>
</tr>
<tr>
<td>2012–2013</td>
<td>75</td>
<td>94</td>
</tr>
<tr>
<td>2014–2015</td>
<td>84</td>
<td>102</td>
</tr>
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### Curriculum and Duration of Training

Currently, ACGME-approved programs in vascular neurology are 1 year in duration. The time period seems reasonable for completion of the additional training. The standards and requirements for programs, which are reviewed periodically, are available for both faculty and trainees. Although individual institutions have the option of tailoring their programs, the overall requirements for content of the vascular neurology fellowship are outlined by the ACGME and the ABPN.

The core content of the educational program should not be eliminated because it is what provides the principal distinction of a vascular neurologist. The primary goal is to provide additional clinical experience and expertise in the diagnosis and treatment of patients with a wide range of cerebrovascular disorders. This emphasis should remain. Trainees should deal with patients with both hemorrhagic and ischemic strokes and should have encounters in both inpatient and outpatient settings, including intensive care and rehabilitation. The component of training in outpatient settings is crucial for its impact on primary or secondary prevention of stroke, which, in turn, has huge public health implications, and for learning about the course of recovery after stroke. Graduates of the programs are expected to have an experience in interpreting diagnostic studies, including both invasive and noninvasive vascular imaging procedures. Because some of the types and causes of vascular events of the central nervous system are relatively uncommon, the trainees may not have direct exposure with these situations during their 1 year of training. As a result, their education should include venues such as journal clubs or discussions with faculty members. In addition, trainees are expected to learn the scientific underpinnings of stroke and its management, often in the setting of didactic conferences. An outline of the general content of the training program and the certification examination is listed in Table 2. Although changes in the expected fund of knowledge for trainees will occur in the future as the knowledge about stroke continues to expand, the basic organization of the fellowship and the substance of the material that is expected to be learned are not likely to change.

Some graduates of vascular neurology fellowships are planning to pursue training in neurointerventional medicine, which may or may not be an ACGME-approved program. To meet their needs, components of vascular neurology training could be adapted to meet the requirements for entry into these programs; in particular, the vascular neurology program could include an increased emphasis on critical care and surgical management of patients with acute hemorrhagic or ischemic stroke. Similarly,

### Table 2. General Content of Educational Program Vascular Neurology Fellowship

<table>
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<tr>
<th>Content Area</th>
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<tbody>
<tr>
<td>Basic science aspects of vascular neurology</td>
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<tr>
<td>Prevention, risk factors, and epidemiology</td>
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<tr>
<td>Clinical features of cerebrovascular diseases</td>
</tr>
<tr>
<td>Evaluation of the patient with cerebrovascular disease</td>
</tr>
<tr>
<td>Causes of stroke</td>
</tr>
<tr>
<td>Treatment of patients with stroke</td>
</tr>
<tr>
<td>Recovery, regenerative processes, and rehabilitation</td>
</tr>
</tbody>
</table>
neurologists are accepting positions as neurohospitalists or in telemedicine-based practices. Because stroke and its complications constitute a large part of both telemedicine-based and inpatient neurological care, integrating general neurohospitalist training with vascular neurology could be considered.

Most fellowships in vascular neurology have only 1 or 2 trainees at a time. As a result, most professional interactions will be with faculty members or residents. This may have an adverse impact on the educational experience because of the lack of a colleague who is in similar position with whom to share experiences and to provide support during a challenging year. One of the ways to address this situation is to develop collaboration between training programs by video conferencing, joint educational programs, and participation in national meetings. The program that was developed to bolster the educational experience of the fellows at sites in the Specialized Programs in Translational Research in Acute Stroke (SPOTRIAS) is an excellent model. This program, which comprises videoconferencing covering a variety of topics related to stroke including research methodology, is part of the National Institutes of Health (NIH) Stroke Net (the new National Institute of Neurological Disorders and Stroke (NINDS) initiative that coordinates and facilitates clinical stroke research and that includes an important training component) and it could be expanded and made available to fellows in all vascular neurology programs in the United States.

Teaching activities by vascular neurology trainees are encouraged; this component of the fellowship measures the trainee’s ability to convey knowledge to both colleagues and patients/families. The core competency of communication skills is in the new milestones. It needs additional emphasis because engaging teachers are an important aspect of promoting the discipline.

Although individual scholarly activity is promoted, it is not mandated and it is difficult to accomplish in a busy, inflexible schedule. A 1-year fellowship does not provide much time for a well-developed research project, especially one that involves the prospective collection of clinical data. It is even less likely to be conducive to a project that can be presented at academic meetings that have submission deadlines in late summer or early fall, an interval that occurs within 2 to 4 months of starting the training program. As a result of these constraints, vascular neurology trainees may not be able to author publications or give presentations at national meetings. Their activities may be limited to writing lower impact articles, such as case reports or retrospective reviews. Besides asking trainees to collaborate in writing of chapters and reviews with their faculty mentors, they also should be involved as coinvestigators in ongoing research projects and stroke registries. They should be stimulated to use these large data sets for projects that are of interest to them. Another possible solution is to involve future trainees in research while they are still in their residency so they have a jump on this component of their education when starting the more structured components of the fellowship.

Assessment of Fellows’ Performance

The most recent modification in the fellowship is the development of milestones that are used to measure the performance of individual trainees. The milestones, which are available at the ACGME Neurology Review Committee website, are organized in a manner that is similar to those required for residents in neurology training. The milestones also reflect that the trainees in vascular neurology have already completed their neurology residency and thus, expectations are higher. For example, vascular neurology trainees are expected to already have expertise in the emergency treatment of patients with stroke, including the administration of recombinant tissue-type plasminogen activator. The effect and utility of this new assessment program are not yet determined.

Impact of ACGME Requirements

Some of the requirements that accompany an ACGME-approved training program are a disincentive for both institutions and trainees. Duty hour rules, limitations in independent clinical activity, and other restrictions implicit to all ACGME-approved training programs apply to vascular neurology fellowships. Most vascular neurology trainees will become certified in neurology by the ABPN during the time of their fellowship, and they would be able to provide (and bill) for stroke care if they were not seeking additional training. However, their status as a trainee in vascular neurology means that their independence as a practitioner is constrained. The limitations in responsibility, which are, in part, related to billing and the necessity for faculty involvement, are formidable and have negative impact on the growth and maturation of young physicians. These curbs adversely impact experiences in emergency treatment of stroke, especially at night and on weekends. This issue needs to be addressed through modification in governmental and graduate medical education regulations.

The Alternative of Non–ACGME-Approved Programs

Non–ACGME-approved programs, which are sponsored by research grants, endowments, or programs from foreign countries, are available at some centers. These programs are not encumbered by the restrictions in duty hours or responsibilities that are inherent with the ACGME certification. These training programs often highlight experimental or clinical research. Although there may be visa and regulatory restrictions that need to be overcome, these programs may enroll trainees who are not graduates of ACGME-certified neurology programs. Thus, the inducements to maintain these programs are considerable. The interactions between these programs, which often are fostering careers in academic medicine, and the ACGME-training program may be limited and may occur at the detriment of the latter group of trainees. The lack of access to research opportunities may impede the ability of trainees in ACGME-approved training programs to participate in national and international academic meetings in stroke. These young physicians, who are part of the future of academic vascular neurology, may lack the ability to obtain national and international visibility, which fetters their ability to acquire the credentials necessary for appointment in academic departments.
While the core components of training in the vascular neurology fellowship should not be changed, modifications in programs that could foster more professional and international diversity are needed. A possible strategy is the increased integration of a research component into the primarily clinically based training program that could be performed in 2 years. A hybrid program of fellowships of 2 different parts could be offered. The ACGME-approved fellowship and requirements would apply to only 1 year and the second year could be devoted to a more flexible educational experience. Enrichments, such as participation in formal programs that would train the physicians in research methodology, epidemiology, statistics, and clinical trial design, could be included. These educational experiences could be sponsored by programs funded through NIH StrokeNet or the ongoing clinical research workshops sponsored by NINDS. Another possible funding stream would be for the fellow to be listed as a junior faculty member during the second year. The trainee could be more independent and assume more responsibility, including leading a team during emergency management of patients with acute stroke. The fellow could participate in stroke initiatives, such as telestroke, during their training. In addition, the fellow could bill for services, which would provide a funding source. An alternative strategy would be to distribute the rotations and experiences required as part of the ACGME-approved training program across the 2-year period. This tactic would allow the trainee to have a longer research experience. However, it could mean that the training program would need to meet the ACGME regulations for 2 years rather than 1, including duty hours and independence. It also may affect funding streams. For these reasons, this approach does not seem to be the best solution.

Other Factors That Affect Recruitment of Physicians Into Vascular Neurology

The stroke community needs to address the impediments to a successful and satisfying career in vascular neurology for the educational programs in the specialty to thrive. Young physicians will not enter a fellowship program in vascular neurology unless they plan to pursue a career in the field. While some young physicians are willing to enter a labor-intensive and demanding specialty like vascular neurology for altruistic reasons or personal satisfaction, others may not be willing to do so for the reasons discussed by Leira et al. Some solutions have been proposed. For example, a program that would help mitigate vascular neurology trainee’s debts similar to that for colleagues that go to rural primary care settings or research has considerable appeal. Increased stipends for trainees also could enlarge the cohort. This step will require addressing the fiscal constraints in funding of postgraduate medical education. Similarly, overcoming the governmental administrative hurdles to non-Americans staying in the United States after completing their vascular neurology training also might expand the profession.

Finally, issues related to the practice of vascular neurology need to be addressed. Increasing remuneration for vascular neurologists is appropriate. Because of their duty hours, need for availability on weekends, holidays, and so on, the expansion of their activities into fields such as telestroke, and the critical care of their decision making, their salaries should be commensurate with the responsibilities. Besides adjustments to salaries, another form of compensation would be additional time off. The model of hospitalist programs in which the physician works 1 week and has no clinical responsibilities the next could be applicable to vascular neurology. Given the magnitude and importance of stroke on the American public’s health and the key role of vascular neurologists in stroke care, these solutions are easily justifiable. However, these initiatives will need the strong support and advocacy from groups such as the Stroke Council, the American Stroke Association, and the American Heart Association.

Conclusions

During the past decade, the development of specialized educational and certification programs in vascular neurology has largely been successful. These programs have evolved, and the advances in stroke are being reflected by changes in educational and certification programs. Still, problems and stresses have been identified. In this review, we identified some issues that are affecting vascular neurology as a specialty and secondarily its training programs. These issues need to be addressed promptly by both professional and public advocacy groups in stroke, including the Stroke Council of the American Heart Association. These groups could collaborate with the ABPN and the ACGME in a strategy that outlines the problems and solutions related to the impending shortage of vascular neurologists. We challenge the leadership of the Stroke Council and other professional groups in neurology and stroke, such as the AAN and ANA, to move forward with plans to address these concerns.

Acknowledgments

We thank Dr Dorthea Juul of the American Board of Psychiatry and Neurology for sharing some of the statistical information.

Disclosures

Dr Adams and Dr Biller are Chair and Co-Chair of the Vascular Neurology Examination Committee, American Board of Psychiatry and Neurology. Both Dr Adams and Dr Biller advised the Accreditation Council on Graduate Medical Education on the development of milestones for training in vascular neurology. There are no other known conflicts of interest.

References


Key Words: physician education ■ stroke ■ subspecialty training ■ vascular neurology
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Stroke. 2014;45:3730-3733; originally published online October 16, 2014;
doi: 10.1161/STROKEAHA.114.006318
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0039-2499. Online ISSN: 1524-4628

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