Neuroscience education of undergraduate medical students. Part I: role of neurosurgeons as educators*

DANIEL K. RESNICK, M.D., M.S.
Department of Neurological Surgery, University of Wisconsin School of Medicine, Madison, Wisconsin

Object. Economic, demographic, and political pressures have mandated that medical schools increase the number of primary care physicians. The goal of this study was to determine the nature of the average medical student’s exposure to neurosurgical issues.

Methods. Surveys were sent to every neurosurgical program director in the United States and to the dean of every medical school in North America, querying the extent of neurosurgical involvement in medical student education. Specifically, the respondents were asked how medical students were educated about the management of low-back pain and radiculopathy, carotid artery disease, head and spine trauma, and headache.

Survey results were obtained from 65 (67%) of 97 neurosurgery program directors and from 57 (40%) of 143 medical school deans. Only one program in North America reported having a required neurosurgical rotation for all medical students, and just over 50% (29 of 57 deans and 34 of 65 program directors) reported that neurosurgery was an option in a required neuroscience or surgical subspecialty course. Neurosurgeons were not listed among the top three sources for medical student education in the topics of low-back pain and radiculopathy or carotid artery disease. Neurosurgeons were the most frequently cited source of education regarding head and spinal injuries, despite the fact that the majority of medical schools do not have any required medical student exposure to neurosurgery.

Conclusions. With rare exceptions, neurosurgeons are not significantly involved in the education of medical students concerning the management of common neurosurgical issues. As a result, most emerging primary care physicians are taught about these issues by other specialists or not at all. The implications of this situation are discussed.

KEY WORDS • neurosurgical education • neuroscience

Abbreviations used in this paper: AANS = American Association of Neurological Surgeons; CA = carotid artery; SAH = subarachnoid hemorrhage.

* See the letter to the editor and response in Neurosurgical Forum, pp. 738–739.
greater involvement of the neurosurgeon in medical school curricula, and we asked about ways to improve medical education regarding neurosurgical issues.

**Clinical Material and Methods**

Surveys were sent to all (97) neurosurgical program directors in the United States who are listed in the 1998 directory and guide to the AANS and Congress of Neurological Surgeons and all (143) deans of medical schools in North America that are accredited by the Association of American Medical Colleges. The surveys are reproduced in Appendices 1 and 2. The surveys dealt with the average medical student’s exposure to neurosurgery. A letter accompanying the survey specifically excluded teaching activities devoted to interested upperclass students. After 1 month, duplicate surveys were sent to program directors and medical school deans who had not yet responded to the first mailing.

**Statistical Analysis**

Data were compiled and analyzed using a spreadsheet computer program (Excel; Microsoft Corp., Redmond, WA). Statistical analysis was limited to the evaluation of parametric data (that is, hours devoted to education or number of students applying for neurosurgery residency positions) and consisted of either Student’s t-test or a chi-square analysis. A probability value less than 0.05 was considered significant.

**Results**

Survey results were obtained from 57 (40%) of 143 medical school deans and from 65 (67%) of 97 neurosurgery program directors. Medical school deans reported that an average of 23.6 neurosurgery-related personnel hours per year were dedicated to the education of the average medical student (range 0–436, median 5, standard deviation 70.1 hours/yr). Neurosurgery program directors reported an average of 68.2 hours/year (range 0–436, median 33, standard deviation 33 hours/year), a discrepancy that was statistically significant (p < 0.011).

One dean and one program director from the same institution reported that this program included a required 1-month neurosurgery rotation for all medical students. Four deans reported that their programs had a required neurosurgery-related component of a neuroscience course. These courses ranged from 4 to 9 weeks in duration, and all included neurosurgery in the core lecture series. None of these four courses required a student rotation on the neurosurgery service, although all students enrolled in these courses had that option. Twenty-four deans reported that neurosurgery was an optional rotation within a required 3rd-year course, either as a surgical selection or as a component of a neuroscience course. The duration of the students’ exposure to neurosurgery within the surgical elective option or neuroscience course ranged from 1 to 160 hours, with a mean of 64 hours. Twenty-eight deans (49%) reported that neurosurgery was not a required rotation, was not included in a combined neuroscience course, was not a component in a required lecture series, and was not an elective option within a surgical subspecialty course. Program directors reported similar results, with 26 (43%) of 60 reporting no neurosurgery-related involvement in the first 3 years of medical student education. In addition to the one required rotation mentioned earlier, program directors from two neurosurgery programs reported that neurosurgery-related experience was required for all medical students at their institution. One program offered a required 10-hour lecture series, and in one program, the specialty participated in a required neuroanatomy course to a significant degree. Overall, one of 57 deans and three of 65 program directors reported that some neurosurgery-related exposure was required for medical students at their institutions.

Of the 57 deans who responded to the survey, 40 thought that neurosurgeons should be more involved in the education of undergraduate medical students. These deans generally believed that the inclusion of neurosurgery in a combined neuroscience course, with elements extending through the first 3 years of medical school,
Neuroscience education, part I

would be an appropriate venue. Some respondents suggested greater participation by neurosurgeons in the basic anatomy and neurophysiology courses. Ten deans did not believe that increased exposure to neurosurgery was desirable for medical students. They contended that exposure to the management of neurosurgery-related issues was not an important issue for the training of generalist physicians. In contrast, 59 of 63 neurosurgery program directors (two programs were not affiliated with medical schools) thought that exposure to neurosurgery for medical students should be increased. They cited the need for the preparation of medical students for the timely recognition and management of common neurosurgical disorders. One chairman said, “These are not neurosurgical disorders, but primary care disorders which every physician will see on a near daily basis.” Sixty of 63 program directors expressed the belief that a neurosurgery component should be a required aspect of the curriculum in medical student education.

In response to our query as to who taught medical students about the topics of low-back pain and radiculopathy, CA disease and stroke, head and spinal injury, and headaches (focusing on those due to hydrocephalus and SAH), the deans reported the following. Family medicine was the most frequently cited source of information regarding the diagnosis and management of low-back pain and radiculopathy. The specialties of neurology, orthopedics, and internal medicine were the second through fourth most commonly cited sources of information regarding the management of low-back pain. Neurosurgery was the fifth most commonly cited source, with 12 of 57 deans reporting a neurosurgery-related component in the education of medical students about back pain and radiculopathy (Table 1).

Neurology, internal medicine, and vascular surgery were the top three sources of information regarding CA disease and stroke (Table 1). Neurosurgery was the fourth most frequently cited specialty, just ahead of the basic science course and cardiology.

Neurosurgery was the most frequently cited source of information for the diagnosis and management of head and spinal injury (Table 1). Twenty-nine of 57 deans listed neurosurgery as an important source of this information, 15 listed neurosurgery as the primary source of information, and eight deans listed neurosurgeons as the only source of information regarding head and spinal cord injury. Of the 29 programs in which neurosurgery was listed as a source of information for the management of head and spinal cord injury, seven did not have a required neurosurgery rotation, an elective option, or a component in a required neuroscience course. Three of the eight programs in which only neurosurgery was listed as the sole source for this information lacked any required neurosurgery-related exposure in the medical school curriculum.

At the majority of programs (43 of 57 [Table 1]) a neurologist was responsible for educating students as to management of headache. Neurosurgery, internal medicine, family medicine, and pediatrics were the next most frequently cited sources of information concerning the diagnosis and management of headache.

Program directors and deans were asked to provide the number of students from their institutions who pursued postgraduate neurosurgical training. Overall, 67 (1.6%) of 4160 students from medical schools in which there is a neurosurgery component to the curriculum (either required, an elective, or part of a neuroscience course) pursued postgraduate training in neurosurgery. This compares with 69 (2.1%) of 3246 students from medical schools in which there is no neurosurgery curriculum. There is no significant difference between the two groups (p = 0.11).

Discussion

Political, economic, and demographic forces have caused medical schools to emphasize the training of primary care physicians. It is anticipated that the emphasis on primary care education will lead to an increased proportion of physicians who pursue postgraduate education in primary care fields. A collateral result of this emphasis is the deemphasis of subspecialty exposure. This situation may be potentially harmful because students destined for careers in primary care may not be adequately exposed to the spectrum of disease traditionally managed by specialists. In the case of neurosurgery, this problem may be particularly acute.

The discipline of neurosurgery, through its national organizations (the Congress of Neurological Surgeons and the AANS) has embraced the concept that better neuroscience training should be provided to medical students and emerging primary care physicians. In March 1997, a proposed “neurosurgery-related” curriculum was mailed to the deans of every medical school in North America. The curriculum was meant to serve as “guidelines, highlighting the minimum breadth and depth of knowledge deemed necessary for any physician confronted with potential neurosurgical disease.” The curriculum was also posted on the Internet (where it is still posted at www.neurosurgery.org/curriculum.html) and mailed to every neurological program director. In addition, the AANS recently published A Guide to the Primary Care of Neurological Disorders, a text designed for use by primary care physicians and residents when treating patients with potential neurological disorders.

Neurosurgeons provide definitive care for a number of very common disease processes that are encountered by virtually all physicians on a regular basis. The management of low-back pain, the diagnosis and management of CA disease, and the management of head and spinal cord trauma are a few examples of common diseases initially treated by primary care physicians that often require subspecialty (neurosurgical or other) input for definitive care. Another concern is the ability of primary care physicians to recognize neurosurgery-related emergencies and to render appropriate care and timely referral. Severe head or spine injury, hydrocephalus, and SAH are examples of disorders that may prove lethal without timely referral to subspecialty care.

At the University of Wisconsin, it is not a requirement of the curriculum that medical students be exposed to neurosurgery. The majority of trained students graduate to careers in primary care fields, and many have never been taught by a neurosurgeon or managed a patient with a “neurosurgical disease.” Furthermore, given the current political and economic environment, easily available consultation with such subspecialists may or may not be
available to these emerging physicians. We questioned whether our medical students were getting an adequate exposure to these issues, and we also wondered if our situation was unique or relatively widespread. To address these questions, we sent a survey to every neurological program director in the United States and to every medical school dean in North America. Despite two mailings, only 40% of the deans and 67% of the neurosurgery program directors responded. Because of the relatively low response rate, firm statements regarding the nature of undergraduate neurosurgery education cannot be made; however, a number of interesting observations were made.

First, neurosurgeons participate minimally in the education of the average medical student at the majority of medical schools in the United States. The number of neurosurgery-related personnel hours devoted to these students’ education is estimated to be just over 20 hours per year by the deans and just over 60 hours per year by the program directors. Three program directors reported that a neurosurgery-related experience is provided to every medical student, and one of these stated that a full month’s rotation was devoted to neurosurgical issues. The full month’s rotation was also noted by the dean of that medical school. Four additional deans reported including a required neurosurgery curriculum within a “neuroscience” or “surgical subspecialty” course. Only half of the responding programs (deans and program directors) reported that neurosurgery was included as an elective option in a required course (surgical subspecialty rotation or neuroscience course). Therefore, the great majority of medical students educated in the United States have no formal exposure to neurosurgery or neurosurgeons.

The overwhelming majority of program directors and the majority of deans thought that more neurosurgery-related training should be included in the medical school curriculum. The most common justification for the inclusion of more neurosurgeon input into the curriculum is the concept that many neurological disorders are in fact primary care disorders and that primary care physicians need to be better prepared to manage common disorders such as back and neck pain, radiculopathy, stroke, and so forth. This sentiment is reflected in the following quotes from survey respondents: One respondent wrote, “Neurosurgeons care for common problems that are often inadequately managed by primary care doctors, [for example], back pain, SAH, hydrocephalus.” Other respondents commented, “Because neurosurgeons treat very common illnesses that all physicians will see (and may experience): head injury, stroke, back pain, and examination of the unconscious person” and “Even gatekeepers should be conversant in the diagnosis and optimal treatment of common spinal and intracranial disorders.” Wrote a different respondent, “We deal with common problems like back ache, stroke, trauma. Misdiagnosis of [a] straightforward problem can lead to serious consequences. [We must] give all physicians a sense of what is urgent and significant.”

Another perceived benefit from increased neurosurgery-related exposure is the attraction of students to the field. Among the comments culled from the various responses were the following: “There is always someone whose first exposure to neurosurgery results in his changing career/residency;” and “Seeing NS [neurosurgery] patients and how they are managed is different than reading about it.” Some program directors expressed frustration with a perceived inadequacy in the preparation of medical students at their institutions: “Current graduates,” one director wrote, “are clueless as to what a neurosurgeon does, how common problems and/or neurologic emergencies are evaluated and treated, and are poorly taught by neurologists in this regard.” A final common theme derived from the responses of program directors was the concept that neurosurgery-related exposure would lead to later neurological referral. One respondent wrote, “[We] must educate future physicians about what we do—i.e. back surgery, carotid disease, etc.” A different respondent commented, “It will enhance quality of neurological referrals and pre-neurosurgeon management of neurological problems.”

Most deans agreed that greater input into the medical school curriculum from neurosurgeons would be advantageous, mainly because of the common nature of many neurological problems. Many deans expressed a frustration with curriculum gridlock or a curriculum that is already overloaded with required courses. Finally, a few deans thought that exposure to neurosurgery would be a complete waste of time for the average medical student because “few students will use the knowledge.”

It is interesting to note that medical students who attended schools in which there was neurological participation in the required curriculum did not pursue careers in neurosurgery at a higher rate than their peers at other institutions.

Because it is clear that the vast majority of medical students do not receive a significant exposure to neurosurgery, we sought to determine which discipline was responsible for teaching medical students about neurological issues. The field of neurosurgery ranked fifth overall as that which was used to educate students about the management of low-back pain, fourth overall for CA disease, first in instruction about head injury, and second in instruction about headache. Given the low number of neurosurgery-related personnel hours reported by both deans and program directors, it is not surprising that neurosurgeons have minimal input into the education of medical students regarding low-back pain or CA disease. It should be noted that orthopedic surgery was ranked third as a source for teaching about back pain, and vascular surgery ranked third as a source for CA disease. It is even more interesting to note that, although neurosurgery was cited as the primary (29 programs) or only (eight programs) source of information regarding the management of head and spinal cord injury at a number of programs, a substantial portion (seven of 29 and three of eight, respectively) of these programs have no required neurosurgery-related curriculum. One wonders how the students at these institutions are trained to manage head and spinal cord injury.

Conclusions

With rare exceptions, neurosurgeons are minimally involved in the education of average medical students. Although the time commitment reported by program directors is substantially greater than that reported by medical school deans, it is still minimal. Medical students are be-
Neuroscience education, part I

ing taught about neurosurgical issues by specialists from other fields or not at all. When subspecialty input is sought for the teaching of certain topics such as back pain, CA disease, more often than not other specialties (orthopedics and vascular surgery) are responsible for medical student education. The existence of a neurosurgery requirement or opportunity during the 3rd year of medical school does not appear to influence the number of students who pursue careers in neurological surgery. The effects of the lack of neurosurgeons’ involvement in medical student curriculum will become more manifest as the new generation of primary care providers emerges and manages patients with “neurosurgical” disorders without the benefit of a “neurosurgical” education.

Appendix 1: Neurosurgical Chairman or Program Director Survey

1) On average, how many faculty man-hours are devoted to medical student education in settings other than the clinical service (i.e. required lectures, anatomy lab, faculty mentorships, etc.)?
2) Is there a required neurosurgical course for medical students at your institution?
3) Is there a neurosurgical component of a required neuroscience or surgical subspecialty course at your institution?
4) If there is a required neurosurgical rotation or course at your institution, what is its duration?
5) Do you believe that neurosurgical faculty should be more involved with undergraduate medical education?
6) What do you think would be the best means to increase medical student exposure to neurosurgical issues?
7) Do you think that exposure to neurosurgery should be a required part of the medical school curriculum for every medical student? Why or why not?
8) On average, how many 4th-year students from your institution rotate through the clinical neurosurgical service?
9) On average, how many 4th-year medical students from outside your institution rotate through the clinical neurosurgical service?
10) On average, how many medical students from your institution apply for neurosurgical residency appointments each year?
   a) How many medical students graduate each year from your institution?

Appendix 2: Medical School Dean Survey

1) On average, how many neurosurgical faculty man-hours are devoted to undergraduate medical student education in settings other than the clinical service?
2) Is there a required neurosurgical course at your institution?
   a) What is its duration?
3) Is neurosurgery included in a required neuroscience or surgical subspecialty course?
   a) What is the duration of the neurosurgical component?
4) Do you believe that neurosurgical faculty should be more involved in undergraduate medical student education?
5) What do you think would be the best way to increase the exposure of the average medical student to neurosurgical issues?
6) From whom does the average medical student at your institution learn about the management of: a) low-back pain and sciatica; b) carotid artery disease and stroke; c) head injury; d) headaches, subarachnoid hemorrhage, and hydrocephalus.
7) Do you think that exposure to neurosurgery should be a required part of the curriculum for every medical student? Why or why not?
8) How many medical students graduate from your institution each year?
9) How many of these graduating medical students pursue careers in neurosurgery each year (on average)?

Acknowledgment

The author would like to thank Dr. Lincoln Ramirez for his guidance and assistance with the preparation of this manuscript.

References


Manuscript received August 8, 1999. Accepted in final form December 10, 1999.
Address reprint requests to: Daniel K. Resnick, M.D., M.S., Department of Neurological Surgery, University of Wisconsin School of Medicine, H4/332 Clinical Science Center, 600 Highland Avenue, Madison, Wisconsin 53792. email: Resnick@neurosurg.wisc.edu.