What we research: survey of American Association of Neurological Surgeons and Congress of Neurological Surgeons member publications

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Object. The goal of this study was to create a searchable database of research manuscripts authored by members of the American Association of Neurological Surgeons and the Congress of Neurological Surgeons (AANS/CNS) to describe the nature and character of the research currently being undertaken by neurosurgeons.

Methods. Manuscripts published by all physician members listed in the 2001 AANS/CNS Membership Directory (6921 physicians) were gathered into a database through individual literature searches of the author name for the calendar year 2001. Duplicate publications were purged and the database was reviewed for accuracy. An internal verification of the database revealed a 4% underreporting rate. Statistics from the database were compiled and displayed with information about AANS/CNS members and their clinical activities.

The AANS/CNS members published a total of 2748 research manuscripts in 479 different journals during 2001. Thirty-eight percent of the manuscripts (1042 of 2748) were authored by US members and 62% (1706 of 2748) by non-US members. The focus of the majority of manuscripts included the areas of brain tumor (26%; 707 of 2748), vascular disease (20%; 558 of 2748), spine (10%; 282 of 2748), and trauma (8%; 233 of 2748). Sixty-nine percent of manuscripts (1897 of 2748) were retrospective and technical clinical studies, and of these 39% (744 of 1897) were case reports. Laboratory investigations made up 15% (414 of 2748) of all manuscripts, whereas prospective randomized clinical trials represented 1% (34 of 2748).

Conclusions. The majority of AANS/CNS member manuscripts are authored by non–US members despite their small AANS/CNS representation. Most research is clinical, based on retrospective data, and includes a large number of case reports. A disparity exists between what neurosurgeons do clinically and both the quantity and subject of their research.

Key Words • research • neurosurgical trial • neurosurgery • spinal surgery • retrospective study

Laboratory and clinical research remain central components of the neurosurgical specialty despite the increased time demands placed on today’s practitioners. Langfitt has emphasized the importance of research to the very survival of neurosurgery as a specialty. More recently, neurosurgical authorities have provided encouragement and practical advice on the publication of research and an entire issue of Acta Neurochirurgica has been devoted to research topics. Unfortunately, there is no formal research reporting instrument in place, so we have little understanding of the types of research conducted by our colleagues. Such information is important because it would allow us to identify underresearched areas within the field and to attract investigation into those areas. The aim of this study was to describe the types of research in which neurosurgeons are currently engaged by using manuscript publication as an indication of research subject matter and scope. We generated a searchable publication database of all neurosurgical research authored by AANS/CNS members for the year 2001. Combining statistics from the database with available demographic information on US neurosurgical clinical practice, we were able to create a descriptive portrait of the state of research within the specialty.

Clinical Material and Methods

Individual literature queries were executed using the National Library of Medicine’s PubMed scientific literature search engine for each of the 6921 physician members listed in the 2001 AANS/CNS Membership Directory. Each member’s last name and initials were used, and the queries and all member manuscript titles for the calendar year 2001 were electronically downloaded into the Endnote reference program (Thompson, Inc., Stamford, CT). The year 2001 was selected because it was the most recent year for which we could be certain that all publications would be indexed on PubMed at the time that data collection was begun. Once all of the manuscript citations had been compiled, duplicate titles were purged and the references were individually reviewed to ensure accuracy. In addition, the database was checked to ensure that there were no significant omissions. To do this, we checked entries in the database against a ref-
ference list maintained by the Department of Neurosurgery at the University of Pennsylvania. This reference list consists of titles and abstracts on topics of neurosurgical interest from 47 journals. From the departmental reference list, we randomly selected 100 articles that were published in 2001 and had at least one AANS/CNS member author. These articles were then cross-referenced with the AANS/CNS 2001 manuscript database we had compiled. If the article was not found in the database, MEDLINE was searched to determine whether the article had been indexed.

The AANS/CNS 2001 publication database was then searched manually to categorize the manuscripts by subject focus, study design, publication location, journal, and publication language. Statistics from the database were processed in Excel (Microsoft, Inc., Redwood, WA) and were displayed with select AANS/CNS member demographics tabulated from the 2001 AANS/CNS Membership Directory as well as from the AANS National Neurosurgical Statistics: 1999 Procedural Statistics.

**Results**

**Demographic Data**

Data were compiled from the AANS publication entitled National Neurological Statistics: 1999 Procedural Statistics and are displayed in graphic form (Fig. 1) to illustrate the types and numbers of procedures currently performed by neurosurgeons in the US. Clinically, spinal surgeries represent 62% of all procedures performed, whereas cranial procedures including both tumor and vascular surgeries represent 26% of procedures. Cerebrospinal fluid shunt placement (5%), peripheral nerve (4%), pain and functional (2%), extracranial vascular (1%), and catheter endovascular procedures (< 1%) make up the remainder.

The 2001 AANS/CNS Membership Directory lists 6921 physician members. Five thousand seven hundred twenty members (83%) reside in the US and Puerto Rico, whereas 1201 members (17%) reside in other countries. The number of members on the rosters of the AANS/CNS joint sections were tabulated and are displayed in graphic form in Fig. 2. Section rosters were found to contain the following number of members: Spine and Peripheral Nerve, 1373; Neurotrauma and Critical Care, 1152; Tumors, 659; Cerebrovascular, 494; Pediatric, 298; Pain, 268; Stereotactic and Functional, 252; and History, 76.

**Authorship in the US and Elsewhere**

The final database of all AANS/CNS member manuscripts indexed on PubMed for the year 2001 revealed a total of 2748 after duplicate entries were purged. As many as 2618 articles (95%) were written in English, whereas 130 articles (5%) were published in other languages. One thousand forty-two manuscripts (38%) were authored by members residing in the US and Puerto Rico, whereas 1706...
Manuscripts Categorized by Subject

Manuscripts were divided by subject matter, and the results are presented in Fig. 4. Our data showed the focus of member manuscripts to be predominantly brain tumors (26%; 707 of 2748) and vascular procedures (20%; 558 of 2748). Articles related to the spine accounted for 10% (282 of 2748) of the total, with other topics receiving less coverage. When manuscripts in the spine category were subdivided further, we found that 19% (54 of 282 manuscripts) were principally focused on spinal tumors, whereas 81% (228 of 282 manuscripts) were focused on degenerative/general spinal disorders. Similarly, when manuscripts in the trauma category (8%; 233 of 2748) were subdivided, it...
was found that 32% (75 of 233 manuscripts) were focused on spinal trauma, whereas 68% (158 of 233 manuscripts) were focused on cranial/general trauma topics. When the database was searched across all subject categories, it was found that 20% (536 of 2748 manuscripts) dealt with pediatric topics.

Manuscripts Categorized by Study Design

Manuscripts were divided according to study design, and the results are represented in Fig. 5. Forty-two percent of manuscripts (1154 of 2748) featured retrospective or technical clinical studies. These articles included retrospective clinical studies, case series, and descriptive articles concerned with patient care or operative procedure. Twenty-seven percent of the publications (744 of 2748 manuscripts) were published as case reports and 8% (214 of 2748 manuscripts) were published as review articles. Fifteen percent of publications (414 of 2748 articles) were published as laboratory research studies. Four percent of manuscripts (102 of 2748) were historical articles or general editorials. Overall, 4% of manuscripts (121 of 2748) were found to be prospective clinical studies, with 3% (87 of 2748) being non-randomized and 1% (34 of 2748) being randomized prospective clinical studies.

Validation Procedure

Of the 100 articles chosen from the independent reference list, 61 appeared in the manuscript database. Of the remaining 39 articles, 29 were found to have no AANS/CNS member authors and six had not been indexed by MEDLINE and therefore would not have been available for downloading into our database. This left four articles that were missed by our indexing efforts, leading us to conclude that the database had an overall 4% underreporting rate.

Discussion

The pace of neurosurgical advancement is determined by research. Neurosurgery has a rich tradition of both clinical and laboratory investigators extending back to the early days of the specialty when figures like Harvey Cushing, Walter Dandy, and Wilder Penfield helped to create a bridge between the neuroscience laboratory and the operating room. Although this bridge remains intact today, the demands of modern medicine have clearly reduced opportunities for laboratory and clinical research. Research funding available to clinicians has decreased, and economic factors have forced academic institutions to view their neurosurgical faculties less as scholars and more as earners. Under these adverse conditions, it is critical that neurosurgeons begin to organize their research at the specialty level to maximize their individual efforts. To do so, we must first understand the types of research our colleagues perform and how this research corresponds to the needs of our patient population. The present study was undertaken to address these issues.

More than half of all AANS/CNS physician member manuscripts were authored by members residing outside the US and Puerto Rico (62%), despite the fact that these foreign members comprise only 17% of the total membership. Although it seems reasonable to conclude that foreign members are more likely to be academic practitioners than US members, the AANS reports that 17% of US members describe their practices as full-time academic. Therefore, these numbers appear to indicate that foreign members are more prolific than their American counterparts and that research may not be as much of a priority in the US neurosurgical community as it is in some other countries. This point is further strengthened by the fact that 95% of all the AANS/CNS publications in the database appeared in English-language journals, indicating that the higher volume of publication by non-US members is not simply due to publication in foreign language journals that are not accessible to US authors.

An increasing foreign authorship is a trend in neurosurgery that has been present for several years and is paralleled in other medical specialties. It is possible that the preponderance of publications by foreign authors is due to other factors such as the downturn in the US medical economy favoring private practice selection for residents, the increasing regulations on research studies, the decreased availability of grant funding, and the increased exposure to malpractice inquiries that is associated with human research. Whatever the reason, foreign research currently makes up a large portion of the neurosurgical literature and, should this trend toward foreign authorship continue, the possibility arises that outstanding young neurosurgeons will seek overseas training much as they did prior to the 1930s.

Analysis of the database manuscripts by study design revealed that the majority of neurosurgical research is clinical (81%), with the remainder being laboratory research (15%) and historical or editorial research (4%). Most of the clinical studies were retrospective case series, technical studies, and case studies (69%). Only 4% of the clinical studies were prospective and a minority of those investigations were randomized. This strong clinical focus in neurosurgical research has remained remarkably constant over the years. In 1990 Davis and Cunningham reviewed 3792 papers published by 50 pioneers of American neurosurgery and discovered that only 11% related to laboratory research. It is difficult, however, to compare directly the number of clinical studies with the number of laboratory studies and to draw meaningful conclusions because the patterns of investigation and the time to complete projects differs greatly between these two methods of research. Furthermore, there are only limited statistics with which to compare the neu-
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rosurgery clinic/laboratory research ratio with those in other medical specialties. Without comparison statistics it would be necessary to follow these figures over time to make even speculative conclusions about whether neurosurgery-sponsored laboratory research is expanding or contracting and whether the current laboratory/clinical research ratio is appropriate for the specialty.

It is important to note that the majority of current neurosurgical literature is based on retrospective data. Although it may be said that the nature of the problems that neurosurgeons treat, such as brain tumors, make conducting prospective randomized clinical trials extremely difficult, the fact that more than one in four manuscripts published by AANS/CNS neurosurgeons takes the form of a case study is difficult to ignore. This appears to have changed very little in the past several years and is likely due to the fact that case reports are less time consuming to complete than other studies and are an avenue of publication open to both academic and private practitioners alike. The large number of case reports may also be due to decisions by medical journal editors to include more of these brief forms of publication in their periodicals. Whatever the reason, the fact that descriptive publications so outnumber investigative studies is troubling because description alone does not often lead to innovation.

The most revealing way in which to comment on the manuscript subject breakdown is by comparing these findings with demographic data on US neurosurgical practice and with the AANS/CNS joint section membership rosters. With regard to section membership, it seems reasonable to conclude that the size of the various memberships of the AANS/CNS joint sections offers some reflection on the clinical and research interests of member neurosurgeons (bearing in mind that it is possible for a member to join multiple sections). If that is true, then the majority of AANS/CNS section members have an interest in the spine and peripheral nerves (1373 manuscripts), whereas many fewer express an interest in brain tumors and cerebrovascular disease.

An examination of the AANS procedural data shows that most neurosurgical procedures performed by neurosurgeons in the US are spinal surgeries (62%), whereas cranial surgeries of all types requiring craniotomy represent only 26% of cases. Considering these data along with the section membership and manuscript topic data, two conclusions can be made. First, there is a discrepancy between neurosurgeons’ subspeciality interests and the volume of research being produced, with spine topics being underrepresented and brain tumor and vascular topics being overrepresented. Second, there is a discrepancy between the clinical activities of most US neurosurgeons and the type of research being published. Here again, the amount of spine research appears to be underrepresented and brain tumor and vascular research appears to be overrepresented. These conclusions remain unchanged even when the manuscripts dealing with spinal trauma (75 manuscripts) are factored into these figures.

Last, there are clear limitations to this type of study. Most obvious is that journal publication is an indirect means of tracking research efforts. This methodology places a case report on par with a basic neuroscience research publication or clinical trial without consideration of the scope of the research or its scientific merit. It is possible that a system that weighted articles differently, depending on the journal of publication, would be more accurate. Such a system might incorporate an impact factor (Journal Citation System impact factor; ISI, Inc., Philadelphia, PA) to define a multiplier factor for manuscript weighting. Using grant funding was considered for this study, but obtaining information regarding the level of funding for non-National Institutes of Health-sponsored research would be extremely difficult and the use of grant support as a measurement would not take into account the large number of manuscripts that are completed without any financial support. Another limitation of this study that should be mentioned is that the database only takes into account those articles indexed on PubMed. Although PubMed includes the majority of peer-reviewed periodicals, it is possible that a more complete manuscript database could be created if AANS/CNS members were asked to submit a list of all the manuscripts they authored on an annual basis when submitting their membership dues.

Conclusions

This analysis of the research manuscripts authored by AANS/CNS members reveals several disparities. First, the majority of AANS/CNS member manuscripts for the time period analyzed were authored by non-US members, despite their small numbers. Second, most research is clinical and based on retrospective data and made up of a disproportionately large number of case reports. Third, despite the fact that the majority of procedures being performed by US neurosurgeons are spinal surgeries and that many more neurosurgeons have declared an interest in spinal disorders than in any of the other subspecialties by their choice of AANS/CNS joint section membership, spine research represents only 10% of member publications, whereas brain tumor research comprises 26% of publications and vascular research comprises 20%.

With the increasing demands on our time, the increasing regulations on the research we conduct, and the decreasing availability of grant funding, it is perhaps more important than ever for neurosurgeons to focus not only on what we research individually, but also on what we research as a group. We propose that more detailed information about neurosurgical research be compiled by the AANS/CNS and that our investigative efforts be organized at the specialty level. We believe this would complement our individual efforts for the following reasons. 1) It would allow the AANS/CNS to identify areas within the field where more research is needed and foster interest in them through pilot grants and young investigator awards. 2) It would enhance research collaboration among neurosurgeons. 3) It would eliminate duplicate research efforts by establishing a centralized database of neurosurgical research. 4) It would allow the AANS/CNS to communicate the specialty’s research goals to the major US funding agencies. 5) It would help to ensure that our research efforts match the needs of the neurosurgical patient population that we serve.

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