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AANS Annual Meeting Pushes Neurosurgery’s Boundaries

New Frontiers

Intrepid Denver, the gateway to Colorado’s breathtaking Rocky Mountains, is a fitting site for the 79th AANS Annual Scientific Meeting, “Discovering Neurosurgery: New Frontiers.”

“From April 9–13 in Denver, we’ll explore the new frontiers we have attained in neurosurgery,” said AANS President James T. Rutka, MD. “High fidelity neurosurgical simulation for teaching residents, neurosurgical art and illustrations recapitulating the complex and sophisticated procedures we perform on a daily basis, and the exciting future of neurosurgical publications and education are all part of the discovery themes we will experience together.”

Working with Dr. Rutka and Annual Meeting Committee Chair Matthew A. Howard III, MD, AANS members have been planning all year to present a stellar and entertaining educational event. They include Scientific Program Chair Carl B. Heilman, MD, Scientific Poster Chair Anil Nanda, MD, Local Hosts Kevin O. Lillehei, MD, and Anne Lillehei, P. David Adelson, MD, Nicholas M. Barbaro, MD, Dean Barone, PA-C, Robert E. Harbaugh, MD, Twyila Lay, NP, Christopher M. Loftus, MD, Cormac O. Maher, MD, Paul C. McCormick, MD, Michael Y. Oh, MD, Lawrence M. Shuer, MD, Vincent C. Traynelis, MD, and Edie E. Zusman, MD.

The meeting features 20 scientific sessions, 66 breakfast seminars, 175 oral abstract presentations, and more than 500 electronic posters, offering up to 42.75 AMA PRA Category 1 credits.

Guest speakers are Cushing Orator Nathaniel Philbrick, champion sailor, award-winning scholar and bestselling author; Robert DiRaddo, PhD; Richard Gilbertson, MD; Kristen Iversen; Doug Kondziolka, MD; Lars Olson, PhD; Jon H. Robertson, MD; Raymond Sawaya, MD; Robert Spetzler, MD; and Ian Suk, BScBMC.

Honorees include A. John Popp, MD, Cushing Medal; Barth A. Green, MD, Humanitarian Award; Thomas A. Marshall, AANS executive director, Distinguished Service Award; and Shigeaki Kobayashi, MD, AANS International Lifetime Recognition Award.

Famed Japanese neurosurgeon Kenichiro Sugita, who pioneered numerous neurosurgical approaches and procedures during his lifetime, will be honored through the AANS-Sugita International Symposium dedicated to his memory. Neurosurgical dignitaries from around the world will be speaking at this educational event.

SyncIt! BringIt! UseIt!

For the second year, meeting content will be delivered digitally via each attendee’s iPod touch. Before the meeting, the 2011 AANS Annual Scientific Meeting application should be downloaded from iTunes.

At the meeting, each attendee’s iPod touch will keep scientific programming, exhibitor information, maps and more at their fingertips. Like last year, the application will offer real-time program and news updates as well as messaging among attendees. New functions this year include note taking with the ability to e-mail the notes, and a personal scheduling feature that can be used to keep track of everything, from sessions and events to committee meetings and dinner reservations.

The same iPod touch used at the meeting also can be used to access AANS on iTunes U, http://itunesu.aans.org. Some of the educational content provided by the AANS through iTunes U includes lectures from some of the leading experts in neurosurgery; demonstrations of procedures or surgical techniques; and discussions of the latest clinical breakthroughs. The free service allows on-demand access to the very latest educational information.

For more information, visit the AANS website. NS
Memory loss. Moodiness. Increasingly erratic and sometimes overly aggressive behavior. Speech difficulties. Movement disorders like tremors and gait disturbances. Eventually, dementia. These symptoms could describe Alzheimer’s disease, an illness that is becoming increasingly well-known to the public as a disease of older adults. But when the symptomatic person is younger and an athlete, the illness could be chronic traumatic encephalopathy, CTE.
HEAD INJURY

CTE apparently is what 1987 NFL Man of the Year Award-winner Dave Duerson feared before his suicide early this year. The 50-year-old former Chicago Bears safety who died of a self-inflicted gunshot wound to the chest left a note asking that his brain be “given to the NFL’s brain bank.” The reference is to the brain bank registry at Boston University Center for the Study of Traumatic Encephalopathy, CSTE.

Through his work with the football players union, Duerson probably had become aware of CTE and other cases of retired players who had suffered from CTE-like symptoms. For example, Michael Lewis Webster, Justin Strzelczyk, and Terry Long, all of the Pittsburgh Steelers, Andre Waters of the Philadelphia Eagles, Chris Henry of the Cincinnati Bengals, and Tom McHale of the Tampa Bay Buccaneers all died after years of strange, erratic and sometimes overly aggressive behavior.

In 2008 John Grimsley, a former NFL linebacker for the Houston Oilers and Miami Dolphins, died at age 45 from a gunshot wound to the chest. He was thought to have been cleaning his rifle and the authorities ruled his death an accident, despite the fact that he was an excellent marksman. Subsequent microscopic analysis of his cerebral cortex by McKee and colleagues at Boston University CSTE demonstrated evidence of tau-positive inclusion bodies and neurofibrillary tangles. In conjunction with clinicopathological features of several other cases, tau-positive inclusion bodies and neurofibrillary tangles have become established as the hallmarks of chronic CTE.

Chronic Traumatic Encephalopathy: Symptoms and Pathophysiology
CTE, originally described by Martland in 1928, is believed to result from repetitive, often minor head trauma. It manifests initially with affective disturbances and short-term memory loss followed by increasingly erratic behavior, speech and gait difficulties, and finally dementia.

Although in CTE tau protein is diffusely distributed throughout the brain, the regions that tau protein most affects are the mesial temporal lobe, entorhinal cortex, amygdala and hippocampus. Areas less involved include the frontal, subfrontal, subcallosal, olfactory bulb, hypothalamus, mamillary bodies, substantia nigra and other brainstem nuclei. This tau distribution, which shows preference for the limbic system, provides an anatomical basis for some of the striking psychological changes seen in CTE sufferers. The tau deposition is typically perivascular in pattern and seen most densely in the superficial cortical laminae I–III. Interestingly, although the tau protein in CTE is histologically identical to that found in Alzheimer’s disease, the two diseases differ in that β-amyloid is not a consistent and never a prominent feature in CTE. Also, the tau in Alzheimer’s disease is most dense in the deeper cortical laminae IV–V.

A point of convergence among Alzheimer’s disease, traumatic brain injury and CTE is the increased prevalence of ApoE ε4 allele carriers in each of these diseases, although its prevalence is less well-established in CTE.

Recent findings indicate that the brain may not be the only site of injury in CTE. A study by McKee and colleagues of Boston University CSTE suggests that tau protein deposition may provide a link between CTE and some cases of sporadic amyotrophic lateral sclerosis, which has been associated with previous head injuries. Three athletes with CTE and motor neuron disease characterized by weakness, atrophy, spasticity and fasciculations were found to have tau protein deposits, TDP-43, in the brain and spinal cord with axonal loss in the corticospinal tracts and medullary pyramids as well as loss of anterior horn cells. While the exact function of TDP-43 is unknown, it is widely expressed and likely is involved in multiple biological processes by binding with DNA, RNA and other proteins. TDP-43 overexpression has been demonstrated to cause neurodegeneration and cell death, both in vitro and in vivo. One hypothesis suggests that mild traumatic brain injury causes an axonal shear injury and cytoskeletal disruption leading to reorganization of neurofilament proteins. TDP-43 is upregulated and binds to neurofilament mRNA in order to stabilize the transcript and mediate the injury response. This upregulation of tau causes protein aggregation, however, and then inclusion body formation, neurofibrillary tangles and, ultimately, neuronal death.
Younger Athletes and Others at Risk

CTE at first was considered a disease of older athletes, but recent studies also have identified it in younger athletes. In 2009 a study commissioned by the NFL and conducted by the University of Michigan Institute for Social Research on 1,063 retired NFL athletes found that 6.1 percent of athletes 50 and older reported that they had received a dementia-related diagnosis; this rate is five times higher than the national average of 1.2 percent. Importantly, those age 30 through 49 showed a rate of 1.9 percent, or 19 times that of the national average (0.1 percent).

In 2010 Owen Thomas, a 21-year-old football player at the University of Pennsylvania, committed suicide by hanging. He subsequently was diagnosed with CTE. Pathological evidence of CTE also has been found in an 18-year-old high school football athlete who had sustained multiple concussions. With more than a million teenagers competing in football every year, the risk of CTE looms as a potential public health disaster.

However, CTE is not unique to football. More than 30 cases of CTE in athletes competing in other sports such as boxing, ice hockey, soccer, and wrestling have been identified. This group notably includes former professional wrestlers Chris Benoit and Andrew Martin as well as ice hockey professionals Reg Fleming and Bob Probert. Boxers may have a higher risk of developing CTE due to sustained, repetitive head blows. Suspected but not proven cases include Muhammad Ali, Jimmy Ellis, Floyd Patterson, Bobby Chacon, Wilfred Benitez, Emile Griffith, Freddie Roach and Sugar Ray Robinson. CTE also has been documented in nonathletes with repetitive head trauma including those who have suffered physical abuse, autism with head-banging behavior, or epileptic seizures, and those engaged in dangerous occupations such as a man who made his living as a clown shot from a cannon.

Taking Action

For the $8 billion-a-year NFL industry the ramifications of CTE have become obvious and urgent. During the 2009–2010 season the NFL publicly acknowledged a link between football and CTE and instituted specific return-to-play guidelines that required a concussed player to be immediately benched from any game or practice and additionally to obtain independent clearance from a neurological expert before returning to the field. Additionally, the NFL has increased public safety awareness, warning young athletes of the dangers of head trauma while simultaneously donating unrestricted funds to inde-
Incidence of Catastrophic Injuries in Sports

Catastrophic injuries in sports, although rare, are tragic events. The National Center for Catastrophic Sports Injury Research defines such injuries as sport injuries that result in brain or spinal cord injury, or skull or spinal fractures. The NCCSI subclassifies catastrophic injuries as nonfatal (permanent functional disability) or serious (transient with no functional disability). These injuries can be fatal either directly during participation in sport or indirectly due to systemic exertion while participating in sport.

During the 25-year period from 1982 to 2007, the NCCSI identified 1,068 direct catastrophic injuries in high school and college sports. Approximately 150 million high school athletes participated in sports within that 25-year period with a combined (direct and indirect) catastrophic injury rate of 0.89 per 100,000. The rate is slightly higher in college athletes, 3.81 catastrophic injuries per 100,000. For all sports, traumatic brain injury that causes intracranial hemorrhage is the leading cause of death.

While there has been a great deal of attention placed on preventing these catastrophic injuries, a silent epidemic has been growing in patients who suffer mild TBI or concussions. The CDC estimates that over 200,000 ER visits per year are for nonfatal sports-related head injuries. Other studies indicate that of high school and college football players, 5.1 percent have suffered at least one concussion each year with 14.7 percent having suffered more than one concussion during the same season. It is well recognized that these figures are underreported by a factor of five or more in football and hockey.

The true incidence of catastrophic injuries in sports is difficult to document, as are the long-term effects of mild TBI. NS
Over the past year there has been a dramatic rise in the number of patients calling my practice for appointments to receive “return to sports clearance” after suffering traumatic brain injury, usually in the form of a concussion.

The NFL’s recent high-profile effort to raise awareness of concussion symptoms and treatment has brought much needed attention to this problem, and the need for good policies has filtered down to the college and high school levels. However, many neurosurgeons have little training to fully assess these clinical scenarios appropriately.

At the end of August, a 17-year-old male athlete whom I’ll call Tim presented to my office with his parents after he had sustained a concussion. At the time of injury Tim was participating in “triples,” that is, three football practices a day to accelerate team preparation before the start of the season. Toward the end of the last practice, he was sandwiched between two defensive linebackers after catching a short pass. Loss of consciousness was brief, less than five minutes. Nevertheless, he was taken by ambulance to the ER for evaluation.

In the ER, Tim related a transient experience of tingling in his hands and feet, and he had a headache and mild nausea. A CT of his head and MRI of his cervical spine were negative, and he was allowed to go home. He presented to my office less than a week later for evaluation. He denied headache, nausea, vomiting, ataxia, or blurred vision. He had been attending practice (there is a code of honor that injured
players come to practice even if they just stand for hours and watch) and more recently classes, none of which precipitated any recurrence of symptoms. His parents denied any personality changes or problems. Neurological testing was normal and review of his imaging studies confirmed that they were all negative. One confounding factor that emerged when taking Tim’s history was his potential for a football scholarship as his best prospect to financially manage the best college opportunity. Without immediate return to practice and his full senior season of football, the potential for a football scholarship would evaporate.

Tim met most of the criteria for safe return to play (Tables 1 and 2). His symptoms had abated and not returned under more stressful conditions. His imaging studies were negative, and his initial symptoms had been mild. I considered having a formal neuropsychological evaluation performed, but without a baseline for comparison this might have limited value. In addition, this process in my community could take weeks and may not be covered by insurance. I had spent a relatively extended time with Tim, insisting that he answer my questions and engage in discussion about his injury and its implications. His responses helped reassure me of his ability to retain complex information, to display appropriate judgment and insight, and to demonstrate focus and a good attention span, along with good recall and memory. I ultimately signed the appropriate papers, clearing his return to play. Even though I was confident in my clinical judgment, I worried that my decision-making might ultimately result in harm to Tim.

I grew up in Westminster, a small town where the Baltimore Colts had their summer training camp. As a result, I was fortunate to stand beside greats like Johnny Unitas, Raymond Berry and Lenny Moore. I was a football fan beyond the pale, spending as many hours as I could playing or watching the sport. I remain a great fan of football though, knowing intimately the potential damage to the brain and spinal cord, I will admit to a higher level of squeamishness when I watch certain hits. This discomfort was so great that I could not bring myself to allow my own son to play football until the end of his high school career when he had at least reached a protective size. As a neurosurgeon and a football fan, I am glad I can help protect student athletes from some of the risks of traumatic brain and spine injury. NS

Deborah L. Benzil, MD, FAANS, a member of the AANS Neurosurgeon Editorial Board, is a neurosurgeon with Mt. Kisco Medical Group, Mt. Kisco, N.Y. The author reported no conflicts for disclosure.

### TABLE 1: CANTU RETURN-TO-PLAY GUIDELINES

<table>
<thead>
<tr>
<th>Grade 1 Concussion (Mild)</th>
<th>Grade 2 Concussion (Moderate)</th>
<th>Grade 3 Concussion (Severe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No LOC, PTA &lt; 30 min., PCSS &lt; 24 hrs.</td>
<td>LOC &lt; 1 min. or PTA ≥ 30 min. &lt; 24 hrs. or PCSS ≥ 24 hrs. &lt; 7 days</td>
<td>LOC ≥ 1 min. or PTA ≥ 24 hrs. or PCSS ≥ 7 days</td>
</tr>
<tr>
<td>1st Concussion: RTP when asymptomatic* one week.</td>
<td>1st Concussion: RTP when asymptomatic one week.</td>
<td>1st Concussion: RTP in one month if asymptomatic.</td>
</tr>
<tr>
<td>2nd Concussion: RTP in two weeks if asymptomatic.</td>
<td>2nd Concussion: RTP in one month if asymptomatic.</td>
<td>2nd or 3rd Concussion: Terminate season. May return next season if asymptomatic.</td>
</tr>
<tr>
<td>3rd Concussion: Terminate season. May RTP next season if asymptomatic.</td>
<td>3rd Concussion: Terminate season. May RTP next season if asymptomatic.</td>
<td></td>
</tr>
</tbody>
</table>

*An asymptomatic athlete is defined as being free of symptoms for one week. LOC, loss of consciousness; PCSS, postconcussion signs and symptoms; PTA, post-traumatic amnesia; RTP, return to play.

### TABLE 2: CONSENSUS STATEMENT ON CONCUSSION IN SPORT*

Progression through each level (at least 24 hours) after athlete is completely asymptomatic. Recurrent symptoms at any level lead to a 24-hour rest period then resumption of progression.

1. No activity with complete physical and cognitive rest.
2. Light aerobic exercise (< 70% of maximum heart rate).
3. Sport-specific exercise (drills specific to athlete’s sport).
4. Noncontact training drills (more intense sport drills with no contact from other players).
5. Full contact practice (following medical clearance).
6. Return to play (normal game play).

*Consensus Statement on Concussion in Sport at the 3rd International Conference on Concussion
ports-related concussions have featured prominently in the news over recent months, and many neurosurgeons are eager to take on a larger role in head and spine injury prevention efforts. There are several ways to get involved.

**Education** One of the best ways for neurosurgeons to get involved in prevention is to start a chapter of the ThinkFirst National Injury Prevention Foundation. Founded in 1986 by the AANS and Congress of Neurological Surgeons, ThinkFirst works through local chapters supported by neurosurgical practices or hospitals. Sponsoring neurosurgeons and chapter directors, who are usually nurses or practice administrators, provide educational programs that teach pertinent anatomy, physiology and safety behaviors to local elementary and high schools. ThinkFirst chapters solicit and respond to requests for information from community leaders, including coaches and athletic directors, school principals and nurses. Reaching over 500,000 students in North America each year, award-winning Think First programs have garnered the Presidential Citation and AMA Adolescent Health Award for Excellence in Education and Prevention. ThinkFirst programs are considered best practice for implementing community-based injury prevention strategies.

**Philanthropy** Many neurosurgical groups, from small practices to state-wide societies, sponsor bicycle helmet giveaways. According to the CDC, more than 700 people die in the U.S. each year as a result of bicycle-related injuries. AANS analysis of head injury statistics from the U.S. Consumer Product Safety Commission Studies indicates that there were an estimated 551,216 bicycle-related injuries in 2009. Of these, an estimated 85,389 were head injuries, including 14,361 concussions and 1,348 skull fractures. Nearly half of these head injuries were incurred by children 14 and younger.

Unfortunately, only one quarter of children wear helmets as often as three quarters of the time they spend biking. Youth who receive helmets in giveaway programs learn that over 80 percent of bike-related head injuries can be eliminated by the use of a helmet. The AANS and ThinkFirst are conducting a bike helmet giveaway before the AANS Annual Meeting opening reception at Invesco field on Sunday, April 10. At the event Denver-area children will be fitted with bike helmets that are theirs to keep.

**Policy** Many neurosurgeons are joining NFL commissioner Roger Goodell in support of Washington state’s Lystedt Law and working to get it passed in all 50 states. Named for Zackery Lystedt, a Washington state football player who was injured at age 13 when he returned to play too soon after a concussion, this law would prevent any youth player suspected of a concussion from returning to play until examined by a professional.

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Gail L. Rosseau, MD, FAANS, FACS, a member of the AANS Neurosurgeon Editorial Board, is a neurosurgeon with NorthShore University HealthSystem, Evanston, Ill. The author reported no conflicts for disclosure.

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Mindful Communication Sets Stage for Realistic Patient Expectations

But, He Told Me I ‘Needed’ Surgery

The Ethics in Practice department covers challenging ethical issues in the practice of neurosurgery. To encourage neurosurgeons to think critically about the role of professional ethics in medicine, a short vignette is presented followed by discussion intended to focus on key concerns. The vignette is not intended to parallel a particular real-life scenario but rather is meant to highlight the ethically relevant considerations a neurosurgeon should explore in mediating the complex and competing interests of professional ethical duties to society and to one’s patient. The perspectives presented and conclusions reached are intended to stimulate thought and promote conversation about these complex relationships; they are neither intended to be nor do they necessarily represent positions of the AANS.

Doing “good” for patients goes beyond the competent execution of technical surgical skills. Surgical success determined by achievement of outcome targets is an obvious means of evaluation. However, success measured by physiological parameters alone may bear little relationship to the expectations patients had when they agreed to surgical therapy during the informed consent process. In order to fulfill the intent of informed consent, physicians must carefully consider what success means to us and what it means to patients burdened with an illness.

Physicians have an ethical obligation to communicate clearly with patients. This includes careful attention to the language used. Consider how the word “need” can be misunderstood or misused in an informed consent process. “Need” entails a professional judgment and a strong recommendation to a particular patient that the procedure under discussion is required for health. Because patients are likely to perceive “need” as a strong recommendation from the surgeon, and because of the natural vulnerability of patients in the patient-surgeon relationship, they might not fully weigh the risks and benefits associated with the proposed treatment.

Words must be chosen judiciously when discussing elective surgeries that are aimed at improving quality of life. The following case of spinal fusions done strictly for alleviation of pain highlights important ethical challenges inherent in the language used during the informed consent process. Under what circumstances could it be ethically justifiable to describe this surgery as “needed” for a patient with this diagnosis?

Vignette
A 22-year-old woman sustained an injury at work that resulted in significant acute low back pain. Two months later she consulted a surgeon who performed discography that was interpreted as positive at L5–S1. The patient then underwent an L5–S1 instrumented posterior lumbar interbody fusion. There were no immediate postoperative complications and her hospital stay was uneventful.

Subsequently her pain failed to improve and in fact worsened. Several months later she underwent removal of the fixation hardware, without noteworthy improvement.

A year after the first surgery, when her surgeon told her there was nothing more he could do to help her, she sought a second opinion. A CT scan of the lumbar spine demonstrated what appeared to be a healed interbody fusion. Her imaging studies indicated no other pathology. When she asked the second surgeon why she continued to suffer, he related that the literature suggests it is not uncommon for surgery for low back pain to fail. He further stated that for low back pain evidenced by a positive discogram and treated with fusion surgery the rate of improvement is in the range of 50 percent. The patient was in disbelief upon hearing this, and said, “But my doctor told me I needed surgery!”

Discussion
Deyo and colleagues argued convincingly in a 2004 article that discography and surgery, whether fusions or total disc arthroplasty, remain controversial for treating discogenic back pain. In a 2006 study Carragee and colleagues attempted to define a gold standard for discography. They compared a group of
patients who underwent lumbar fusion for positive discography at a single level with a similar cohort of patients with spondylolisthesis at one motion segment and found that discography was not highly predictive in identifying lesions causing low back pain. Clearly, when recommending surgery with the goal of pain relief it is important that the patient be given appropriate expectations based on the best available information. Doing so can be a challenge when discussing an indication for surgery based on a complex test such as discography and the many issues that surround evaluation of the test’s reliability.

“When surgery for pain relief is recommended, patients must have the opportunity to formulate a realistic assessment as to what the outcome will be.”

When surgery for pain relief is recommended, patients must have the opportunity to formulate a realistic assessment as to what the outcome will be. This is the foundation of the informed consent doctrine. For discogenic back pain, most surgeons would agree that a pain-free state and complete return to previous lifestyle are highly improbable.

In this case, what constitutes informed consent? What should a reasonable, prudent surgeon communicate to a patient about the likely outcome?

First and foremost, the surgeon should advise the patient that surgery for discogenic pain is done with the intent of improving pain and that delaying or declining surgery would not entail physical risk or lead to irreparable harm. As a result, the phrase “need surgery” should be replaced with a discussion of the likelihood of improvement in pain. Language that would have greater ethical support includes: “a surgical option that has been tried with uncertain benefit,” or “although studies have not proven benefit, in your case the surgery may provide pain relief.” Appropriate language would clearly communicate to the patient the optional nature of the procedure and the uncertainty of achieving pain relief.

Carragee and colleagues also recently described a novel tool called “minimum acceptable outcomes” for assessing outcomes in fusion surgery. Preoperatively patients were given standard questionnaires, including the Oswestry Disability Index, visual acuity scale, medication usage, and work status. They were asked to provide their own assessment of what they would consider the minimum acceptable improvement that would justify the burden and risk associated with their surgery. Patients prospectively described their own expectations of significant improvement that constituted an acceptable goal in light of the risks of undergoing such surgery. At the conclusion of the study, 43 percent of patients thought to have “discogenic pain” had met their goal, based upon the minimum acceptable outcome ratings they had established preoperatively.

This study raises the second important ethical consideration. Physicians must help patients interpret data in relation to the patients’ goals. It is never appropriate to withhold material facts that a prudent person would want to know when making a decision involving surgery. Some patients will believe they will be among the 43 percent that achieves diminished pain and some will decline surgery, but all will have had the opportunity to make the decision based on all available information and their own priorities.

Formulating language that clearly communicates with patients about the surgery at hand mirrors the preparation and precision required for the surgery itself. Before speaking a word, it is worthwhile to reflect carefully on how a particular patient is likely to comprehend the language used, especially considering the vulnerability of a person in pain. Developing an understanding between the patient and surgeon of how the surgery’s success will be measured is an important extension of the informed consent process, an ethical process that exists to ensure that surgery does a patient “good.”

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MORE ONLINE

The AANS Neurosurgeon online, www.aansneurosurgeon.org, offers links to resources related to this article.
My professional life has been dedicated primarily to a rather narrow mission: the creation of new radiosurgical technology and the accompanying development of new clinical applications. Looking back over the 25 years during which I started and led a company to accomplish these goals, I realize that intense focus was essential for creation of the CyberKnife, an event which in turn served to catalyze the entire field of modern image-guided precision radiation.

The basic ideas for a radical new method of stereotactic targeting emerged over several late-summer Stockholm days in 1985. I was in the first month of a traveling fellowship at the Karolinska Institute, the mecca of radiosurgery at the time; this rich environment deserves much of the credit for inspiring me. As fortune would have it, my office was in a largely unused wing of the hospital where none other than Lars Leksell, inventor of GammaKnife radiosurgery, was my immediate neighbor. Our mutual proximity allowed me to witness Leksell’s fiery intellect, and more importantly his iron will. The combination of a fertile setting and boundless free time with few real responsibilities afforded by my fellowship position allowed me to reflect and dream big. It quickly became clear that radiosurgery was destined to spark a revolution in brain surgery. The realization led me to the next logical question: Why not radiosurgery for the rest of the body? This question marked the start of my lifelong quest.

The need for a stereotactic frame seemed to be the main impediment to advancing the field. Why not simply use the skeleton itself as a fixed frame of reference without the frame? Real time skeletal imaging, perhaps starting with precisely calibrated simple orthogonal X-rays, could provide unique projections depending on exact cranial (or other bony anatomy) position and orientation. If one could analyze digital images quickly enough, patient positioning could be determined and the radiation beam retargeted automatically, obviating the need for skeletal fixation. While the computers of the time were rather slow, they continually and inexorably were getting faster; perhaps at some point they would be up to such a task. My line of reasoning suggested it was possible that radiosurgery eventually could be “framelessly” targeted anywhere in the body merely by using X-ray imaging. It was patently obvious to me that someday, someone would do this. Why not me?

After experiencing a eureka moment, an interesting thing happens. You cease to control an idea, and the idea starts to control you; the accompanying sensation is simultaneously exhilarating and terrifying. Even so, my quarter-century journey can be characterized less by one dramatic moment than by a gradual unveiling of what would become my lifelong passion.

Like a good shepherd, serendipity seemed ever ready to keep me on my course. I returned to Boston to complete my residency. At the Brigham and Women’s Hospital I worked with neurosurgeon Ken Winston, who was making the first U.S. linac-based system for stereotactic radiosurgery, and at Ken Winston Lab. When Winston and colleagues published their results in 1990, I was struck by how much was needed. I also went to a meeting of the Radiosurgery Society, which had just been established, and was impressed by the enthusiasm of the other members.

I returned to Stockholm in 1991 to establish a company to make the CyberKnife. It was a time of great uncertainty, but a time of great excitement as well. The first patient was treated in 1992, and the company went public in 1994. It was a thrilling time, and I was fortunate to have been a part of it. Today, the CyberKnife is used in more than 300 hospitals around the world, and I am proud to have been a part of this exciting journey.
Representing a tumor volume in stereotactic space is not simple. I discovered this in 1978 when planning Iridium 192 radioactive source placement so that the dosimetry fit the geometry of subcortical tumors. CT was available, but multiplanar reformatting was not. So dose planning was done on CT-derived clay models of the tumor in order to optimize the number and placement of the Ir192 sources. The simulated source locations were then transferred back to the stereotactic radiographs from which stereotactic frame coordinates were determined. It was a hassle!

Why not use a computer to represent and reformat a CT-defined virtual tumor volume within stereotactic space? But in 1978 affordable, sufficiently powerful computer workstations were not available. A mainframe or minicomputer—like those that then supported CT scanners—was needed to store and manipulate the CT database and to perform calculations. However, no grants were available, and I couldn’t afford such a computer on my university salary.

So, in 1979 I left Texas and went home to Buffalo—to make money. I soon bought my own minicomputer and hired Bruce Kall, a computer scientist, and Steve Goerss, an engineer. We modified an arc-quadrant stereotactic frame for CT compatibility and developed fiducial systems for translations of CT and angiographic data into stereotactic frame space. Software was written to interpolate 10 mm thick CT-defined tumor contours into 1 mm cubic voxels within a 3-D image matrix. This virtual volume could be sliced orthogonally to any specified surgical trajectory and displayed as a series of cross sections for simulation and graphic superimposition of the Ir192 dosimetry for the best “fit” of isodose geometry over the defined tumor volume.

I had done a few cases when it dawned on me: Why not use these computer-generated cross sections to identify in an open surgical field where tumor stopped and “normal” brain tissue began, and then take the tumor out? But first I had to worry about “brain shift.” Traditional centrifugal surgical methods—internal debulking and working toward the periphery of a tumor—could result in collapse of brain and tumor and render these cross-sectional (slice) images unreliable. I addressed this problem by employing two important procedural innovations.

First, stereotactically centered trephine craniotomies, not much larger than the lesion, must be positioned in the least dependent part of the surgical field. This was accomplished by rotating the stereotactic headholder and elevating the head of the operating table so that the craniotomy was “on top.” Second, we developed a “centripetal” method for tumor removal: The computer-displayed slice images identified and facilitated development of a surgical plane that first isolated tumor from surrounding brain tissue before it was removed enbloc. After tumor removal brain shift was obvious, but by then it didn’t matter as the tumor was out.

Superficial tumors were removed though a stereo-

A virtual tumor volume is sliced perpendicular to the surgical trajectory (viewline). These cross-sectional images when indexed to the trephine (or cylindrical retractor) indicate the margins of the tumor from most superficial to the deepest within the surgical field. Previously published in J Neurosurg 64:427–439, 1986. Used with permission.
tactically placed trephine craniotomy, while resection of deep tumors was done through a stereotactically directed cylindrical retractor that was 2 cm in diameter. The perfect circles of the trephine and the distal end of the cylindrical retractor provided references for indexing the computer-generated tumor slice images to the surgical field. A “heads-up” display system for the operating microscope was used to inject and scale the slice images onto the surgical field. We added the MRI database when the Mayo Clinic hired Bruce Kall, Steve Goerss and me in 1984.

I did my first image-guided volumetric tumor resection in December 1979. Fortunately, it was a success. Over the next 28 years I performed about 4,000 similar cases. These image-guided, minimally invasive procedures allowed total removal of any imaging-defined lesion with significantly less morbidity than was then associated with conventional surgery. The process rendered “inoperable” brain regions operable, thus improving outcomes for many patients. 

Patrick J. Kelly MD, FAANS, FACS, is the Joseph P. Ransohoff professor in the Department of Neurosurgery, New York University School of Medicine, New York, N.Y. The author reported no conflicts for disclosure.

MORE ONLINE
The AANS Neurosurgeon online, www.aansneurosurgeon.org, includes links to resources related to these articles.

IMAGE-GUIDED RADIATION
From page 13

Massachusetts General Hospital I was on the service of Ray Kjellberg, who almost alone was driving proton SRS. After residency I joined the faculty at Stanford, which is nestled amidst Silicon Valley, with its burgeoning computer industry and most of the world’s medical linac business.

The rest of my saga proved to be more a tale from the Book of Job. I can only now fully understand Edison’s expression that “genius is 1 percent inspiration and 99 percent perspiration.” In the 20 years during which I took my idea from dream to commercially successful reality, almost everything that could go wrong did go wrong. Naivete, stupidity and just plain bad luck conspired against me repeatedly, but somehow providence delivered. Clearly I was fortunate to be able to work with so many talented and committed individuals in realizing my life’s dream. Knowing that my basic ideas for image-guided radiation now are industry standards is an indescribable feeling. Ultimately, realizing that my life’s work will improve the lives of countless patients has been an unbelievable privilege.

Neurosurgery as a field has a long and proud tradition of innovation. It is my sincere hope that young neurosurgeons reading this tale will feel emboldened enough to dream big and to start pursuing their dreams, thereby again pushing the frontiers of our specialty. NS

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Scott D. Simon, MD, Department of Neurosurgery; Tatsuki Koyama, PhD, Department of Biostatistics; Joseph S. Cheng, MD, Department of Neurosurgery; Robert A. Mericle, MD, Department of Neurosurgery, Vanderbilt University School of Medicine, Nashville, Tenn.

Dr. Mericle is a paid-physician proctor for eV3 Neurovascular, Irvine, Calif. The other authors reported no conflicts for disclosure.

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Abbreviations: ACGME, Accreditation Council for Graduate Medical Education; CI, confidence interval; CPT, Current Procedural Terminology

Introduction
The development of endovascular procedures has had a significant impact on how cerebral aneurysms are treated (4–6, 8–9). Nonetheless, there has been only one published report of the respective numbers of craniotomies and embolizations for aneurysms of the last few years in the U.S. (1). In that report Andaluz and colleagues examined the Nationwide Inpatient Sample database to determine the relative numbers of clipping and coiling 1993–2003. Their report demonstrated that while the number of embolizations increased, the number of craniotomies for aneurysm remained stable.

We examined Medicare data 1996–2006 and used these data to speculate on the socioeconomic consequences of the most current trends in aneurysm treatment for neurosurgeons in practice and in training.

Materials and Methods
We retrospectively reviewed the Medicare database for the 11-year period 1996–2006. This database collects the CPT codes submitted for Medicare payment. We began with 1996 data because Gugliemi detachable coils were approved by the Food and Drug Administration in 1995, making 1996 the first full year this device was available in the U.S. for use in endovascular embolization (3). We studied data through 2006 because these were the most recent data available for our study. The CPT codes associated with craniotomy for clipping of cerebral aneurysms are 61697, surgery of complex intracranial aneurysm, intracranial approach, carotid circulation; 61698, surgery of complex intracranial aneurysm, intracranial approach, vertebrobasilar circulation; 61700, surgery of simple intracranial aneurysm, intracranial approach, carotid circulation; 61702, surgery of simple intracranial aneurysm, intracranial approach, vertebrobasilar circulation.

Embolization of intracranial aneurysm is coded 61624, transcatheter permanent occlusion or embolization (e.g., for tumor destruction, to achieve hemostasis, to occlude a vascular malformation), percutaneous, any method, central nervous system (intracranial, spinal cord). This code obviously applies to more than just aneurysm coiling, but it is the code most commonly used for aneurysm coiling. The general nature of

ABSTRACT
The development of endovascular procedures has added embolization using coils to surgical clipping as an option for treatment of cerebral aneurysms. To determine trends in incidence of coiling procedures compared to craniotomies for aneurysm clipping, we retrospectively reviewed Medicare data for 1996–2006. The Medicare database collects the CPT codes submitted for Medicare payment. The craniotomy codes for clipping of cerebral aneurysm (61697, 61698, 61700, 61702) and for endovascular embolization (61624) were tabulated for each of the 11 years studied. An ordinary regression model was created to capture the trend in the number of craniotomies performed during the period studied. The number of craniotomies decreased from 3,204 in 1996 to 1,702 in 2006, declining at a rate of 131 per year (95 percent CI). Conversely, the number of endovascular embolizations increased from 808 in 1996 to 5,152 in 2006. The change in the frequency of each type of procedure has significant consequences for neurosurgical training and treatment of cerebral aneurysms.
of this code makes it difficult to determine the absolute number of aneurysm coilings in a given year. However, it does allow for generalization or identification of trends in the number of intracranial embolizations.

The patient population studied represents all Medicare patients in the U.S. The majority of Medicare patients are 65 and older, but a smaller proportion represents patients younger than 65 with disability.

An ordinary logistic regression model was created to capture the longitudinal trend for the number of craniotomies performed 1996–2006. The rate of change with a 95 percent CI was computed based on the regression model. The number of embolizations and the total number of procedures also were recorded and tabulated. However, formal statistical analysis was not attempted on these endpoints due to the inherent difficulty in determining the absolute number of aneurysm coilings represented by code 61624, which encompasses repeat embolizations as well as embolization of lesions other than aneurysms.

Results
Craniotomies for aneurysm clipping decreased during the period studied. Procedures coded 61700 decreased from 2,942 in 1996 to 865 in 2006, and those coded 61702 decreased from 262 to 42 (Table 1). The introduction of two new

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*CPT, Current Procedural Terminology
61624 - Embolization of intracranial aneurysm, transcatheter permanent occlusion or embolization; percutaneous, any method; central nervous system (intracranial, spinal cord).
61697 - Surgery of complex intracranial aneurysm, intracranial approach; carotid circulation.
61698 - Surgery of complex intracranial aneurysm, intracranial approach; vertebrobasilar circulation.
61700 - Surgery of simple intracranial aneurysm, intracranial approach; carotid circulation.
61702 - Surgery of simple intracranial aneurysm, intracranial approach; vertebrobasilar circulation.
codes in 2001 to denote aneurysms of greater complexity led to a decrease in the number of procedures coded 61700 and 61702, but their introduction should not affect the total number, which decreased from 3,204 to 1,702. Our analysis shows that the number of craniotomies for aneurysm clipping decreased by 131 per year, with 95 percent CI: 109 to 154 (Figure 1).

The number of endovascular embolizations increased from 808 to 5,152 during the period studied, representing a six-fold increase in the number of coiling procedures. The percentage of coiled aneurysms climbed from 20.1 percent in 1996 to 67.0 percent in 2006.

Discussion
Andaluz and colleagues surveyed hospital discharge data 1993–2003 and found the number of embolization procedures doubled while the number of craniotomies for clipping remained stable (1). Our data concur with the rapid increase in endovascular coiling therapy they reported, but differs starkly from their finding of a stable rate of craniotomies for clipping.

The primary reason for this difference is that the data we studied were more recent. Also, our data represent Medicare patients, those 65 and older or on disability, whereas Andaluz and colleagues examined all patients at the hospitals studied. Certain studies have indicated that older patients or those with significant surgical morbidity have better outcomes with endovascular treatment (2, 4–6). Our data suggest that the neurosurgical community has embraced the age of 65 and older as an indication for coiling, and this change in thinking also may account for the decline in craniotomies for clipping in the Medicare population. Given the increasing percentage of the U.S. population that will

![Figure 1: Comparison of Cerebral Aneurysm Treatment by Craniotomy for Clipping or Endovascular Embolization, 1996–2006](image)

The gray fitted line is $Y = 3034 - 131X$, where $X$ is year since 1996 and $Y$ is the number of craniotomies.
qualify for Medicare in the coming decade as well as the four times higher prevalence of intracranial aneurysms among older adults, the trend toward an increasing number of endovascular procedures is very likely to continue (6–7).

Whether or not the sharp decline in the number of craniotomies for aneurysm clipping applies to all age groups is beyond the scope of the Medicare data presented here. However, it is possible to extrapolate from the previously reported stable number of craniotomies for clipping in all patients and from our data showing the decreasing number of craniotomies for clipping in the Medicare population that the number of clipping procedures in younger patients must be increasing.

These trends will necessarily affect neurosurgical training. Endovascular training will play a larger role during neurosurgery residency. The current training philosophy that requires all neurosurgeons to learn aneurysm clipping but only a handful of fellowship-trained specialists to learn aneurysm coiling seems outdated. The increasing number of clipping procedures we have described suggests that case volumes will be more than adequate to train all neurosurgeons in treatment of aneurysms via endovascular coiling. The ACGME Residency Review Committee for neurological surgery has recognized this fact and has taken steps to integrate basic endovascular skills training into the residency curriculum (http://www.acgme.org/acWebsite/RRC_160/160_prIndex.asp).

The effect of these trends on the training of residents for clipping of aneurysms is less clear. It is possible that improved imaging might lead to the discovery of more occult aneurysms in young patients and increase the number of elective clippings. It is also possible that as a greater proportion of aneurysms are coiled, fewer clipping cases will be available to train residents.

**Conclusion**

The number of craniotomies for aneurysm clipping decreased significantly 1996–2006 in the Medicare population, while the number of endovascular embolizations increased in the same population. This change has significant consequences for neurosurgeons with regard to their training and treatment of cerebral aneurysms. Continued monitoring of clipping and coiling trends will aid in determining how to prepare future generations of neurosurgeons with an optimal skill set for treatment of cerebrovascular aneurysms.

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**REFERENCES**

AANS President’s Perspective

New Rules for Neurosurgical Residency Duty Hours

Why Less Is Not More

James T. Rutka, MD

“Residency is an essential dimension of the transformation of the medical student to the independent practitioner along the continuum of medical education. It is physically, emotionally, and intellectually demanding, and requires longitudinally concentrated effort on the part of the resident.”

So begins the text of the common program requirements for residents in all specialties as stipulated by the Accreditation Council for Graduate Medical Education. However, the concept of “longitudinally concentrated effort” has been the object of intense scrutiny, much discussion and significant change over the past decade.

The latest iteration of the ACGME residency requirements (http://acgme-2010standards.org) becomes effective July 1. Medicine and organized neurosurgery have carefully reviewed these new standards. The AANS, the Society of Neurological Surgeons, the Congress of Neurological Surgeons and the American Board of Neurological Surgeons collectively have expressed concern with the new standards in areas of resident supervision, maximum duty period length, maximum in-hospital on-call frequency, minimum time off between scheduled duty periods and maximum frequency of in-hospital duty. The limitation of first-year residents to 16-hour shifts is a provision of the new standards that we strongly opposed.

Ultimately, thanks to organized neurosurgery’s involvement during the development process for the new standards, the new measures are expected to ensure the safety and quality of care rendered to patients by residents in an environment that is safe and humanistic.

Back in Time

On July 1, 2003, new ACGME standards for resident education and training went into effect that notably limited the number of hours residents could work to a maximum of 80 hours per week. Despite considerable initial concern by many neurosurgery educators that the new paradigm would be a step backward for resident training, the 2003 standards ultimately have been embraced. Today, most would agree that the 2003 standards are in fact reasonable given the awareness of the public and government officials in associating fatigued and overworked residents with medical errors and patient safety.

In 2008 an Institute of Medicine committee recommended further reductions in resident duty hours, including the consideration of a 16-hour maximum shift length. Organized neurosurgery responded to the IOM committee’s recommendations in a report which gave voice to the concerns of neurosurgical leaders in the field. The report reviewed special characteristics of neurosurgical practice, distinguishing features of neurosurgical training, the time needed to acquire advanced technical skills and the importance of continuity of care. The report also argued for the self-selection process that occurs when prospective residents apply for a neurosurgical career and noted the fact that 45 of the 60 programs which applied
for an eight-hour extension of the 80-hour resident workweek were in neurosurgery.

Organized neurosurgery held that the deleterious effects of implementing the IOM’s recommendations for reduced duty hours would be far-reaching and would include: 1) a reduction in resident procedural skills and medical judgment competence; 2) a decline in the continuity of patient care with an increase in the number of patient “hand-offs”; 3) the marginalization of neurosurgical residents in the care of patients; 4) a severe reduction in the education of the neurosurgery resident in the operating room and on the ward; and 5) a devaluing of the prime importance of the chief residency experience since it is during this time that residents are ultimately enabled to reach critical clinical and operative independence.

Over the past six years several neurosurgical programs have analyzed the effects of the 80-hour workweek on resident education. The results of one survey indicated that the chief residency experience, overall surgical experience, resident training, and cognitive development were all diminished in a statistically significant manner. Interestingly, a general survey of residency program directors showed that surgical program directors were more likely than their nonsurgical counterparts to disagree with the requirements regarding maximum work hours and length of duty period. This finding underscores the differences among training programs in different specialties and suggests that one size does not fit all.

A Look at Residency in Europe and Canada
It may well be worthwhile to examine the effects of reduced work hours for neurosurgery residents elsewhere in the world. The European Working Time Directive as implemented by the National Health Service in England in 2009 stipulates a minimum daily consecutive rest period of 11 hours and a total work week of 48 hours (reduced from 56 hours). After this work-hour reduction, Maxwell and colleagues demonstrated a statistically significant reduction in continuity of care and training opportunities for neurosurgical residents. Of greater concern, the authors demonstrated that fewer residents in this system have an opportunity to operate on patients they have admitted to the hospital for urgent or semi-urgent procedures.

There can be no question that in neurosurgery a continuous review of patients by trainees is essential for resident education and patient safety. In Canada, there are no duty hour restrictions. Rather, there is an in-hospital call restriction (one in four nights). On days when residents are not on call or post-call, they can remain in the hospital to satisfy their educational requirements and patient care obligations. The core competency of professionalism is used by residents to determine whether they should disengage from a clinical situation because of overwhelming fatigue and/or fear for patient safety.

Where Do We Go From Here?
Where do we go from here? Organized neurosurgery has argued that less is not more. A further decrement in resident work hours will have the potential to cause more harm than good, as was documented after implementation of the European Working Time Directive.

Thanks to key neurosurgical leadership in the dialogue concerning resident duty hour reductions and their effect on training, the ACGME standards for neurosurgery resident education that go into effect this July on the whole will help to preserve all that is good and great about neurosurgery. For this, we owe a great debt of gratitude to Sean Grady, University of Pennsylvania; Hunt Batjer, Northwestern University; and Ralph Dacey, Washington University.

James T. Rutka, MD, PhD, FAANS, FRSC, FACS, the 2010–2011 AANS president, is RS McLaughlin Chair of the Department of Surgery at the University of Toronto, Canada. The author reported no conflicts for disclosure.
Funding for medical research and neurosurgical education is needed now more than ever with government support diminishing and the funding given directly to hospitals and academic programs by corporate supporters under increased scrutiny. In response to this need, the AANS Neurosurgery Research and Education Foundation has expanded beyond its traditional research grants and young clinician awards to facilitate funding of postresidency fellowships.

The NREF entered into agreements with DePuy Spine Inc. and Codman & Shurtleff Inc. in fiscal 2010 to fund the NREF’s new Postresidency Fellowship program. Under the terms of these agreements, DePuy Spine provided funding to the NREF for 2010–2011 postresidency clinical fellowships with a focus on spine, and Codman provided funding for fellowships with a focus on neurosurgery and neurocritical care. These agreements have served the dual purpose of enabling the NREF to support neurosurgical education in another meaningful way while also allowing DePuy Spine and Codman to continue their support of high-quality education and training in spinal care and other neurosurgical specialties in a transparent and independent manner.

“Through this funding, both Codman and DePuy Spine have demonstrated their ongoing commitment to furthering clinical neurosurgical education,” stated NREF Chair Griffith R. Harsh IV, MD. “The training provided will give neurosurgeons at these institutions the opportunity to continue their training and practice innovative, state-of-the-art techniques in areas including spine, cerebrovascular, pediatrics, and neurocritical care. This additional education will enhance their ability to successfully treat patients with debilitating conditions in the years to come.”

The NREF is responsible for all aspects of the fellowship grant program, including review and approval of grant applications. The NREF has awarded grants based on established fellowship program criteria and the needs of the requesting hospital and/or academic institution. The NREF Educational Grants Committee, formed in fall 2009, is composed of neurosurgeons who do not receive financial or other support from the medical device industry. The committee reviews and approves fellowship grant applications for funding in an independent, randomized and unbiased manner. Individuals serving on the committee are volunteers and do not receive compensation from the NREF for their efforts. DePuy Spine and Codman had no input into the selection of fellows or training institutions which received funding, or any other aspect of the administration of the postresidency fellowship program.

The DePuy Fellowship Awards
The NREF awarded DePuy Spine fellowship funding for 2010–2011 to: Cleveland Clinic’s Center for Spine Health; Northwestern University; Rush University; Stanford University; Temple University; University of California at Los Angeles; University of California at San Francisco; University of Miami; University of South Florida; University of Utah and University of Virginia.

Codman Fellowship Awards
The NREF also awarded Codman fellowship funding for 2010–2011 to: Baylor College of Medicine (pediatric neurosurgery), Brigham & Women’s Hospital (general neurosurgery), Rush University (stereotactic/functional neurosurgery), University of Utah (pediatric neurosurgery), and University of Washington (skull base/cerebrovascular neurosurgery).

Jay Riva-Cambrin, MD, fellowship coordinator for the Division of Pediatric Neurosurgery at the University of Utah, was honored that his program was selected as a recipient of an AANS NREF Postresidency Clinical Fellowship grant for the 2010–2011 academic year. “The funding has strengthened both the clinical and research aspects of our fellowship,” he said. “The process of applying has also been invaluable as it resulted in a complete self-appraisal of our program, from which numerous enhancements have blossomed.”

NREF Postresidency Clinical Fellowship grants for the 2011–2012 academic year will soon be announced. These programs will be supported through funding contributed by Codman & Shurtleff Inc., DePuy Spine Inc., LANX Inc., Medtronic, and Zimmer Spine.

Additional information about the program is available on the AANS website. NS
ADVANCING NEURORESEARCH

2011 William P. Van Wagenen Fellowship Awardees

JULIE A. QUATTROCCHI

The Van Wagenen Fellowship and Van Wagenen Selection committees are pleased to announce that two individuals have been awarded the 2011 William P. Van Wagenen Fellowship: Nicholas Marko, MD, from the Cleveland Clinic, Cleveland, Ohio, and Ben Waldau, MD, from Duke University Medical Center, Durham, N.C., who is currently doing a fellowship in endovascular surgical neurology at the University of Florida in Gainesville, Fla.

The William P. Van Wagenen Fellowship was established by the estate of Dr. Van Wagenen, who was one of the founders and the first president of the Harvey Cushing Society, now the AANS. The Van Wagenen Fellowship was designed to give freedom in scientific development without the restrictive limitations imposed by many research grants and fellowships.

Awarded annually, the William P. Van Wagenen Fellowship is offered for postresidency study in a foreign country for a period of 12 months. The fellowship stipend is $120,000 with supplemental funding of $6,000 available to fellows should they need it for family travel expenses and up to $5,000 for health insurance. In addition, each year $13,000 is made available to the university, laboratory or institution sponsoring the Van Wagenen Fellow to help defray research, education and investigation costs.

Dr. Marko will travel to both Belgium and the U.K. In Belgium, he will study with Prof. Michel Verleysen at Universite Catholique de Louvain, Machine Learning Group, the Institute of Information and Communication Technologies, Electronics and Applied Mathematics (ICTEAM) and in the U.K. he will study with Prof. Raymond Goldstein at the University of Cambridge, Centre for Mathematical Sciences. This fellowship will enable Dr. Marko to pursue focused training in each of two areas of data modeling critical to conducting innovative, clinically relevant investigations using molecular brain tumor data.

The first half of the fellowship will focus on gaining experience with mathematical strategies that facilitate selecting subsets of phenotypically significant molecular data from noisy, large-volume molecular data sets. The second half of the fellowship will focus on using nonlinear dynamic modeling strategies to construct probabilistic tools capable of using appropriately selected molecular data to accurately predict outcomes and response to therapy for patients with malignant brain tumors.

Dr. Waldau will travel to Germany to study with Prof. Gerd Kempermann at the University of Dresden (Center for Regenerative Therapies). Dr. Waldau will work on a project involving isolation and propagation of dentate gyrus stem-like cells and transplantation of these cells into a mouse model of chemotherapy-induced suppressed neurogenesis. He hopes to prove through his work the concept that niche-specific precursor cells are effective in restoring learning and memory in neurodegenerative disorders.

The fellowships will commence July 1, 2011, and will be completed within the 12-month period of the grant. Additional information on the Van Wagenen Fellowship is available on the AANS website.

Julie A. Quattrocchi is AANS development coordinator. The author reported no conflicts for disclosure.
Participants in AANS Educational Activities Must Disclose and Resolve Conflicts of Interest

HEATHER M. HODGE

Physician relationships with pharmaceutical and device companies (“commercial interests”) as they relate to continuing medical education and ultimately, to patient care, have been heavily scrutinized of late. The Accreditation Council of Continuing Medical Education mandates the AANS and all accrediting institutions and organizations offering continuing medical education to have mechanisms in place that identify and resolve conflicts of interest in CME activities.

“As all neurosurgeons know, the issue of physician relationships with our industry colleagues is a flash point topic that has reached the attention of national media and Congress,” stated H. Hunt Batjer, MD, chair of the AANS MOC/CME Committee.

“The AANS must assure that its CME offerings are completely free of bias and that all potential conflicts of interest have been resolved prior to the various scientific programs.

“This article reflects policies that have been carefully developed by AANS leadership and have been approved by the ACCME during the AANS’ recent reaccreditation process,” he continued. “Please read these policies closely so that we all are on the same page and to avoid confusion when you receive feedback from the scientific program committees.”

While there are a variety of ways that a CME provider can maintain compliance with ACCME mandates, the steps the AANS has taken are outlined below.

1. For all CME activities, the AANS must obtain disclosure information regarding relationships with commercial interests from anyone who is in a position to control the content of that activity. This includes scientific program planning committee members, abstract reviewers, speakers, authors, co-authors and others. If an individual refuses to disclose, he or she will be disqualified from participating in the activity in any capacity.

   a. All individuals have access to http://www.MyAANS.org and have the ability to log in and disclose online. Before they actually see the disclosure form, they must agree to the AANS content validation statements and to the AANS expectations regarding presentations being free of any commercial bias. If an individual indicates that he or she does not agree with these statements, an e-mail is automatically generated to AANS staff who then follow-up with the individual regarding which part(s) they do not agree. This creates two-way communication which is mandated by ACCME in order to show that the expectations were communicated and agreed to. Should an individual not agree to the statements and expectations, he or she will not be able to participate in the activity.

   b. Disclosure may also be obtained via a paper form, via e-mail and/or via telephone provided that the content validation statements and the expectations are communicated and agreed to in advance.

2. For all individuals who do have a financial disclosure, it is automatically assumed that there is a conflict of interest, and that conflict of interest must be resolved. The AANS has created a Resolution of Conflict of Interest form that outlines the different ways conflicts can be resolved as summarized below:

   a. If the disclosure is not related to the content of the faculty’s presentation or to the nature of the individual’s position on the scientific program committee, the conflict is resolved.

   b. If there is a history with the speaker for the same exact presentation and if no bias has been detected in the past, the conflict is resolved.

   c. In some instances, the content of a presentation must be reviewed. If after this review a staff person or committee member is able to determine that there is no conflict, then it is resolved. However, if a conflict of interest is detected the additional steps to resolve it may include replacing the speaker, changing the role of the speaker, and/or altering the control over the content in other ways.

Continues on page 26 ▶
CSNS REPORT

CSNS Continues Successful Fellowship Program

DEBORAH L. BENZIL, MD

The Council of State Neurosurgical Societies proudly announced the initiation of the Socioeconomic Fellowship program in 2007. The goal of this fellowship is to provide neurosurgeons-in-training with exposure to relevant socioeconomic issues facing medicine and neurosurgery today.

Qualified applicants must be in a U.S. neurological training program and have the ability to attend two consecutive CSNS meetings. A total of 13 fellowships are awarded each year through an online application process that was extremely competitive for the 2010–2011 fellowship with 64 applicants.

Clemens Schirmer, MD, is a 2009–2010 fellow who was so enthusiastic about his experience that he returned the following year as a delegate to the CSNS. He describes his experience below. NS

On Being a CSNS Socioeconomic Fellow

Clemens M. Schirmer, MD, PhD, Baystate Medical Center and Tufts University, Springfield, Mass.

A dmittedly, I did not know very much about socioeconomic issues during the first few years of my residency. My first encounter with the CSNS was through the late Samuel Hassenbusch, MD, who urged me to get involved. While I was busy learning neurosurgery, it took until almost the end of my residency to realize that medicine as a profession is rapidly changing and that we, as future neurosurgeons, can either remain passive or take an active role in shaping the future framework of how we are going to deliver neurosurgical care.

Friends who were a few years ahead in their residency training told me about the socioeconomic fellowship sponsored by the CSNS. I applied for the 2009–2010 CSNS Socioeconomic Fellowship and was awarded the position during my chief residency year. My commitment was to attend the two CSNS meetings, which take place on Friday and Saturday preceding the two major neurological meetings presented annually by the AANS and the Congress of Neurological Surgeons.

The constituents of the CSNS are the state societies which are organized into geographical quadrants (Northeast, Northwest, Southeast, and Southwest). Every quadrant selects its fellows and assigns mentors. My mentor, Stephen Johnson, MD, contacted me early in 2009 during a regional neurological conference, and we discussed the fellowship role and potential projects that I could work on during my fellowship.

The first CSNS meeting introduced me to a world slightly alien—a succession of committee meetings and plenary sessions with formal votes on resolutions all outlined by an agenda sent to members along with the resolutions weeks before the meeting. A primer on the procedures of the CSNS by Randy Smith, MD, the CSNS historian, brought some much-needed clarity. I met my co-fellows and discovered that we were remarkably diverse when it came to our previous exposure to and experience with socioeconomic issues. We rubbed shoulders with many of the famous names in neurosurgery, and I was surprised by the genuine interest in my questions and contributions expressed by the senior representatives of our field.

With Darlene Lobel, MD, chair of the CSNS Young Neurosurgeons Committee, I focused on a project that explored the state of virtual reality and its impact on neurosurgical practice and training. I offered to contribute by surveying existing research and commercial products for VR applications that would be of interest to neurosurgery. During the following months, I conducted a systematic overview of the literature and contacted companies to inquire about the availability and pricing of commercial VR applications. Together with contributions from other fellows, we saw the fruits of our work during a plenary presentation during the spring CSNS meeting. A peer-reviewed publication of our findings is under way and will be a fitting culmination of our efforts.

After meeting with my mentor, I had also begun to work on another project: evaluation of the impact of the Massachusetts health insurance mandate on a neurosurgical practice. I worked with the coding and billing department of our hospital to obtain anonymous billing data for 2004–2009, a period that spanned the introduction of mandated health insurance in Massachusetts in 2007.

At the conclusion of my second meeting, my fellowship was evaluated. I was encouraged to continue to contribute to the CSNS and to return as an appointee to the CNS caucus. This is one of the multiple ways that allow interested residents and practicing neurosurgeons to participate after getting interested in socioeconomic issues and serving as a CSNS Socioeconomic Fellow.

Would I do it again? In a heartbeat, but much earlier. I tend to disagree with friends and colleagues who hold that we as a profession should not take an active stance in the way healthcare is delivered. The CSNS fellowship is an ideal platform for learning about and getting involved in our profession. NS

Deborah L. Benzil, MD, FAANS, a member of the AANS Neurosurgeon Editorial Board, is vice-chair of the CSNS, www.csnsonline.org. The author reported no conflicts for disclosure.
3. Once this process is complete and the activity has taken place, the AANS must then determine if there were any individuals who violated AANS content validation statements and expectations regarding commercial bias in presentations. This is done by monitoring evaluations, which include a question about whether or not commercial bias was detected, or by the use of a peer reviewer and/or room monitor.

   a. If bias is detected, staff reviews the comments to determine if in fact there was actual bias. If it is determined that there was bias or if it is impossible to determine, staff sends a letter on behalf of the AANS MOC/CME Committee chair to the individual and/or to the course directors for the session in which the bias was detected.

   b. Each violation is considered on a case-by-case basis. In some instances, the individual is not allowed to present in the future. In other instances, presentations by the individual are closely monitored in future activities to ensure the violation is not committed again.

In March 2010 the AANS received reaccreditation from the ACCME to continue to provide CME for the next four years. The process outlined above was part of what was submitted in the AANS self-study report and in the applicable performance-in-practice files.

Additional information on this process is delineated in AANS Updated Standards for Managing Conflicts of Interest in Educational Activities, available on the AANS website. NS

Heather M. Hodge, hmh@aans.org, is AANS education and meetings coordinator. The author reported no conflicts for disclosure.

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KATIE O. ORRICO, JD

Thanks to the generosity of neurosurgeons from around the country, NeurosurgeryPAC raised more than $285,000 in 2010, bringing the total donations for the two-year election cycle to $485,000, just shy of our $500,000 goal. With your contributions, NeurosurgeryPAC was able to play an important role in the historic 2010 elections.

Neurosurgeons cannot afford to sit on the political sidelines, and NeurosurgeryPAC can only work to ensure that we have a strong voice on Capitol Hill if we have the necessary financial resources. Your contributions will help in our continued fight for Medicare physician payment reform, repeal of the Independent Payment Advisory Board, rescission of punitive quality reporting requirements, medical liability reform and stable funding for biomedical research and graduate medical education. Thank you for your continued support!

Election Successes

The 2010 elections saw significant gains by the Republican Party and an enormous shift in the balance of power. Neurosurgery scored many key victories with 89 percent of NeurosurgeryPAC-backed candidates winning their general election bids.

Due to the generosity of neurosurgeons around the country, NeurosurgeryPAC contributed a total of $115,500 to 39 Democratic candidates and party committees and $284,500 to 73 Republican candidates and party committees.

Additional information about NeurosurgeryPAC, including how to make a donation, is available in the Legislative Activities area of the AANS website.

Katie O. Orrico, JD, korrico@neurosurgery.org, is director of the AANS/CNS Washington office. The author reported no conflicts for disclosure.
Instrumented Lumbar Fusion in the Degenerative Spine

To Brace or Not to Brace?

The following case presentation is intended to assess current practice habits for common neurosurgical challenges when class I evidence is not available.

The Case

A 60-year-old man presents with a progressive history of low back pain and bilateral leg discomfort. He says that over the last year his ability to walk long distances has decreased due to bilateral leg pain and paresthesias radiating from his buttocks to his thighs. He must sit down or lean forward to alleviate the leg symptoms. He definitely feels that he can walk longer distances when he is leaning forward such as when pushing a shopping cart or a lawn mower. He clearly states that his leg symptoms are more bothersome than the low back pain. On physical examination there are no focal neurological deficits. His symptoms are reproduced when he extends his lumbar spine, but they are alleviated when he flexes it.

MRI of the lumbar spine reveals spinal stenosis at the L4–L5 level due to ligament and facet hypertrophy and a Grade I degenerative spondylolisthesis. X-rays at this level show significant mobility with standing flexion and extension (greater than 4 mm movement with flexion which reduces in extension).

Clinical history, examination and MRI findings are consistent with a diagnosis of neurogenic claudication due to L4–L5 spinal stenosis. The patient agrees to a L4–L5 posterior decompression, instrumentation with pedicle screws and rods, and posterolateral autograft fusion. Upon signing the consent forms he asks whether he will need to wear a lumbar brace after surgery.

How Would You Treat This Patient?

Would you prescribe an external lumbar brace for this patient in the postoperative period? Read the case discussion online and tell us what you would do by taking this Gray Matters survey. Go to www.aansneurosurgeon.org and select Surveys at the top of the page. Results to the previous case, Persistent, Painless Foot Drop, also are available online.

Discussion

Posterior decompression via laminectomy and partial facetectomy is a common neurosurgical procedure used to alleviate neurogenic claudication due to degenerative lumbar spinal stenosis. However, in associated cases of spondylolisthesis, many surgeons advocate for spinal stabilization through a posterolateral bone fusion. With the advent of posterior instrumentation methods to provide rigid internal fixation, posterolateral bone fusion rates have increased significantly in comparison to noninstrumented fusions (2).

Read more at AANS Neurosurgeon online.

Aleksa Cenic, MD, MSc, FRCSC, is a fellow in neurosurgery, and Rajiv Midha, MD, MSc, FAANS, FRCSC, is professor and deputy head of the Department of Clinical Neurosciences at the University of Calgary in Canada. Dr. Midha is a member of the AANS Neurosurgeon Editorial Board. The authors reported no conflicts for disclosure.

(A) T2-weighted sagital MRI of the lumbosacral spine showing Grade I spondylolisthesis with associated central spinal stenosis at L4–L5. Standing lateral plain film X-rays of the lumbar spine showing (B) increased anterolisthesis on flexion, and (C) reduced anterolisthesis on extension. (D) Postoperative plain film X-rays reveal the posterior instrumentation at L4–L5.
Hiring a Physician Assistant

As more Americans access healthcare services, more healthcare providers will be needed. Shortages of neurosurgeons in some subspecialties and changes in resident work hours are already affecting the neurosurgical field, exacerbating the demands on neurosurgeons’ time. In an already taxed system that demands ever more efficiency, physician assistants can be key allies in helping neurosurgeons provide patients with high-quality care.

Physician assistants (PAs) can play a pivotal role in the development, integration and success of both private and hospital-based neurosurgical practices. They typically conduct physical exams, diagnose and treat illnesses, order and interpret tests, counsel patients on preventive healthcare, assist in surgery and prescribe medications. Although state and hospital regulatory committees play a role in determining the practice scope of PAs, the level at which a PA is able to practice is primarily reliant on a strong working relationship with the supervising neurosurgeon.

Compatibility between the supervising neurosurgeon and PA is particularly important given the apprenticeship model in which PAs practice. This model has been part of the PA profession since its inception at Duke University Medical Center, where Eugene Stead, MD, developed a two-year curriculum for Navy corpsmen who had received considerable medical training during their military service. The first class graduated in 1967, and today the American Academy of Physician Assistants puts the number of PAs in medical and surgical practices at more than 73,000.

What to Look For

Like physicians, PAs engage in intense didactic and hands-on clinical training. Of 154 programs accredited by the Accreditation Review Commission on Education for the Physician Assistant, 127 confer master’s degrees. Program graduates receive the PA-C credential when they pass a national certification examination developed by the National Commission on Certification of Physician Assistants in conjunction with the National Board of Medical Examiners. To maintain their national certification, PAs are required to log 100 hours of continuing medical education every two years and pass a recertification exam every six years. Both graduation from an accredited PA program and passage of the national certification exam are required for state licensure.

Credentials of a potential hire can be verified on the National Commission on Certification of Physician Assistants website. State licensing boards require PAs to be certified by this organization.

Where to Look

Whether interested in hiring a full- or part-time PA, in addition to general channels such as newspaper listings and professional recruitment agencies, it pays to go where the PAs are; that is, to organizations that are affiliated with the PA profession.

For posting open PA positions, the American Academy of Physician Assistants, the Association of Neurosurgical Physician Assistants, and the AANS, which extends associate membership to PAs, have online career centers that are affiliated with the HealthCareers Network. The American Association of Surgical Physician Assistants has a separate online job board, while the peer-reviewed Journal of the American Academy of Physician Assistants offers classified advertisements.

Those interested in hiring new graduates locally can check with the Physician Assistant Education Association to find the closest accredited programs. In addition to posting an open PA position on the local program’s job board, neurosurgeons can consider becoming mentors as all schools look for mentoring agreements with private practitioners as well as teaching hospitals. Neurosurgeons in independent neurosurgery practices can supervise PA students working to fulfill their surgical subspecialty requirements.

Salary ranges for PAs will reflect their level and area of experience as well as geographic location. The American Academy of Physician Assistants sells a report that details salary information, but as a general reference, in 2009 CNN Money listed the median income of an “experienced PA” at $90,900.

What to Expect

New graduates who enter a neurosurgical practice should be able to perform a history and physical for...
initial, follow-up, and postsurgical patients. On-the-job training might commence with learning how to interpret laboratory and imaging tests along with the formulation of a treatment plan. With time and experience, the PA will be able to evaluate and treat some patients independently and provide initial clinical guidance to patients and referring doctors. Depending on individual interest and aptitude, PAs also may play an important role in organizing and performing clinical research trials and practice management. A sample job description offering general guidance for neurosurgeons and PAs is available from the Association of Neurosurgical Physician Assistants.

Reductions in resident work hours in the last few years have increased the need for PAs on the inpatient service. A very important role for PAs is their presence in hospital family meetings or discharge rounds. These meetings are often time-consuming for physicians to attend, but PAs can provide a critical link to the neurosurgeon’s expertise and guidance. Depending on the specific state and hospital, PAs with significant experience may be able to go beyond first-assisting in the operating room. Some uncomplicated procedures such as opening and closing incisions and bedside placement of intracranial pressure monitors can be performed by PAs independently.

Because a PA may stay with a practice for an entire career, he or she can be a source of stability in the practice that closely reflects the supervising neurosurgeon’s practice style. When properly utilized, a PA can be a key contributor to the success of any neurosurgical practice. NS

Thai Vu, PA-C, is lead physician assistant, and Lawrence S. Chin, MD, FAANS, is neurosurgeon-in-chief, Boston Medical Center, and professor and chair of neurosurgery, Boston University School of Medicine, Boston, Mass. Dr. Chin is a member of the AANS Neurosurgeon Editorial Board.

MORE ONLINE

The AANS Neurosurgeon online, www.aansneurosurgeon.org, offers links to resources for this article.
As 2011 progresses, the Current Procedural Terminology coding updates that were developed during 2010 are being incorporated into practice. As usual, the process is challenging. While in some years the coding changes primarily involve simple editorial alterations and the occasional introduction of new codes for procedures that employ new technology, this year a large number of commonly used codes have been revised, including codes for bundling of anterior cervical decompression and anterior cervical arthrodesis. New codes for these procedures are among the CPT coding changes that practices should be incorporating into their billing systems for 2011.

One of the most common procedures performed by neurosurgeons involves anterior cervical decompression, code 63075, followed by anterior cervical arthrodesis, code 22554. While each of these procedures can be performed independently of the other (hence the individual codes), the codes are used together more than 90 percent of the time.

The Centers for Medicare and Medicaid Services has been working with the American Medical Association’s RVS Update Committee, known as the RUC, to analyze a number of services that may be misvalued. It was anticipated that there would be additional overlap of work not accounted for by the application of the –51 multiple procedure modifier, which carries with it a 50 percent reduction in allowable payment on the lesser-valued code. A coalition of societies, including the AANS, American Academy of Orthopaedic Surgeons, Congress of Neurological Surgeons and North American Spine Society, was mandated by the RUC to develop a combined procedure code that reflects concurrent performance of an anterior cervical discectomy for decompression and fusion, ACDF. Beginning in 2011, surgeons are required to code the initial level ACDF as 22551 and each additional level as 22552. Use of the operating microscope in microdissection for the cervical decompression remains bundled with these codes.

### New Codes in 2011

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>63075</td>
<td>Anterior cervical discectomy for decompression and fusion (ACDF).</td>
</tr>
<tr>
<td>22551</td>
<td><em>Initial level</em></td>
</tr>
<tr>
<td>22552</td>
<td><em>Each additional level</em></td>
</tr>
<tr>
<td>20930</td>
<td>Morselized bone allograft or other osteopromotive material for spine surgery.</td>
</tr>
<tr>
<td>20931</td>
<td>Structural bone allograft using machined bone allografts.</td>
</tr>
<tr>
<td>22851</td>
<td>Interbody prosthetic device placement.</td>
</tr>
<tr>
<td>64779</td>
<td>Cervicothoracic spine transforaminal epidural injection; requires and includes image guidance using either fluoroscopy or CT. <em>Initial levels</em></td>
</tr>
<tr>
<td>64780</td>
<td><em>Each additional level</em></td>
</tr>
<tr>
<td>64783</td>
<td>Lumbosacral spine transforaminal epidural injection; requires and includes image guidance using either fluoroscopy or CT. <em>Initial level</em></td>
</tr>
<tr>
<td>64784</td>
<td><em>Each additional level</em></td>
</tr>
<tr>
<td>61781</td>
<td>Stereotactic computer-assisted navigation. <em>Intradural cranial surgery</em></td>
</tr>
<tr>
<td>61782</td>
<td><em>Extradural cranial surgery</em></td>
</tr>
<tr>
<td>61783</td>
<td><em>Spinal surgery</em></td>
</tr>
<tr>
<td>64568</td>
<td>Cranial nerve neurostimulator electrode and generator. <em>Placement</em></td>
</tr>
<tr>
<td>64570</td>
<td><em>Removal</em></td>
</tr>
<tr>
<td>64569</td>
<td><em>Revision or replacement</em></td>
</tr>
</tbody>
</table>

*Use of the operating microscope in microdissection for the cervical decompression remains bundled with codes 22551 and 22552.*
The older codes 63075 and 22554 were not deleted since they still can be performed in isolation, and the arthrodesis code 22554 also may be used with code 63081 for anterior cervical corpectomy. In the initial months of 2011 billing, staff may see denials from payers who have not incorporated the new codes into their software. Written communication with the payers to determine an agreeable method for communicating performance of these services is recommended. Procedures that remain separately reportable services are those involving bone graft harvest, placement of an intervertebral body prosthetic device, and anterior instrumentation.

Additional changes involve edits to the bone graft and prosthetic device codes. The nonstructural bone allograft code 20930 now describes use of either morselized bone allograft or other osteopromotive material for spine surgery. This change was meant to clarify the use of code 20930 for use of such materials as bone morphogenetic protein and demineralized bone matrix, and it is consistent with instruction provided over the past decade at the AANS coding courses. There was also an editorial change applied to code 22851 for placement of an interbody prosthetic device. The previous parenthetical example of a threaded bone dowel was removed in order to clarify that machined bone allografts are described with code 20931 for use of structural bone allograft.

In keeping with the CPT’s trend toward bundling of services, editorial revisions were made to the spinal transforaminal epidural injection codes to require and include the image guidance. Previously, one would additionally report code 77003 when using fluoroscopic guidance to perform a transforaminal epidural injection. Beginning in 2011 codes 64779 for initial level and 64780 for each additional level of transforaminal epidural injection in the cervicothoracic spine require and include the image guidance with use of either fluoroscopy or CT. Similarly, codes 64783 for initial level and 64784 for each additional level of transforaminal epidural injection in the lumbosacral spine also require and include the image guidance with use of either fluoroscopy or CT.

In contrast to these examples of services typically performed together and bundled for payment, there has been a separation of the former neuronavigation code 61795 into three different navigation codes based on the body region where the navigation is applied. This change is rooted in a nearly five-fold increase in use of neuronavigation that has been observed in the Medicare population over the past decade. Much of this growth was thought to come from application of navigation outside of the intradural cranial surgery for which it primarily had been used. For example, in 2009 code 61795 was used more than one third of the time by otolaryngologists. With the deletion of 61795, there are three new CPT codes to describe the physician work of image-guided navigation. When performing stereotactic computer-assisted navigation for intradural cranial surgery, the neurosurgeon should report code 61781. For stereotactic computer-assisted navigation used in extradural cranial surgery such as nasal sinus surgery, the surgeon should report code 61782. Performance of stereotactic computer-assisted navigation for spinal surgery should be reported with code 61783.

Lastly, a new code set was developed for surgery to distinguish cranial nerve neurostimulator and generator placement from that of the vagal nerve. When performing both the placement of a cranial nerve neurostimulator electrode and generator, code 64568 is reported. Removal of the electrode and generator is reported with code 64570. If the stimulator electrode array is revised or replaced, code 64569 is reported. Open placement of a vagal nerve stimulator electrode remains coded 64573, whereas the placement of the generator is reported with either 61885 or 61886.

On first impression, many of the changes for 2011 that have been reviewed seem to be minor. However, these changes represent rebundling of services performed together the vast majority of the time as well as separation of different types of services that were formerly reported with one code. Practices should be prepared to monitor explanations of benefits during the first quarters of 2011 in case the payers have not yet incorporated these changes into their claims software. If a payer requests reporting of services based on 2010 coding conventions, the practice should obtain the request in writing and subsequently report the procedure(s) as requested by the payer. NS

Gregory J. Przybylski, MD, FAANS, a member of the AANS Neurosurgeon Editorial Board, is chair of the AANS/CNS Coding and Reimbursement Committee and represents the AANS on the American Medical Association’s RVS Update Committee. He instructs coding courses for the AANS and for the North American Spine Society. He is president of NASS, an appointee to the Advisory Panel on Ambulatory Payment Classification Groups of the Centers for Medicare and Medicaid Services, and an advisory board member at United HealthCare.
Review of Closed-Claim Malpractice Litigation in Neurosurgery

Introduction
Medical malpractice is a topic that weighs heavily on the minds of most neurosurgeons. A thorough understanding of factors that underlie malpractice cases may help neurosurgeons and the neurosurgical profession in several ways. This information might prospectively help neurosurgeons understand which types of cases represent a litigation risk. It also is possible that specific nuances in patient care exist and could be heeded to help avoid potential patient safety risks. Knowing which patients tend to pursue malpractice claims additionally might help prove or dispel misperceptions about those patients, particularly under what types of situations they tend to present.

In this review we seek to evaluate the epidemiological profile of neurosurgical malpractice claims and educate neurosurgeons on those issues, including the characteristics of patients who bring malpractice claims, the types of cases most often litigated, the injuries most frequently associated with neurosurgical malpractice claims, the underlying causes of those injuries, and the most important factors driving a medical malpractice suit.

Methods
We initially developed a set of 12 questions that were thought to be useful in describing malpractice plaintiffs and the type of care associated with a malpractice claim. The questions addressed the type of case (spine, cranial, peripheral nerve), the specific allegation associated with the case (e.g., wrong level), the plaintiff’s age, the state where the case was filed, whether published clinical guidelines were used during the case, other defendants named in the case, the clinical outcome of the plaintiff, the outcome of the litigation, the costs incurred by the defendant, insurance status of the plaintiff at the time of treatment, and whether the plaintiff used an expert witness report or testimony.

The data source was the TDC neurosurgical database for closed neurosurgical malpractice claims. From several hundred charts at TDC the authors randomly selected and examined claims that occurred between Jan. 1, 2004, and June 30, 2009, regardless of indemnity payment or amount of allocated loss adjustment expense (e.g., fees paid to outside attorneys, experts, and investigators used to defend claims). TDC writes malpractice coverage across the U.S. and has particular market penetration in its home state of California. The charts contain information on the litigants and allegations generating the claim, costs of those injuries, and the most important factors driving a medical malpractice suit.
incurred by TDC as a result of the claim, and a narrative by TDC employees and attorneys on legal processes pertinent throughout the history of the claim. The charts do not contain clinic notes, operative reports, imaging studies, laboratory values or physician depositions.

First we randomly selected 21 charts. Each of the first 10 charts was reviewed and discussed by all three authors, and the original 12 questions were adjusted to define issues raised during discussion that were worthy of being tracked. The remaining 11 charts were each reviewed and discussed by two authors, and the questions once again were altered based on the authors’ collective sense that the data should be tracked.

A list of 46 questions was finalized (Table 1, online). The authors then developed an online survey (Survey Monkey, http://www.surveymonkey.com) based on the 46 questions and proceeded to review and score the initial 21 cases. At least two authors checked and verified the data that were included in this review. Two authors reviewed an additional 69 cases at TDC nine months later. Thus a total of 90 cases were reviewed and comprise the data for this paper.

Results
In the 90 cases reviewed there were 57 male plaintiffs and 33 female plaintiffs. The average age of the plaintiffs was 45.4. All plaintiffs were alive at the time the claim was initiated, and no estates initially brought claims against defendants. Claims were filed in 20 of 50 states in which TDC writes policies. The highest number of cases occurred in Illinois (17 cases) and California (14 cases).

Thirty-one of 90 cases (34 percent) were dismissed by the court, and an additional 33 cases (37 percent) were settled before trial, during trial or after a mistrial. Four cases were abandoned by the plaintiff and 13 were concluded by summary judgment (one for the plaintiff and 12 for the defendant). Nine of the cases (10 percent) went to trial. Of those nine cases, verdicts were returned for the plaintiff in two cases and for the defense in seven cases. For all 90 cases the average cost of defense was $86,882. The cost more than doubled to defend the nine cases that went to trial, averaging $182,734.

The defendant physician was successful in 54 of 90 cases (60 percent). Success is defined as case dismissal, abandonment
by the plaintiff, verdict for defendant, or summary judgment for the defendant. Nearly all of the defendants in the 90 cases reviewed were certified by the American Board of Neurological Surgery (81 certified, four not certified, five unknown).

The plaintiff was successful in 36 of 90 cases (40 percent), and 33 of these cases were settled. The settlement amount was reported for 31 cases, and these settlement payments averaged $392,433 with a range of $7,500 to $1,950,000. Two of the nine cases that went to trial resulted in a victory for the plaintiff. The average total payment after trial was $378,369, an amount that is not significantly different from the average settlement payment. All of the payments were listed as economic damages. However, 17 plaintiffs alleged noneconomic damages of $1 million or more at the beginning of the suit.

Additional defendants were listed in 86 cases. In more than half of these cases the hospital was named as a defendant along with the neurosurgeon. Others also named as defendants were physicians (38 percent) and the neurosurgeon’s group (20 percent). The most frequently named specialty for additional physician defendants was internal medicine/critical care.

The patient initially presented to the neurosurgeon’s office in 85 percent of all cases. Only 6 percent of the cases were generated after initial treatment in the emergency room, and 9 percent started as a hospital consultation. In one additional case the neurosurgeon met the patient in the operating room for the first time. Even though very few of the cases started with care provided in the emergency room, it should be noted that in around one-third of cases there was a remote history of trauma, accident or prior injury that was thought to play a role in the patient’s presenting symptoms.

Almost all claims (87 of 90) were generated after some type of neurosurgical procedure. The procedure involved cranial care in 23 percent of cases and spine care in 70 percent of cases. Most spine cases involved the lumbar spine (54 percent), followed by the cervical spine (37 percent) and the thoracic spine (9 percent). A majority of these spine cases (55 percent) utilized some type of implant or instrumentation. The underlying source of the plaintiff’s pathology was most commonly degenerative, reflecting the preponderance of spine cases in this series (Figure 1). Following surgery 54 percent of the plaintiffs did not have a new or worse neurological deficit, and 7 percent had no neurological deficits and no pain. The plaintiff’s condition, not necessarily related to any surgery, was most commonly minor neurological deficits with pain at the time of lawsuit resolution (Figure 2).

In 62 of the 87 cases that followed a neurosurgical procedure the patient was noted to have a neurological deficit prior to surgery (Figure 3). Most commonly this was radiculopathy. In fewer than half of the cases patients were noted to have

### TABLE 2

Factors Other Than the Defendant Neurosurgeon’s Actions That Instigated or Encouraged the Lawsuit

<table>
<thead>
<tr>
<th>Factors</th>
<th>Occurrence</th>
<th>%</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other (specified)</td>
<td>48.7</td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>Other (unspecified)</td>
<td>39.7</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td>Subsequent treatment/surgery by another physician</td>
<td>34.6</td>
<td></td>
<td>27</td>
</tr>
<tr>
<td>Wound infection</td>
<td>11.5</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Durotomy</td>
<td>10.3</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Instrumentation positioning</td>
<td>9.0</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Medical management preoperatively or postoperatively</td>
<td>9.0</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Subsequent opinion by another physician</td>
<td>9.0</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Pseudarthrosis</td>
<td>9.0</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Instrumentation failure</td>
<td>6.4</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Postoperative hematoma</td>
<td>6.4</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Anesthesia complications</td>
<td>5.1</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Total* cases with other factors</td>
<td>100</td>
<td></td>
<td>78</td>
</tr>
</tbody>
</table>

*Other factors were absent in 12 of the 90 cases reviewed.
a new or worse neurological deficit after surgery than they had before surgery. Whether or not the patients had a new or worse neurological deficit following surgery, the majority of plaintiffs (60 percent) had an additional surgery to address problems such as complications or lack of improvement after the first surgery. The outcome after the second surgery was variable: About 44 percent of patients were unchanged, 32 percent were worse and 24 percent were improved.

Very few of the cases (7 percent) involved surgery on the wrong side or at the wrong level. Even fewer cases (2 percent) alleged a retained foreign body such as a surgical sponge.

The legal allegation against the defendant in 70 percent of the cases was improperly performed surgery. However, a plaintiff can make more than one legal allegation against a defendant in a medical malpractice case, and this was done in 46 percent of cases in this series. These other allegations included failure to diagnose (28 percent), lack of informed consent (16 percent), unnecessary surgery (9 percent), and inappropriate postoperative care (9 percent).

Given the entire narrative of the case, the reviewers tried to identify factors other than the defendant physician’s actions that may have contributed to the generation of the case. We found that in 78 of the 90 cases the litigation was the result of other such factors, most commonly subsequent treatment or surgery by another physician (Table 2). In some cases comments made by that physician to the plaintiff seemed to have some influence on prompting the lawsuit.

Discussion
This review of 90 neurosurgical malpractice claims from one medical malpractice insurer, TDC, offers several insights for neurosurgeons as to who sues them and why.

First, the vast majority of cases involved elective spine surgery for degenerative spine disease, and the majority of those spine cases involved placement of instrumentation. Other studies of neuro-
surgical malpractice also have shown a preponderance of spine patients (2). Spine care has come to dominate neurosurgical practice, and instrumentation has become commonplace in spine surgery. The fact that most of these malpractice claims arose from elective, degenerative spine disease underscores the importance of appropriate patient selection, establishment of reasonable patient expectations, and proper execution of the technical aspects of the surgery in this patient population.

Second, the average age of these patients, 45.4, was much younger than what might be expected in a degenerative spine population. Other studies also have noted a peak in malpractice claims in the fifth decade of life (3). This data may reflect the fact that younger patients would be able to seek larger claims since they have a longer time span to either suffer from their injuries or have limited income due to their inability to work. In contrast, from an actuarial perspective older patients would not have the time to accumulate the economic damages that could be calculated for a younger patient. In our review the economic damages (lost wages, additional medical care) were far more prevalent than noneconomic damages (pain and suffering): All of the reported damages were economic despite some excessive claims for the latter.

Third, it may be that younger patients undergoing elective spine surgery represent a more attractive patient population for plaintiff attorneys. For example, younger patients undergoing elective spine surgery who later bring a malpractice claim due to either neurological injury or pain (thus generating higher economic damages) would offer greater opportunity for generation of a large award, justifying the financial risk of litigation for the plaintiff attorney.

Fourth, the absence of a neurological deficit following surgery does not necessarily eliminate the risk for generating a malpractice claim. In our review 54 percent of the plaintiffs did not have a new or worsened neurological deficit following surgery, and 7 percent had no neurological deficits and no pain. One explanation for this circumstance could be that good outcomes or quality care may differ in meaning to patients and their neurosurgeons. It is possible that even though the ultimate outcome for a patient met with the neurosurgeon’s expectations, the journey to that outcome was simply not acceptable to the patient. Further, in some cases there may be an impetus to settle simply because of the severity of the plaintiff’s neurological deficits and the resulting sympathy engendered in jurists during a trial. Other authors have pointed out that it is not uncommon for settlements to occur in neurosurgical malpractice cases where the plaintiff has neurological deficits, despite the common belief that the deficits are unrelated to actions of the physician (1). This reasoning may be supported by our findings that all of the claims in this series were generated by patients who were alive at the time the claim was initiated. No plaintiff’s estate brought an initial claim against a defendant neurosurgeon, although if the plaintiff died subsequent to filing the claim the plaintiff’s estate may have carried on the claim.

Fifth, surgery was performed in 87 of 90 cases, and in 70 percent of these surgical cases one of the specific allegations was improperly performed surgery. Conclusions drawn from this fact are limited since the TDC charts do not contain operative and clinic notes, images or physician depositions, making it impossible to determine whether the operative case was performed within a reasonable standard of care. However, in a substantial minority of cases (46 percent), the plaintiff also made a claim of failure to diagnose, unnecessary surgery or inappropriate postoperative care. These claims indicate that while proper surgical technique is clearly important, a real source of risk for neurosurgeons is also the preoperative and postoperative care period. This is also the period when the neurosurgeon is building a relationship with patients and their families. As such, listening to patients, understanding their stories and attending to their needs may be as important as proper execution of the surgery.
More than 90 percent of the defendant neurosurgeons in this series were board certified. Since board-certified neurosurgeons typically have more experience than board-eligible neurosurgeons, one possible interpretation of this data is that experience does not guard against liability exposure. Thus, even an experienced neurosurgeon who executes a technically perfect surgery but fails to develop the requisite relationship with patients and their families before and after the surgery may be in no better position from a liability perspective than the inexperienced neurosurgeon who is less technically astute but has excellent rapport with patients and their families. Another interpretation is simply that the longer a neurosurgeon is in practice and accumulates more case volume, the greater the risk of eventually defending against a malpractice claim. Alternatively it could be that neurosurgeons with more recent training (typically board eligible) have fewer claims because they are able to leverage training in the latest techniques into lower surgical risk.

Lastly, it is notable that in 78 cases in which the reviewers felt that the litigation was the result of factors other than the defendant physician’s actions, 35 percent involved subsequent treatment by another physician. We do not know from reading the TDC files whether that subsequent physician-plaintiff interaction directly led to the claim. It is plausible, however, that the words and actions of subsequent physicians (neurosurgeons or otherwise) treating the plaintiff’s condition may have a significant impact on the desire of a patient to bring a malpractice suit against the original surgeon.

There are significant limitations in this type of closed-claim review. It represents the experience of a single malpractice carrier and may not be representative of all neurosurgeons throughout the country. Another limitation is that we cannot determine from the TDC data whether the claims were legitimate because operative reports, images and clinic notes were not available to further determine whether the standard of care was met in these cases. Further, we do not know if the expert witness testimony in the case was legitimate or how it contributed to the ultimate outcome of the claim. This is an area for further investigation.

**Conclusions**

In this review of 90 neurosurgical malpractice claims, the average cost for defense was $86,882, while the cost of defending cases that went to trial more than doubled. The defendant physicians were successful in 60 percent of the cases. Approximately one third of the plaintiffs were ultimately successful in obtaining some compensation from the defendants. The majority of cases were elective spine surgeries where the patient initially presented to the neurosurgeon’s office with a degenerative condition. Cranial and peripheral nerve cases as well as those related to trauma were uncommon. Plaintiffs tended to be relatively young and thus have a longer anticipated work life, which may have increased the amount of economic damages alleged or obtained in the lawsuit. In 54 percent of the claims the plaintiffs had no neurological deficit following treatment. Seventy percent of cases alleged an improperly performed surgery, but a substantial minority also alleged unnecessary surgery or improper postoperative care. A number of factors other than the defendant’s actions may contribute to generating a malpractice claim, perhaps most notably the words and actions of physicians who subsequently provide treatment to the plaintiff.
When Borrowing Makes Sense

Still Sick After Healthcare Reform?

How is it possible that all industrialized democracies besides America provide universal healthcare at a reasonable cost? Journalist T.R. Reid traveled the globe attempting to answer that question. Some readers may be familiar with the “Frontline” television program based on Reid’s travels, but his book is a must-read for everyone living in the U.S., home of the 37th best healthcare system in the world according to World Health Organization rankings in 2000.

The book is dedicated to President Dwight D. Eisenhower, who spearheaded construction of a U.S. interstate highway network patterned after another country’s superior national highway system, the autobahn network in Germany. Allied forces under Eisenhower’s command used the autobahn to shorten the war in Europe, and the impressive highway system was fresh in his mind when he tackled U.S. infrastructure in the 1950s.

Reid visits and describes the healthcare systems of Germany, France, Japan, Great Britain, Canada, Switzerland, Taiwan and India. In each country he seeks relief for a chronically aching shoulder that he injured as a U.S. Navy seaman in 1972.

In the course of his adventure, Reid dispels many misconceptions concerning other countries’ healthcare systems. In particular he finds that universal healthcare is not an idea too “foreign” for the U.S. and that it does not have to involve socialization of medicine, rationing by waiting lists and limited choices, wasteful systems run by bloated bureaucracies, or insurance companies.

Perhaps the most surprising misconception Americans have about other nations’ healthcare systems is that they are all the same. There are countless variations in the way different nations organize the financing and delivery of healthcare. Yet every country has a system, and this system applies to everyone, young or old, employed or unemployed, military or civilian, sick or well, aboriginal or immigrant, private citizen or prime minister, newborn or about-to-die. Everyone is included in the same system and covered by a single set of rules. A unified system makes it easier to use digital record-keeping and smart cards that encapsulate patient health information, and it eliminates the gamesmanship and cost-shifting that has permeated American healthcare.

Taiwan is a particularly interesting example. Twenty years ago healthcare in Taiwan was a disaster, with 60 percent of the population having no coverage at all. When the legislature decided to overhaul healthcare in Taiwan, officials brought in a consultant from the Harvard School of Public Health. He designed a system that is considered the most efficient in the world. Since 1995 this system has provided healthcare for everyone at a very low cost to patients while holding national healthcare spending to approximately 6 percent of gross domestic product. In comparison, U.S. healthcare spending is close to 17 percent of its GDP.

Reid’s conclusion sounds simple: The U.S. could provide universal healthcare at a fraction of what is spent today; it just needs a system.

Why read a book about healthcare systems in other countries when the U.S. already has the Patient Protection and Affordable Care Act? Because even with this legislation healthcare will cost the nation too much without achieving universal coverage. In addition, opponents of the law are intent on repealing it.
The Affordable Care Act is being implemented over several years, and there will be many opportunities to modify and amend how healthcare reform evolves. Considering the law as it reads presently, the Congressional Budget Office has estimated that by 2020 there will be 24 million uninsured people in the U.S. Anyone who finds this projection disturbing can benefit by reading this book. NS

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Open Book: Genius on the Edge

SAMUEL H. GREENBLATT, MD

This new biography of William Halsted, 1852–1922, should be of special interest to neurosurgeons. Although Halsted was a general surgeon who probably never did a “brain case,” his influence on the development of neurosurgery was probably greater than that of most of the early pioneers. The reason, of course, is that Halsted trained Harvey Cushing in surgery. If Cushing had not trained with Halsted, it is likely that the development of successful neurosurgery would have been delayed by a few decades.

One reason for welcoming Gerald Imber’s Halsted biography is the limitations of the two old ones. The first was published in 1930 by Halsted’s younger colleague at Johns Hopkins, the pathologist William MacCallum, and the second in 1957 by Halsted’s former resident Samuel Crowe. Both are short and highly respectful of Halsted’s memory. They are not overtly hagiographic, but they are incomplete because they concentrate largely on Halsted’s professional activities, giving short shrift to Halsted’s personal life. Imber, on the other hand, covers Halsted’s personal life with a vengeance, as indicated by his book’s title and subtitle.

Halsted was always “on the edge” because he was addicted to narcotics as a result of cocaine experiments, which started when he was 32. But for the visionary faith of his friend, William Henry Welch, Halsted’s accomplishments might have been lost to posterity. Only Welch, who happened to be dean of the new Johns Hopkins medical school, and a few others knew about the addiction. Although Cushing as a resident saw that “the Professor” was odd at times, he was apparently clueless about the reason until many years later.

The book’s author is a plastic surgeon, so he understands Halsted’s surgical problems and solutions. The writing (like the title) is sometimes overwrought, but in general this is a good read. NS

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REVIEWS WELCOME

The AANS Neurosurgeon invites readers to contribute brief reviews of a recently read book in any genre. Reviews of no more than 300 words should relate the book’s value as an interesting, entertaining, or enlightening work. The “Write” link to information for all types of submissions to the AANS Neurosurgeon is available at www.aansneurosurgeon.org.
Because It’s There and Other Reasons

Why Study Neurosurgical History?

Why study the history of any particular subject? A simple answer is because someone wants to. Once a place, nation, idea or discipline has existed long enough and has had some measurable impact on the world, historians get to work.

Study of the history of medicine, and of neurosurgery in particular, is worthwhile on several counts. Such study can broaden perspectives on how to manage technological and socioeconomic change, according to AANS Historian Samuel Greenblatt. Potentially, it may have a “humanizing” effect: A greater understanding of how illness was treated in the past can inspire medical students and doctors to become more sensitive to patients’ needs. In addition, a dose of humility gained from knowledge of our predecessors’ struggles can be a stabilizing influence on the physicians of today and tomorrow.

Before neurosurgery was recognized as a specialty, one relevant procedure was studied extensively. Beginning with Paul Broca, the French surgeon who associated aphasia with injury to the inferolateral frontal lobe, several authors in the 19th century explored the significance of prehistoric skull trephination. These writers prepared the ground for later historical reviews of neurosurgery. These were written in the 1950s by neurosurgeons Earl Walker and Gilbert Horrax, among others, half a century after the inception of modern neurosurgery. As in many historical works written then, these histories tended to catalog rather than analyze landmark developments and the individuals who achieved them.

These earlier efforts have proven invaluable. That there now exists a body of neurosurgical history upon which we can draw suggests another benefit of such study: It preserves for posterity the voices of neurosurgeons along with their deeds. In 1896 Rosswell Park, a pioneer of intracranial surgery, noted:

What a disgrace it is that, while to the great murderers of mankind, men like Napoleon in modern times and his counterparts in all times, the world ever does honor…and writes volumes of encomiums and flattering histories, the men to whom the world is so vastly more indebted for all that pertains to life and comfort are scarcely ever mentioned save in medical history, while the world at large is even ignorant of their names.

Future medical historians will analyze the development and impact of such advances as spinal instrumentation, stereotactic radiosurgery and endovascular neurosurgery. They will view these improvements as neurosurgical contributions to the extent that we take a part in writing our own history.

Neurosurgery is a young field, barely a century old. The specialty is a small part of medicine as a whole, smaller still of civilization. Big changes are happening in neurosurgery as in medicine, and the only guarantee is that things will look very different in the future. To know where we are going as a specialty, we have to know where we have been. How better to know ourselves than through the words of neurosurgeons engaging in robust discourse and analysis of the specialty’s past, and of the present as it passes into history? NS

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