The Intersection of Art + Neurosurgery

13 THE BEAUTIFUL BRAIN

17 THE LEGACY OF ALBERT L. RHOTON JR.
Welcome to the fall issue of Congress Quarterly (cnsq), which focuses on the intersection of Art and Neurosurgery. This issue deviates from the typical news theme of our magazine and highlights the importance of taking time to be expressive, creative, and to think “outside the box.”

On the surface, it may seem that creativity has little role in a scientific discipline like neurosurgery. Our field is highly technical and complex, requiring great concentration, discipline, and exquisite attention to detail. However, it is quite the opposite. For starters, the brain is the most complex organ in the human body (yes, of course we are biased). A neurosurgeon must continually adapt to new findings and employ creativity and flexibility to solve problems, some which are anticipated and others which are not. Neurosurgeons use the latest technology to develop breakthroughs in our specialty—and this passion is captured through expressive creativity which leads to even greater innovation.

In this edition, we take you on a tour into the minds of neurosurgeons to learn how their passion for art has complemented and been fed by their neurosurgical careers. You’ll see intriguing new parallels between art and neurosurgery. You’ll discover how these two fields merge in unexpected ways that not only bring a needed balance to our specialty, but preserve and expand our human spirit. We also interview a neuroscientist who has developed new artistic techniques that portray the intricacies of human neurology and the brain.

We’re also excited to share stories on the lives of prominent medical illustrators, including David Peace, loyal and dedicated illustrator for the late Albert Rhoton Jr. for over 35 years, and Doris Hager Paget, a pioneer in the field of neurosurgical illustration, who worked at Walter Dandy’s side until his death.

Turn to page 28 for a perspective on the use of ICD-10 for ambulatory patients compared with ICD-9, and read updates from the American Society for Stereotactic and Functional Neurosurgery, the CNS Resident Committee, the Joint Tumor Section, and the Washington Committee.

Thank you to Antonia Callas, Ruby Thomas, and Danielle Slowey for their tireless efforts on behalf of the Congress of Neurological Surgeons. This is my last issue as editor the Congress Quarterly as I pass the baton to the next Publications Chair. I thank my coeditors and editorial staff for a job well done! The winter issue will be the 2016 Annual Report for the Congress of Neurological Surgeons.
CONTENTS

Editor's Note
Gerald A. Grant

President's Message
Russell R. Loneser

THE INTERSECTION OF ART AND NEUROSURGERY

The Neurosurgeon's Paintbrush: Katherine Ko
Katherine Ko
Kyle Smith

The Education of an Artist: Keith Kattner
Keith Kattner
Ruby Thomas

Compatible Worlds: The Work of Audrius Plioplys
Kristopher Kimmell

Greg Dunn's Self Reflected: The Beautiful Brain
Vivek Mehta

Windows into Other Worlds: The Photography of Shelly Timmons

MEDICAL ILLUSTRATORS

A Medical Illustrator Reflects Upon His Career Working with Albert L. Rhoton Jr.
David A. Peace

Dorcas Hager Paget: Medical Illustrator for Walter E. Dandy
Jared Travnicek, Antonia Callas

INSIDE THE CNS

Resident Committee Report
Krystal L. Tomei, Angela Taylor

ICD-10: The History of a Coding Set and Its Recent Impact on Neurosurgery
Stacey Snodgrass, John Kinna

Washington Committee Report
Katie O. Orrico

CNSQ BACK PAGE

Images in Neurosurgery

Image on cover and page 3:
The artistic depiction of neuroanatomy, biology, and surgery plays a fundamental role in neurosurgical education, development and understanding. Throughout time, illustrations and other art forms have been used to facilitate the ability of neurosurgeons to visualize critical anatomy, understand biologic/pathologic principles, and describe surgical approaches. Our early specialty pioneers, including Harvey Cushing and Walter Dandy were outstanding illustrators in their own right. To this day, their—as well as others,—renderings of anatomy, pathology, and surgical management of neurologic disease provide the foundation for our understanding as a specialty. Without these illustrative efforts our field would not be where is it is today.

Albert L. Rhoton Jr, the premier educator of our generation, not only embraced the critical intersection of art and neurosurgery for educational purposes, but he extolled the exquisiteness of neuroanatomy through his lifelong illustrator David A. Peace. His use of outstanding illustrations coupled with brain dissection photographs will leave an indelible mark on current and future generations of anatomists, medical students, trainees, and neurosurgeons. Dr. Rhoton developed and expanded the use of 3-dimensional (3D) neuroanatomic visualization to educate neurosurgeons around world. His concept of the 3D educational platform is now evolving through advanced imaging and illustration coupled with augmented and virtual reality.

Art intersects with neurosurgery in a variety of ways that go beyond the educational perspective. The intrinsic beauty of neuroanatomy has been illustrated and depicted for artistic purposes by individuals across the basic and clinical neurosciences as an artistic outlet, a way to transform understanding of biologic principles, and to express the intricacies of the nervous system to both specialist and lay person. Neurosurgeon Kathryn Ko uses art to capture the essence, as well as define and depict the life experiences, associated with neurosurgery. Her work provides an important example of using complementary passions that enhance personal and professional excellence within the context of a demanding neurosurgical career. The discipline of medicine has also served Shelly Timmons, Keith Kattner, and Audrius Plioplys well in their artistic endeavors. They have found that the intense training in neurosurgery and/or neurology influenced their art in profound ways.

Because of the fundamental nature of neuroanatomy and characteristics innate to neurosurgeons, our specialty will optimally reside at the most developed intersection of art. The advent of emerging technologies and techniques is also narrowing the gap. New collaborative initiatives are exploring crossovers and serve to further integrate and blur the lines between these seemingly disparate fields. Emerging technology shows us neuroanatomy in a vivid artistic palette that rivals any Van Gogh, while artists use a range of new technology to evoke the intricacies of human systems. Whether traditional or abstract, the art linked to our field will evolve in ways that are directly and indirectly tied to us as surgeons, anatomists, and scientists. What we know for certain is that art not only enhances our personal experiences, it also serves to improve and influence our professional experiences—and those of our patients. We can only expect the cross-fertilization between neurosurgery and art to grow and inspire us in the future.
It’s been said that the brain is the most fascinating thing in the world. It has been called the ultimate mystery and the most complex structure known. Exploring the brain through the lens of art is an ongoing fascination in the field of science. And, much like the left and right hemispheres of the brain, the cross-fertilization of knowledge and ideas you’ll find in these interviews is as enlightening as it is engaging.
Neurosurgical case illustrations, whether drawn or painted, have played an important role over time in sharing knowledge of neurologic anatomy and surgical techniques. Artists have captured the evolution of neurosurgery in permanent display. Neurosurgical greats such as Walter Dandy and Harvey Cushing have drawings and paintings attributed to their career which we still look back on today, whether for educational or entertainment purposes. Artists have a unique ability to capture a detail in medicine or anatomy in such a way that reveals something unknown, or illuminates an emotion which was otherwise obscure. It is this vision, detail, and mastery of touch that makes art and neurosurgery complimentary. Kathryn Ko, MD, MFA, is a practicing neurosurgeon at Kings County Hospital in Brooklyn. She is also a serious multimedia artist who takes her inspiration from her neurosurgical career. For her, art is not a hobby, but a co-existent skill which hones her neurosurgical passion and provides the necessary spark for her paintbrush.

Dr. Ko grew up in Oahu, Hawaii, and moved to New York City in 1983 to pursue neurosurgery. She received her medical degree and completed residency at Mt. Sinai Medical Center in New York City. She ended up staying on after residency, largely due to her gravitation toward the arts. Painting was something Dr. Ko initially began as a hobby during her neurosurgical career. She had early experiences in writing and in holography, which is a unique blend of physics and art, and one which also lends itself to other forms of art. She didn’t think about art as a career, but nonetheless took up weekly evening art classes, eventually deciding to pursue a MFA in Representational Painting and Drawing from the Academy of Art University. Early inspirations included Caravaggio for perception and understanding of light, and Andy Warhol for numerous media types. Although Dr. Ko’s early experience in writing and holography primed her artistic pathway, she notes that she became an artist when she picked up the scalpel, and the New York arts scene kindled the flame. She states, “I see myself making art with the analysis of a surgeon and doing surgery with the vision of an artist.” A neurosurgical career prepares the mind for three-dimensional reconstructions of two-dimensional objects such as MRIs, and an artistic hand deconstructs real-world objects onto paper with a poetic interpretation. The two
I see myself making art with the analysis of a surgeon and doing surgery with the vision of an artist.
careers are complimentary and improve each other.

It is intriguing to note that Dr. Ko is an ambidextrous brain surgeon and artist. She writes, operates, draws, and paints with two hands and both right-left brains. She does representational work (realism) with her right hand and abstract work with her left hand. She works in oil, acrylics, graphite, charcoal, pastels, collage, assemblages, video, ink, watercolor, holography, and glass. Her main interest now is medical subjects, including portraits of surgical cases, and medical cartoons. She founded The HaBluds, a cartoon collective where she collaborates with other artists to write and illustrate comics. She also hosts an engaging YouTube series titled Art on Call where she interviews physicians in the arts. Dr. Ko has done artwork for several journals, textbooks, and articles including several covers of World Neurosurgery, and her paintings will appear on the cover of Youmans and Winn Neurosurgery book. Social media is the largest venue for Dr. Ko. She can be found on Instagram at doc_ambidexter with over 10,000 followers.

A recurring question among many neurosurgeons is whether it’s possible to balance the time commitment of a neurosurgical career and another hobby or passion—a question that is also asked of Dr. Ko quite often from artists. Her advice: if something is still missing in your life, you should pursue it, especially if it is going to help people. After all, you have one shot on earth—kill it. Dr. Ko advocates for individuals to fulfill their passions in life. She proves that it is possible to be a true hybrid and successfully develop another passion in life at more than just a hobby level.

Dr. Ko’s work can be found on her website kathrynko.com. See her hologram video on Instagram at http://bit.ly/2aXvmE9
The Education of an Artist: Keith Kattner

Keith Kattner, DO, retired from a successful neurosurgery practice at the age of 49 to pursue his first love—art. A prolific researcher, residency program director, and co-founder of the Central Illinois Neuroscience Foundation, Dr. Kattner packed up in December 2010 and moved to Manhattan for two years to immerse himself in the New York art scene and the Metropolitan Museum of Art.

Seven years and 600 paintings later, Dr. Kattner leads a bohemian existence, roaming like Van Gogh, from his home base in the Midwest to the Hudson River Valley to the Canadian wilds, in constant pursuit of adventure and of the masters that artists dream of surpassing.

Congress Quarterly: Was art always something you wanted to pursue?

Dr. Keith Kattner: I was an artist before I went into medicine. I was actually going to plan a career in art. I worked for a pathologist about 30 hours per week as an undergraduate, and he's the one who convinced me to become a surgeon. I told him, “I’m not smart enough to get into medical school,” and he chewed me out. I realized if you study hard, you actually could get good grades. No one particularly told me that in high school or college. I eventually got into medical school, but I still was an artist to begin with.

Residency and neurosurgery didn’t allow too much time for painting, but I collected art. I have a major American art collection sitting in a museum in Memphis, the Dixon Gallery and Gardens. I collected art to replace what I really wanted to do, which was paint.

CQ: How did you make the decision to retire from neurosurgery?

KK: I told myself, if I’m ever going to do this thing, I have to do it young enough, because you don’t want to look like some old, retired guy walking around New York City! Plus, I knew it was going to take me a while to catch up. Most of the artists out there had been painting for 30 years, and I was already 49 years old. I started painting about three years before I retired. I used to work, put in 16-, 18-hour days, and come home and paint for three to four hours to give myself a running start. But I was used to working 80, 100 hours a week, so it really wasn’t that hard.

CQ: How did you continue your art education after retiring?

KK: I intentionally did not pursue an art degree. I lived in Manhattan for a couple of years to study art in the Metropolitan Museum of Art. My school was the museum, and I read 20,000 pages on Modernism.

CQ: How did your experience as a neurosurgeon influence your development as an artist?

KK: Neurosurgery is a very conservative field of medicine. What I learned from neurosurgery is, first of all, hard work goes a long way. If you think you’re going to do one painting a year and be a good artist, you’re not. Just like with surgery, you’re not going to be a very good surgeon unless you do many surgeries.

It also taught me that education is everything. You have to understand what the artist’s composition is about, the history and context of the painting, the formulistic elements. With art education, like neurosurgery education, you have to understand this stuff, and you can’t understand this stuff until
you’ve read 20,000 pages. I’ve met a lot of artists in New York City who don’t understand what they’re doing and why they’re doing it. That’s where the education aspect comes in.

Here’s where neurosurgery played a really important role in my education. If you want to get an article published in a journal, like the red book, Neurosurgery, you have to have something new, but your work also has to be very soundly based in history. You cross reference other articles and build upon that. Artwork is very much the same way. A lot of the great artists build their ideas upon historical bases.

So neurosurgery taught me hard work, be educated, and come up with something new based upon history. If I did not become a neurosurgeon, there is no way a professor could have taught me what I have learned about art.

**CQ:** When you look back at history, a lot of the great artists were also scientists.

**KK:** DaVinci was a scientist. Gauguin was a stock broker. Oscar Bluemmer was an architect. Rousseau was a customs agent in France. There are a whole bunch of famous artists out there who had other careers and I’m sure learned from their other careers.

**You have to understand the history of training too. Artists were trained like physicians back in the day. Let’s take Rembrandt and the Dutch artists from the 17th century. If you were a Dutch artist, you had to work under a master for years, and he would teach you to paint a tree. When he felt you were good enough, he’d send you overseas, and you’d go spend a year in Italy training under another master. Then when you came back to Amsterdam, you had to have two artists other than your master recommend you to the guild, which was a union (if you went around trying to sell art without being a part of the guild, you’d probably get your legs broken). In order to get into the guild, you had to do a painting. Guess what that painting was called? A **masterpiece**, because now you’re a master. Artists were trained like physicians, like residents at that time. You were an apprentice under an artist, just like a resident is an apprentice under a program director. The artist would go down to Italy for a year, just like you would go do a fellowship.

**CQ:** Tell us about your recent work, which is showing in New York right now.

**KK:** My newest work is deconstructive. I did twelve paintings in this particular group, and they’re based upon Cézanne’s Bathers from around 1906. That was the overall theme.

In these particular paintings (Figures 1-3), I borrowed from the Renaissance for the very symmetrical structure, so there are hidden geometries. For example, in the painting with...
the diver, you’ll see the triangle, the circle. This is a post-modernistic painting. It’s two-dimensional. The painting is really about form, light, space, and color. You have a diver who looks like Jesus on the cross, you have twelve people on the shore, you’ve got Judas in a tube, and you’ve got the devil-dog off to the side. That’s the conceptual idea of that particular painting.

I took the hidden geometry from Renaissance paintings. The light has been taken from 19th century luminism landscape art of the Hudson River School. I used cool light for the sky and warm colors for the bodies, which is what Cézanne did with Bathers, because warm colors come out and cool colors recede on a canvas. For the bodies, most of the figures have been appropriated over the entire span of 500 years of European art, everywhere from Raphael to Eakins. So you take different elements from different parts of art history, you put them together in one painting, and we term that deconstructive.

**CQ:** What kind of feedback has your work received?

**KK:** These are a bit conservative compared to what you see in New York, where people are trying to shock you with sex and violence. But I think it was refreshing to see something different for once—the patrons really love this work. I was surprised because it was so different from what they are used to seeing.

**CQ:** Looking back, how do you feel about your decision to transition to a second career?

**KK:** I have absolutely no regrets. And I have no regrets about becoming a neurosurgeon, because neurosurgery taught me a great deal about life and what it means to achieve a goal in life.

Towards the end of my neurosurgery career, I used to wonder what could have been if I had pursued art from the beginning. Now that I have seen how artists live in New York, I’m glad I didn’t become one to begin with, because they starve, they work two jobs, they have no time to paint, and they live with three roommates. They’re 25 years old and then they’re 55, and they’re still working two jobs and living with three roommates.

So I’m glad I did it the way I did. I financially set myself up to be able to do this so I don’t have any pressures. I preplanned this. I’m not like Gauguin who walked away from a wife and five kids to become an artist. I learned from neurosurgery that it’s all about planning.
Compatible Worlds:  
The Work of Audrius Plioplys

Audrius Plioplys, MD, is both a neurologist/neuroscientist and a professional artist. His neurologic concentration was on cognitive disorders; from autism in children to Alzheimer’s disease in the elderly. During his career he worked to improve the care provided to severely disabled cerebral palsy children. He has 75 neurology articles and received $2.8 million in research grants. In addition to a productive clinical career, Dr. Plioplys is a prolific artist, seeking to blend his neuroscience background with artistic expressions through a number of different media. His art is neo-conceptual: a metaphorical investigation of thinking and consciousness. His works have been displayed in public venues in the US and internationally. He retired from neurology seven years ago, and is now engaged in art full time.

Congress Quarterly: Please tell us a little bit about your background and upbringing.  
Dr. Audrius Plioplys: I was born and raised in Toronto, Canada. When I was 12-years-old, my family moved to the Chicago area. I graduated from the Pritzker School of Medicine at the University of Chicago in 1975. My medical internship was at the University of Wisconsin in Madison, adult neurology at the Mayo Clinic, pediatrics and child neurology at Toronto’s Hospital for Sick Children. This was followed by two years of neuroimmunology laboratory research in Quebec City, funded by the Medical Research Council of Canada. Subsequently I was a staff neurologist, and neuroimmunology researcher at Toronto’s Hospital for Sick Children, with a faculty appointment at the University of Toronto. In 1990, I moved to Chicago where I continued my basic laboratory research, and was the head of both child neurology and the Alzheimer’s disease research program.

CQ: Was there a seminal moment or event that led to your interest in the nervous system?  
AP: When I was in seventh grade, I became enthralled by my science teacher. By the end of the year, I had decided to become a scientist. The late 1960s was an exciting time for physics, new atomic particles were being discovered almost daily, and quarks had just been postulated. When it was time to go to college, I chose the University of Chicago as it had one of the best physics programs. Everything was going well until the start of my second year when I found out that I would have to take a year of biology. I had no interest in frogs, bugs, or blood. Begrudgingly, I attended a biology class taught by Richard Mintel. When he started lecturing about the nervous system, I was mesmerized. How is it that this ensemble of cellular tissue could produce thought, self-awareness, and consciousness? This question gradually became of immense interest to me. So I left physics.
CQ: Why did you choose to go to medical school?
AP: In starting to pursue my interests in the nervous system, I had two options. Either enter a neuroscience doctorate program, or go to medical school and become a neurologist/neuroscience researcher. I decided to take the longer and harder course—medical school. I reasoned, correctly, that if I want to understand how the brain functions, having access to patient material would enhance any laboratory work that I might undertake.

CQ: You have mentioned that you spent a lot of time as a medical student on the neurosurgical wards. Is there a memorable patient or surgical case that you can recall?
AP: When I started medical school, my interest was in the nervous system, although I did not know if I should pursue neurology, neurosurgery, or psychiatry. Somehow, operating rooms appealed to me, and I decided to pursue this route. During free time and summer breaks I attended neurosurgery clinics and assisted in neurosurgical operative procedures. The chairman of neurosurgery at the university at that time was Sean Mullan, a pioneer in aneurysm surgery. He took a liking to me and acted as my mentor. In my third year of medical school I actually opened, drilled the burr holes, removed the skull flap, and prepared the surgical site for Mullan’s aneurysm clipping. I also closed at the end of the procedure. I was well on my way to a career in neurosurgery. But when visiting neurosurgery residency programs, I discovered that residents were on call every other night—they rarely slept. I understood my own biology and knew that I would not be able to physically handle that kind of workload.

CQ: What were your earliest artistic endeavors?
AP: When I was growing up in Toronto, my best friend was a mischief maker, constantly in trouble. One summer, his parents decided to keep him off the streets by enrolling him into an art program. When I visited him, I saw him start with a blank canvas, which then, very gradually, would get filled with lines, then layers of colors, resulting in a beautiful painting. Beauty from nothing! That stunned me. This was the seed for art that was planted in my soul during childhood. It started to grow when I was in medical school.

CQ: What led you to begin painting during medical school?
AP: I started painting at the beginning of my second year. In addition to medical school and my volunteer work, I avidly painted, studied art, and went to museums and galleries. The passion for art became so great that it reached a crisis situation. I thought that I had made a mistake by going into medical school. Instead of dropping out, my friends convinced me at least to finish my internship, which I did, and then I left medicine. I had no intention of returning to neurology or neuroscience. I thought that neurology and art were incompatible worlds.

CQ: You initially left medicine to pursue your artistic career, but then decided to resume your medical training and profession while maintaining your artistic endeavors. Was there a moment or event that led you to this decision?
AP: I moved to Washington, DC, and established a studio. Everything went very well. My art quickly adapted to the current trends of conceptual art, with installations using light and sound systems. I had art exhibits and received positive reviews and write-ups from the major DC magazines and newspapers. However, I gradually started feeling guilty. I had accumulated so much knowledge of neurology, but I was not using any of it to help others. In a gospel story, Jesus said that no one puts a lit candle under a bushel basket. That is exactly what I was doing. I decided that I had made an error. I realized I could blend the two disciplines—I could make neurology/neuroscience compatible with art.

CQ: What have been the most important sources of inspiration for your art? What about your practice of clinical medicine and research?
AP: For me art has always been a profession, an occupation. I actively work on creating images, hopefully attractive ones, with depth and content. Inspiration does not play a role. How much inspiration does it take for a neurosurgeon to successfully perform a surgical procedure? In that regard, the practice
of neurology, neuroscience research, and art are all similar—hard work and dedication are the cornerstones to success.

Artistically, I have been exploring the origins of thought, of consciousness. Approaches have included large scale paintings, prints on paper, site-specific installations, and light sculptures with LED light systems. The underlying images are of my own previous art works. I transform them into exotic forms, just as our memories transform visual impulses into vast neuronal web-works. Multiple layers are assembled, modified, and blended. Cerebral cortical neuronal drawings, superimposed and subtracted from the surrounding color, reveal deeper layers of thoughts and memories. My own MRI brain scans and EEGs are interwoven. From neuronal complexity, words, thoughts, and consciousness emerge. Basic neuroscience issues are incorporated into my art work.

**CQ:** Do you have a painting of which you are particularly proud? What is it about that piece that makes it stand out for you?

**AP:** Actually two pieces, *Dreams / Explorations* and *Blue Consciousness*. These are paintings on canvas, 5-by-6-feet and 10-by-10-feet, respectively. The underlying image in *Dreams / Explorations* are the foot paths on the cliffs of Sagres, Portugal, where Christopher Columbus started to dream of distant travels. The work appeared on the front cover of the January 2013 issue of *Neurology*. It was the first time that a visual image graced the cover of the most widely read neurology publication. *Blue Consciousness* was commissioned by the Blue Man Group in Chicago. The 10-by-10-foot original painting was installed in September 2013 on an exterior wall of the theater. The underlying image is that of a polar bear that I photographed on Beechey Island in the high Canadian arctic. In the near future, *Blue Consciousness* will also grace the front cover of *Neurology*.

**CQ:** There is much talk recently about a rising tide of burnout amongst physicians. As someone who spent a long time practicing medicine and other intellectual pursuits, what do you think are the remedies to this growing trend?

**AP:** This is the one question that I do not have a good answer for. I was very fortunate in that I was able to balance two professional careers with a host of personal matters. I wish that others would likewise be able to do so.

Dr. Plioplys’ art can be found at his website, [www.plioplys.com](http://www.plioplys.com), and select items are available for purchase at [www.plioplys.net](http://www.plioplys.net).
Greg Dunn earned a PhD in neuroscience from the University of Pennsylvania before devoting his time to art. His work focuses on artistic renderings of neurohistology and neuroanatomy. His newest work, *Self Reflected*, is a collaboration with Brian Edwards, a physicist at the University of Pennsylvania, that was supported by the National Science Foundation. Taking over two years to complete from conception to completion, the work is the most complex and detailed artistic depiction of the human brain to date. It consists of an 8-by-12-foot gold panel which depicts an oblique sagittal slice of the human brain—500,000 neurons connected in a fractal web.

To illustrate the neural activity within the brain, the team developed a new technique called micro-etching, which combines a complex array of hand drawing, scientific data, computer simulation, photolithography, gilding, and strategic lighting design. When the light source moves in relation to the gold panel, electric signals seem to spread from one region of the brain to another, as if waves of activity are sweeping through it. What you see is a portrait of your own brain, essentially, the communication happening in your own head as you perceive a work of art. *Self Reflected* is on view at the Franklin Institute in Philadelphia.
**Congress Quarterly:** You have found a really beautiful way to intersect art and science. Your work is particularly interesting for neurosurgeons because it visually depicts the incredible intricacy and complexity that we only develop an understanding of after years of training. Can you tell us about your artistic background?

**Greg Dunn:** I had been a musician and had recorded for many years. It wasn’t until I started to work on art for album covers that I became more interested in graphic design and visual art. I was also fortunate that my parents did a great job of exposing me to aesthetic traditions from around the world.

**CQ:** How did you decide you wanted to pursue a PhD in neuroscience?

**GD:** There’s this general societal noise saying, “Don’t ever go into art. You’re never going to make a living doing that.” I never even considered art as a career option, but luckily I was equally interested in science. I studied molecular biology and genetics in college, and minored in music. After college, I realized that I was interested in too many things, but understood that the brain was the common root of everything. Everything that you can possible by interested in has its root in the brain. It is the absolute fundamental aspect of who we are. It seemed to me that the ultimate mystery, not just scientifically, but in terms of trying to solve the human problem of who we are and why are the way we are, lies in understanding the brain. For me, it seemed like an excellent place to devote my energies.

**CQ:** When you started your PhD program, did you know your career would transition back into art?

**GD:** Definitely not. It was something that dawned on me slowly as I was going through graduate school. If you’re going the academic route, you see how much work it entails, and how constraining a lifestyle it can be. That didn’t appeal to me. I didn’t feel like I was contributing something at the bench that others couldn’t have contributed. As I started to experiment with this combination of art and science, I realized I was producing something that was uniquely my own, and that people were responding to my work in a positive fashion. I was reaching people, who otherwise wouldn’t be interested in science, by using the emotional power of art to teach them something about themselves and the world that they live in. I do think there’s just a lot more crossover between the field of art and science that is not appreciated.

**CQ:** We are living in the era of the Obama BRAIN initiative with an ambitious goal of accelerating the neurosciences. How do you see your work playing a role in this?

**GD:** At the top of my list of things to do with my life is to help people better understand the brain. The brain is more fundamental to ourselves than anything else in the universe. Even those of us who are intimately involved in neuroscience have a limited understanding, so you can imagine how difficult it can be for the average person to understand. The knowledge about the connectivity, functionality, temporal dynamics, and the flexibility is woefully inadequate. That was really the whole reason that we took on this project and why the National Science Foundation—I believe—saw promise in our idea, which was to try to bridge the gap between the cellular world of the brain and how that, in time and in space, makes up the entire macroscopic structure.
CQ: Can you tell us about your newest opening, Self Reflected?

GD: Self-Reflected is a combination of science and art. To show the microscopic and macroscopic structure to this degree of accuracy we had to make this piece gigantic. It is 8-by-12-feet, and it has half a million neurons in it, all of which have very precisely calculated neural circuit dynamics. In science there is a tendency to reduce concepts to their most fundamental variables for clarification’s sake, but a reductionist approach is insufficient to demonstrate the brain’s many complex features. Billions of neurons communicating creates consciousness, and to illustrate this irreducibly complex system we had to depict an enormous number of working parts functioning at once. We used reflected light to create a unique visual effect because we wanted to touch people’s emotions. Essentially it was important for us to get away from communicating information through language. If you’re telling somebody that the brain has 80 billion neurons, it makes no impact, but if you see and can perceive half a million neurons in a gigantic piece of art in front of you, all of which are activated at the same time, you get a much greater appreciation for the scope. Self Reflected gives the average person a better understanding of the complexity of the human nervous system. It’s more a comprehensive illustration than people have been used to seeing. And even though this piece of art is 100 million times (at least) less complicated than the brain is, it gives people a starting point to imagine, then, further steps of complexity. That’s the core idea of what this piece is about, and through our approach we hope to communicate a tiny sliver of the unimaginable vastness of complexity that is the human brain.

CQ: How do you balance dedication to accuracy versus aesthetic appeal?

GD: This project was more focused on accuracy than some of my previous work. Sometimes I’ll intentionally make things look more lyrical or abstract to make aesthetic or artistic points. The brain doesn’t need to be beautified, it’s so magnificent in its natural state, and it’s important for people to see it that way. I very much wanted to have something out there that communicates how beautiful and complex the brain is. And, I want it to stand the test of time and scrutiny as being as accurate as we could possibly get it at this point in time. This piece is as much for professional neuroscientists, neurosurgeons, and neurologists as it is for the lay public.

There were aesthetic decisions made where sometimes we moved the structure into or out of the plane depending upon how cleanly we could show a circuit. For example, we moved the LGN, which would be more lateral to the slice, into our slice so we could show more completeness in the visual circuitry. That’s one example of the type of decisions we made, but it was always for serving the concept of neuroscience.

CQ: You use a variety of techniques from ink to microetching. How did you come about creating the effect you want?

GD: I started with a foundation in Asian art, which I thought translated well into the world of neuroscience. When you look at a catalog of Asian art, trees, branches, and flowers are depicted with a fractal-like shape to them. A neuron is functionally doing something similar to what those macroscopic objects are doing, so it fits into the aesthetic principles of Asian art very cleanly. The artistic point I was making was that this category of beauty exists at many different scales. The masters of Asian art had also figured out that by putting very few things on a canvas one can have a high amount of detail in one place and a low amount of detail in another place, and your brain responds to the contrast. There’s something inherently pleasing about that type of silhouette. Your brain puts emotional inflection on basic form very quickly, and as an artist I realized the importance of silhouette because of our primal response to it.

Experimenting over the years with gold and some other techniques taught me how metals behave under different conditions. One big turning point in my career was when I realized that I wanted to start showing the brain closer to its three-dimensional form rather than a minimalist form of just a couple neurons. The micro-etching technique was invented as a strategy to depict the brain much closer to its full complexity than we had ever attempted before.

CQ: Do you have any ideas in mind for future projects and where do you see your work heading to in the future?

GD: I’m keeping an open mind at this point. What I want to do now is go back in the studio and be a little bit free for at least a couple months to uncouple myself from the extreme rigor that was this last project. Over the long term, I’d like to do large micro etchings of different scales of nature such as string theory, particle interactions, cell nucleus interactions, DNA, and a single cell. These are all very complex systems and it would be great to show nature’s complexity through these different orders of magnitude. I want to enrich people’s understanding of how elaborate this world is.

To learn more about Greg Dunn’s work, and to see a Self Reflected video teaser, visit gregadunn.com. ✪
Whether bringing the light in a person’s eyes to life with a pencil, or distilling the visually complex to simple lines that speak volumes, the act of putting pencil or brush to paper to me is all-engrossing and peaceful. Photography appeals to me in a different sense. I enjoy framing perspectives of ordinary objects that often go overlooked, especially patterns in architecture and nature, as in the branches of a tree, fallen in the woods. I love the stories told by the intersection of nature with the manmade and the impenetrable—where something has happened; a cow has scratched her side on a barbed wire fence, a castle has fallen and the fortifications have been overgrown. I particularly love to depict the work of human hands, where human hands are unseen, as in the salt-worn lashings on the inside of a leather boat that sailed across the north Atlantic Ocean. These images to me provide windows into other worlds and times, and spark my imagination about those who went before.
Very few medical illustrators are given the opportunity to spend their entire career working primarily for one employer; I am one of the fortunate few to have that distinction. In my case, that employer happened to be a world-renowned neurosurgeon and neuroanatomist. I am extremely proud to have spent 35 years of my professional career producing medical illustrations for Albert L. Rhoton Jr., a man who literally changed the world of neurosurgery. Additionally, by having my name associated with his research, I attribute the substantial amount of recognition I have enjoyed, in both the medical illustration and neurosurgery communities, to Dr. Rhoton.

I knew from an early age that I wanted to be an artist, but I didn’t always want to be a medical illustrator. In fact, it wasn’t until my junior year in undergraduate education that I started seriously looking into the field of medical and biological illustration. As a studio art major at the University of North Carolina at Pembroke, also minoring in biology, I had few prospects for employment upon graduation outside of teaching in one or both of those areas. Having grown up in and around Washington, DC, the Smithsonian Natural History Museum was my favorite place to visit, and I was very impressed with the artwork produced by the natural science illustrators working there. When I called the Smithsonian and inquired as to what techniques I needed to master in order to work there, they said many of their artists were trained as medical illustrators. That prompted me to call the National Institutes of Health and speak with the head of their medical illustration department. Howard Bartner, the department head and a classically trained medical illustrator, gave me a list of the five graduate schools granting degrees in medical and biological illustration. I chose the Medical College of Georgia and in 1978 graduated with a master of science degree in medical and biological illustration. During my three years at MCG, I became fascinated with human anatomy and consequently changed my thoughts about becoming a natural science illustrator, focusing entirely on medical illustration instead. While at MCG, I found the challenge of incorporating artistic sensitivity into surgical and anatomical teaching images provided me with an additional incentive.
to excel. Upon graduation I was offered a staff illustrator position in MCG’s medical illustration services department. I continued working in that department for an additional eight months until I became aware of the position with the neurosurgery department at the University of Florida.

Dr. Albert L. Rhoton knew the value of working with professional medical illustrators. By the time I interviewed for the full-time medical illustrator position in the Department of Neurosurgery, he had already utilized the services of many excellent medical artists. During his tenure at the Mayo Clinic and there at University of Florida, Dr. Rhoton had worked with Robert Benassi, John Hutcheson, Bill Westwood, Robert Beach, and the most famous medical artist at that time, Frank Netter (Figure 1). Those of us in the Association of Medical Illustrators were very familiar with these names, and for me, someone just a year out of graduate school, they were mighty big shoes to fill.

After glancing over my meager portfolio and asking me a few questions about my desire to be part of his team, Dr. Rhoton offered me the position. I started March 1, 1979, just in time to work on the illustrations for one of Dr. Rhoton’s research fellows, David G. Hardy, and his paper titled “Microsurgical Anatomy of the Superior Cerebellar Artery.” This would be the first of many peer-reviewed journal articles to have my name included as a contributing author. Dr. Rhoton was very generous in granting my request that medical illustrators receive co-authorship on certain papers due to the huge amount of time and skill that went into the preparation of artwork for publication. In those days, a typical Rhoton paper would consist of 60 to 70 black and white matte photographs re-tooshed by the artist (Figure 2) and six to eight full-color acrylic or watercolor paintings (Figures 3).

When Dr. Rhoton had any free time away from the hospital, he could be found in his microsurgical anatomy lab, overseeing the progress of his research fellows. At any given time, there were at least four fellows working on anatomical dissections for their research papers—all requiring artwork. It soon became obvious that the services of a second illustrator were needed. My work station was situated in a small closet in the rear of the Theodore Gildred Microneurosurgical Laboratory, a space familiar with these names, and for me, someone just a year out of graduate school, they were mighty big shoes to fill.

After glancing over my meager portfolio and asking me a few questions about my desire to be part of his team, Dr. Rhoton offered me the position. I started March 1, 1979, just in time to work on the illustrations for one of Dr. Rhoton’s research fellows, David G. Hardy, and his paper titled “Microsurgical Anatomy of the Superior Cerebellar Artery.” This would be the first of many peer-reviewed journal articles to have my name included as a contributing author. Dr. Rhoton was very generous in granting my request that medical illustrators receive co-authorship on certain papers due to the huge amount of time and skill that went into the preparation of artwork for publication. In those days, a typical Rhoton paper would consist of 60 to 70 black and white matte photographs re-tooshed by the artist (Figure 2) and six to eight full-color acrylic or watercolor paintings (Figures 3).

When Dr. Rhoton had any free time away from the hospital, he could be found in his microsurgical anatomy lab, overseeing the progress of his research fellows. At any given time, there were at least four fellows working on anatomical dissections for their research papers—all requiring artwork. It soon became obvious that the services of a second illustrator were needed. My work station was situated in a small closet in the rear of the Theodore Gildred Microneurosurgical Laboratory, a space familiar with these names, and for me, someone just a year out of graduate school, they were mighty big shoes to fill.
that I shared with Margaret “Robin” Barry, our newly hired medical illustrator. Robin was a very talented artist and recent graduate of the Art as Applied to Medicine program at Johns Hopkins University. I owe a huge debt of gratitude to Robin for being able to work, literally elbow-to-elbow, with me in such confined quarters. In fact, it wasn’t until 1998, when the department moved into the newly opened McKnight Brain Institute, that Robin and I were finally able to work in a spacious new illustration studio. At some point in every day, Dr.
Rhoton would stop by the studio and check on the progress of our illustrations to make sure the anatomy was not only correct but pleasing to his eye. I think that Robin would agree with me that it felt like Dr. Rhoton was constantly over our shoulders pointing out changes and additions to our artwork (Figure 4).

Albeit small, my work station was very much like what could be found in the average illustrator’s studio. I worked primarily in wet media, so my drawing board was surrounded by a cluttered pile of art supplies: paint brushes, watercolor and acrylic paints, several airbrushes, and color pencils (Figure 5). My color illustrations in the early 1980s, long before the advent of computer workstations, graphic tablets, and illustration software, were a combination of airbrushed watercolors and acrylic paint applied to illustration board. This was the standard technique for color illustrations at that time and, although tedious and laborious, produced pleasing results (Figure 6).

In 1995, I started using the computer to assist in the production of medical art, and my workstation changed dramatically. Programs such as Adobe Photoshop and Illustrator changed forever the way medical illustrations would be created. That software, used in combination with the Wacom pressure-sensitive graphics tablet, made the production of artwork easier and more efficient. Each illustration would start with a very comprehensive pencil sketch that would be scanned into Photoshop and rendered in multiple layers above the background sketch (Figure 7). Many times over the years, prior to Photoshop, I would have an illustration nearly finished only to have Dr. Rhoton want drastic changes that could only be corrected by starting over. By rendering illustrations in Photoshop layers, I could easily make those changes without sacrificing the total image, especially when working with large, multi-image illustrations, such as a plate (Figure 8) demonstrating the anatomy encountered during the initial stages of a middle cranial fossa approach. As the years passed and digital photography became the journal submission standard, our research fellows would document their beautiful brain dissections and save them as TIFF files. This eliminated the need to scan 35mm slides and proved to be the perfect format for me to adapt and modify with the computer.

Despite many arguments over the years about what the perfect medical illustration should be, Dr. Rhoton and I became good friends. When he was not working he enjoyed a good laugh, often at his own expense. For example, of all of his distinguishing characteristics, Dr. Rhoton had a distinctive and recognizable speaking voice that he knew many of the residents would imitate. Occasionally Dr. Rhoton would have the illustrators working on the weekends, so not surprisingly, one Sunday morning my phone rang and it was Dr. Rhoton wanting to know if I would come in and work on the posterior inferior cerebellar artery (P.I.C.A.) paper. I started laughing, as I thought it was my friend Richard Lister having a bit of fun. Dr. Lister was the senior resident and first author on the P.I.C.A. paper, and particularly good at imitating Dr. Rhoton’s voice. When I realized it was in fact Dr. Rhoton, I gathered my composure and said I could be there in half an hour. Later that afternoon, after working on the figures, we laughed about which of the residents was best at imitating his voice and concluded that, when heard over the phone, Dr. Lister held that distinction.

Dr. Rhoton lost his fight with cancer almost two years to the day after I retired from the neurosurgery department in February of 2014. During those two years we stayed in touch, and I often visited the lab, where I would find him busy working on another paper. I happened
to catch Al in his office three weeks prior to his passing, and we spent about half an hour talking about many things. With a smile, he asked me when I was coming out of retirement and returning to work. He asked me if I was doing any artwork for my own enjoyment, and he was pleased to hear that I am getting back into oil painting. We talked about our friendship and collaboration with the more than 100 research fellows that had studied in his lab and the colossal amount of published work we had produced over the years. We found it difficult to even speculate on the total number of illustrations I had created for him and the department as a whole.

Dr. Rhoton remained totally dedicated to his research fellows and continued working and editing their manuscripts up until a week before his death. The world has lost arguably the greatest neuroanatomist of our time, and I have lost a friend (Figure 9). The opportunity to learn neuroanatomy from this man, and artistically translate his ideas into teaching images, was indeed a gift. I am proud of the working relationship that Dr. Rhoton and I developed over the years and, as a medical illustrator, truly honored to have contributed to his legacy.

Figure 8. Illustration of surgical anatomy encountered in the initial stages of a middle cranial fossa approach. Photoshop.

Figure 9. A line drawing of Dr. Rhoton by the author. Photoshop.
If it’s true that neurosurgeons are in love with their history, it is also true that they hold a particular passion for the legacy of Walter E. Dandy. A neurosurgical pioneer, he helped shape the foundation of neurosurgery in the first half of the 20th century. He remains relevant today because of the weight and impact of his exceptional contributions in the field.

What is perhaps lesser known is that Dr. Dandy had a significant talent for anatomy and drawing. It was first noticed by his anatomy professor at Johns Hopkins University, Dr. Franklin P. Mall, who encouraged Dandy to reconstruct and describe a very early human embryo. This led to his first article, published in 1911, accompanied by a black-and-white drawing of an embryo (Figure 1).

During Dr. Dandy’s medical school years, he also had the benefit of instruction of one of the world’s foremost medical illustrators, Max Brödel, director and founder of the department of Art as Applied to Medicine at Johns Hopkins University. Brödel coached Dandy as he began illustrations of the nerve supply and blood supply of the pituitary (Figure 2). Another striking testament to Dandy’s talent is given by Donlin Long, MD, who attended the University of Missouri Medical School in the 1950s. (Dandy had attended before transferring to Johns Hopkins.) Donlin states, “We were shown pathology drawings made by Dr. Dandy as a second year student as examples of what we should do in the same class. I later encountered the majority of the drawings at Johns Hopkins. Dr. Dandy was a remarkable medical artist, and these drawings demonstrate that talent.”

By 1928, Dandy’s career had progressed to the point where he needed an illustrator. Dorcas Hager Paget, born 1906, was the oldest of three sisters raised in Albany, New York. During high school, Hager Paget showed great interest in biology and illustrated a
botany textbook with teacher Ada Wadler. She received a grant to attend Vassar College and was accepted into its honors program, which allowed her to attend laboratory courses.

Professor Treadwell at Vassar admired Hager Padget's illustrations and decided to introduce her to the Art as Applied to Medicine department at Johns Hopkins. In the early summer of 1926, Hager Padget wrote to Max Brödel suggesting that she would leave Vassar one year early to take a course in medical illustration. Brödel wrote her back saying she should finish her degree and apply. Hager Padget responded in August, sending along drawings she had done in the laboratory. Brödel reconsidered her application. He knew that Dandy was in need of an illustrator. Brödel said that if Hager Padget qualified for the position, she would be allowed to work on a stipend at the end of her first year, and possibly assume a full-time position after graduation. Hager Padget left Vassar without graduating.2

"The exceptional pupil of this Group is Miss Hager. She is a Vassar girl and very gifted both in science and art," wrote Brödel in his 1926-27 annual report to the Johns Hopkins University President. Her illustrations from this time expose her genius for rendering technique, design, and storytelling. She was evidently learning a tremendous amount about neuropathology and neuroanatomy. Like many illustrators of that era, she worked mostly in the operating room, standing behind Dr. Dandy while he performed surgery. She made many quick sketches and took notes regarding the case then used them to create a refined illustration. Many of these illustrations were used in Dandy's book Surgery of the Brain. She became one of the leading medical illustrators in the country.3

Dandy's book The Brain, an updated and reprinted version of Surgery of the Brain, is filled with illustrations that demonstrate a thorough understanding of anatomy, a sensitivity with the medium, and a deftness of storytelling. Hager Padget's illustrations produce an almost instantaneous understanding of the procedure, while also allowing dense details to slowly wash over the viewer. Hager Padget employs three components that make her pieces exceptionally successful: didactic quality, exquisite rendering, and elegant design.

The first illustration of the surgical treatment of a ruptured internal carotid artery aneurysm (Figure 3), stands out for its exceptional didactic qualities. Three standard views of the patient are given for orientation. The two smaller views from the side and from above give enough information to orient the viewer to the third, larger view. The heads and brains are perfectly aligned, showing the craniotomy and a dashed line where the coronal section occurs. We also see the patient's sex and age in text directly adjacent to the smaller heads. This technique of weaving text into the illustration was a hallmark of Hager Padget's illustrations. This illustration encapsulates Hager Padget's

Figure 3: Aneurysm Internal Carotid Artery from The Brain (1969) by Walter Dandy, MD. Illustrated by Dorcas Hager Padget.

Figure 4: Enormous Hypophysial Cyst from The Brain (1969) by Walter Dandy, MD. Illustrated by Dorcas Hager Padget.
ability to take a very complex subject and break it down into teachable moments.

Hager Padget’s rendering ability was exceptional. This illustration (Figure 4) shows an enormous hypophysial duct cyst which extends up into the frontal lobe. It displays her thoughtful design and didactic talents by showing not only a coronal and sagittal section, but also the positioning of the head with incision, craniotomy, and the surgeon’s view during the procedure. But the focus of the piece is the beautifully rendered cyst. The light reflects and refracts as it passes through, describing its texture, viscosity and opacity. The image on the left shows the cyst and brain cut sagittally. It interweaves precise but loose pen and ink strokes with detailed tone renderings. From a distance the architecture of lines form the muscles, skin, fat, bone, and brain with precision and detail; but if you look closely, you can see how loose the pen work becomes. These marks are unique and show the hand of the artist.

Great design in illustration takes careful thought and planning. This illustration (Figure 5) describes the removal of an ependymal tumor from the right lateral ventricle. It has a beautiful, quiet, and elegant design. Starting at the upper left corner, our eyes make a full clockwise circle. Hager Padget uses hashed lines to indicate the region of the brain to be removed. Dashed lines along with the craniotomy and skin flap move our eyes to the right where we see the tumor and brain removal in overlay. We move down to that figure’s face, through the chin and into the glove of the surgeon. As we sweep by the tumor and brain, we flow through the gentle fade of the patient’s face back to our starting point. Using size, contrast, and level of detail the illustration establishes a hierarchy of importance, as well as an order of understanding.

Hager Padget worked at Hopkins for 22 years in the same desk she had used as a student. Over time, she became more interested in research. After Walter Dandy’s death in 1946, Hager Padget shifted gears and began to work for the Carnegie Institution of Washington in Baltimore. It was here that she did some of her most research-intensive and well-known work. She was tasked with describing the fetal arterial development by tracking the vessels through 22 separate embryos, ranging from three and a half to seven weeks. The monograph for arterial development was published in 1948 and was a significant step in the field of neuroembryology.

In 1952, Dr. James G. Arnold, Jr. at the University of Maryland School of Medicine Division of Neurological Surgery hired Hager Padget as a “research assistant”—a title she chose for its ambiguity. She wanted to shake off the idea that she was simply an artist. But her lack of credentials caused difficulties. Despite barriers, she published articles on nervous system and neural tube malformations, including one that challenged the idea that spina bifida was solely caused by incomplete neural tube closure. In her research of the Arnold-Chiari and Dandy-Walker syndromes, she coined the term “neuroschisis,” which described abnormal clefts in the neural tube. She authored numerous papers on congenital malformations of the nervous system, and was a pioneer in visualizing the complex development of embryological vasculature.

Hager Padget had struggled with cancer beginning in the early 1950s. Despite health problems, she continued her research until September 15, 1973, when she passed away at the Johns Hopkins Hospital. Dorcas Hager Padget illustrations remain masterful works of art: thoughtful, precise, and exquisitely rendered. Her transition from illustrator to scientist was accomplished in an era where women met resistance entering the male-dominated fields of science and medicine. More amazingly, she accomplished all of this without a bachelors or graduate degree. She set the standard for neurosurgical illustration and her effect on the fields of neurosurgical illustration and neuroembryology are still felt today.

To read the full, unedited article A Scientist Renders by Jared Travnicek, visit fortnightjournal.com. Jared Travnicek is a medical illustrator based in Indianapolis, Indiana. To see his illustrations, visit jtsciencevisuals.com.

Figures 3-5: Original illustrations from the Dandy/Padget collection of the Max Brödel Archives, in the Department of Art as Applied to Medicine, The Johns Hopkins University School of Medicine, Baltimore, Maryland, USA.

REFERENCES

1 Dandy Marmaduke ME, Long D. Walter Dandy: Commentary on the Hopkins Years. Walter Dandy, the Personal Side of a Premier Neurosurgeon. 2015; 49-52.
3 Padget, DH. A few research career findings from no-degree thistles. Vassar Quarterly. 1973; 38-42.

Figure 5: Exirpation of an Ependymal Tumor of the Lateral Ventricle, from The Brain (1969) by Walter Dandy, MD. Illustrated by Dorcas Hager Padget.
ASSFN Develops Priorities in Training, Research, and Advocacy

The American Society for Stereotactic and Functional Neurosurgery (ASSFN) serves as an affiliate joint section of the AANS and CNS, and remains deeply involved in a variety of educational, organizational, and advocacy activities on behalf of North American functional neurosurgeons and our patients.

The ASSFN recently held a very successful biennial meeting last spring in Chicago, Illinois, with the help of CNS staff. With over 500 attendees and industry experts, the 2016 ASSFN Biennial Meeting showcased the progress and current state of stereotactic and functional neurosurgery with a stellar list of invited talks and concurrent sessions. Konstantin Slavin was the meeting chairman and Joshua Rosenow was the local host. The topics covered were wide-ranging and included the most current approaches for the treatment of movement disorders, epilepsy, pain, and neuropsychiatric disease. The ASSFN Executive Council appointments for 2016–2018 were announced during the meeting. New ASSFN President Emad Eskandar takes the reins from Aviva Abosch, Robert Gross was elected as vice-president, and Ron Alterman became the new secretary treasurer.

Members of the ASSFN/Stereotactic and Functional Section have taken great advantage of the recent BRAIN Initiative from the federal government. The Defense Advanced Research Programs Agency (DARPA) has been a very generous supporter. One initiative of DARPA is the SUBNETS program to develop a closed-loop next generation neuromodulation device for the treatment of neuropsychiatric disorders such as PTSD, major depression, and substance abuse. Another is the RAM project to develop a neuromodulation device for enhancing memory. Members of the section are deeply involved in these projects and gave presentations at the recent ASSFN meeting on the progress toward what are likely to be the next generation of neuromodulatory treatments for many new indications.

Current ASSFN Membership numbers 375, including 36 residents and fellows. This number is the highest it has been in years, and reflects growing interest in our burgeoning multidisciplinary field. Society membership is now open and free to medical students. The section is financially healthy and investigating ways to support our priorities in training, research, and advocacy. The Roy Bakay Fund, which supports trainee research in stereotactic and functional, is one such example. We continue to work towards expanding our international footprint, and our section leadership was broadly represented on the program of the World Society of Stereotactic and Functional Neurosurgery (WSSFN) meeting in Mumbai, September 2015. In return, we encourage and actively solicit participation from the leadership and members of our international partner societies for our section sessions.

As part of ongoing efforts to promote the training and education of residents, fellows, and neurosurgeons in stereotactic and functional neurosurgery, ASSFN held its third annual Hands-on Training Course in Stereotactic and Functional Neurosurgery at the University of Colorado Anschutz Medical Campus in November 2015. Industry sponsorship was generous, and we were able to offer the course free to residents. The 2016 course is being held November 4–6, at the Hyatt Regency Aurora-Denver Convention Center in Colorado. With a registration cap of 30 people, the course is full and has generated a waiting list.

Finally, ASSFN leadership continues to look for ways to broaden and deepen the engagement between our society and our current key industry partners with respect to our shared priorities of (1) patient care and access, (2) advancing the field through research, (3) training the next generation of practitioners, and (4) the formation of joint task forces to tackle the obstacles associated with each of these priorities.
Tumor Section Update: Honoring Pioneers and Transitioning to an Exciting Future

This April the AANS/CNS Joint Tumor Section transitioned in leadership, as Frederick G. Barker II, chair from 2013 to 2016, passed the baton to our new chair Steven N. Kalkanis. Dr. Kalkanis and newly elected secretary/treasurer Manish Aghi will each serve two-year terms, after which Dr. Aghi will assume the chair position. This past year, the Tumor Section has enjoyed contributions from many dedicated volunteer leaders, and we had the opportunity to recognize a few of them at the recent 2016 Tumor Section Satellite Symposium, September 23-24, in San Diego.

At the Satellite Symposium, our section presented several awards, including the first annual Andrew Parsa Mentorship Award. Dr. Parsa passed away on April 13, 2015, shortly before he would have become chair of the Tumor Section. The Andrew Parsa Mentorship award was presented to Dr. Barker, whose track record for mentoring trainees and junior faculty reflects the spirit of Andrew Parsa. This award was a direct result of the numerous trainees who nominated him and whose nominations were read aloud at the Satellite Symposium. The impact of Dr. Barker’s mentoring has been tremendous for a significant portion of the Tumor Section Executive Committee, including current leaders Drs. Kalkanis and Aghi, both of whom trained at Massachusetts General Hospital (MGH) under Dr. Barker. As we continue to honor Dr. Parsa’s legacy, the Tumor Section is also working to fully fund a Parsa Research Fund to support trainee research in neurosurgery, a mission that was central throughout Dr. Parsa’s career.

Dr. Joseph Piepmeier received the Distinguished Service Award, in recognition of his legacy of distinguished service to the Tumor Section from 1993 to 2016, including serving as chair from 1999 to 2001. Under his leadership during those years, the Tumor Section launched many initiatives that would become its core tenets during the ensuing fifteen years, such as establishing the Tumor Immunology Task Force and publishing practice parameters for the treatment of single brain metastases.

The Tumor Section also honored the lifetime achievement of Dr. Mitchel Berger by presenting him with the Charles B. Wilson Award in honor of his career accomplishments in the field of neuro-oncology. Dr. Berger’s career has included two decades as chair of neurosurgery at UCSF, where he succeeded Dr. Charles Wilson, for whom this award was named. At UCSF, Dr. Berger built a pre-eminent brain tumor research center and defined the importance of extent of resection for gliomas and the principles of functional brain mapping that have done so much to advance neurosurgical oncology and outcomes for patients with gliomas. Dr. Berger is the sixth winner of this award since its inception in 2004. He was also one of three keynote speakers at the Satellite Symposium, where he presented a talk on low-grade gliomas and maximizing resection for survival.

Other notable speakers at the symposium included Drs. Hugues Duffau and James Rutka. The theme of the meeting, held for the first time in conjunction with the CNS Annual Meeting, was recent innovations and advances in the treatment of patients with low-grade gliomas. Sessions covered topics such as adjuvant therapy, ionizing radiation treatment, surgical techniques, clinical trials, and guidelines. Breakout groups specifically for residents, fellows, and young attendings focused on topics such as how to become a clinical trial investigator or to find an academic position as a brain tumor surgeon. This year Zeiss also partnered with us to offer a special lunch seminar focused on the controversies in fluorescence-guided surgery of gliomas with the use of 5-ALA and Fluorescein.

The Tumor Section remains active in the production of guidelines for the management of brain tumors. We are proud to share that new guidelines on the management of nonfunctioning pituitary adenomas have just been released, an effort led by Dr. Manish Aghi, and endorsed by the AANS/CNS Joint Guidelines Committee. Read the executive summaries in the October issue of Neurosurgery, and access the full chapters at cns.org/guidelines.

Finally, looking forward to 2017, we would like to announce that 2015-16 CNS President Russell Lonser has been invited to deliver the Ronald L. Bittner Lecture at the AANS Annual Meeting on Monday, April 24, 2017, in Los Angeles, California. We will also continue to work to advance partnerships internationally, with two joint Tumor Section and World Federation of Neurologic Surgeons (WFNS) courses planned for 2017 at host institutions from around the world. For the latest details on Tumor Section activities and for information on becoming a member, please visit our website, tumorsection.org.
INSIDE THE CNS

Resident Committee Report

The Congress of Neurological Surgeons Resident Committee is pleased to announce a successful start to the CNS Leadership Fellow program, with 36 residents in ACGME approved residencies participating in various CNS committees. The Leadership Fellow program was inaugurated in 2015 to provide leadership development opportunities for CNS Resident members while enhancing their contributions to the CNS. Leadership Fellows serve for two years and are expected to participate in committee processes and activities. Fellows have contributed articles to Congress Quarterly, worked to develop the Resident Roadmap, helped to create educational cases for our many educational offerings, and are working to help develop an app to serve as a pocket resource for residents. Fellows will be attending their committee meetings at the CNS Annual Meeting to discuss their experience in the program thus far. We look forward to their feedback as we continue to evolve and enhance the program. We are hoping to select our second class of leadership fellows in early 2017, with the call for applications forthcoming following the 2016 CNS meeting.

Our latest venture includes the development of a resource that helps guide residents through the various steps of residency, from boards to research and on to application for jobs and fellowships. This new resource is called “CNS Resident Roadmap and Beyond” and was rolled out in June. The new Resident Roadmap covers topics that every aspiring neurosurgeon needs to know, including written boards preparation, grants and awards, fellowships, finding a position, polishing a CV and writing a cover letter, interviewing, and contract negotiation. This resource is available on the CNS website for residents to review at any time at cns.org/roadmap. We will continue to develop the Roadmap over time and add additional CNS resources to help residents navigate their way into successful graduation and career planning.

This summer we also instituted a Resident Liaison program. Specially selected resident volunteers from various neurosurgery institutions receive regular updates on current resident activities from the CNS headquarters. The resident liaisons are responsible for sharing information about live course events, online webinars, volunteer opportunities, discounts for residents, and other interesting news to their fellow residents. They also serve as social media ambassadors, sharing information on the various social media platforms about CNS courses, neurosurgical research, and other various activities. The purpose of this program is not only to disperse crucial information to residents, but also to encourage mentorship between upcoming neurosurgical leaders in the field.

CNS membership benefits for neurosurgical residents and medical students are substantial, and contribute to fulfilling the CNS mission of leadership in neurosurgical education. Initiatives such as free live and archived webinars, complimentary online course recordings, exclusive member registration rates, and complimentary housing at the CNS Annual Meeting (on a first come, first served basis) have proven highly successful. Resident members have access to all SANS Lifelong Learning products at reduced rates, are eligible for CNS Fellowship Awards, and have the opportunity to attend the 3-D Surgical Anatomy Course for senior residents. We will continue to evaluate and develop opportunities for residents and medical students across a broad spectrum of neurosurgical educational and career opportunities.

> THE CNS RESIDENT ROADMAP AND BEYOND... COVERS TOPICS EVERY ASPIRING NEUROSURGEON NEEDS TO KNOW... TO NAVIGATE THEIR WAY INTO SUCCESSFUL GRADUATION AND CAREER PLANNING. <

WWW.CNS.ORG
ICD-10 is everywhere; it is the newest unavoidable implementation of regulations that impact the business processes of healthcare practices and institutions. Although it may be less onerous than Meaningful Use and PQRS regulations, it has had a large impact on the daily workflow of all neurosurgeons and their staff. Long gone are the days that we could rattle diagnosis codes from memory: 348.4, 724.2, 432.1, 742.0—everyone had their favorites.

The International Classification of Diseases (ICD) is rooted in international history. Attempts at systematic classification of diseases (through the study of deaths) dates as far back as the 1700s. More formal models came into existence in the late 1800s, and underwent interval revisions in the early 1900s. Recognition of international lists of diseases corresponding to international lists of causes of death came about in 1938. ICD-9 was introduced in the late 1970s, and in 1989, ICD-10 was borne. Ironically, it took 8 years to adopt a US version of ICD-10 and another 19 years until implementation (implementation was delayed three times over the course of four years). Final implementation came about on October 1, 2015.

ICD-10 has taken us from approximately 13,000 codes (using a five-digit structure) to more than 68,000 codes (using a seven-digit, alpha-numeric structure). And we aren’t finished yet. More codes are coming in 2016. Not only did CMS challenge our lives with the initial 68,000+, another 2,000 are being added later this year, with an additional 500 revisions coming to existing codes. The insanity! We now have a subset of codes for encounters with a duck. Or better yet, look up the expanded subset on spacecraft injuries. Thank goodness for the numerous smartphone applications and the ability to search by keyword or crosswalk.

CSNS and NERVES each conducted pre- and post-implementation surveys evaluating the impact of ICD-10 on neurosurgery. Data comparison spanned Jan–Sep 2015 (pre-implementation) to Oct–Dec 2015 (post-implementation) (Figure 1). Response was low, but the data showed that ICD-10 has had little impact on neurosurgery thus far. Respondents have reported decreased billing lag, increased average charges/day, essentially no change

Figure 1: NERVES survey data evaluating the impact of ICD-10 on neurosurgery.

A supplemental post-implementation survey has been conducted gathering additional ICD-10 data (Jan-Mar 2016); however, data was not available at the time of submission.
to days in AR, and a stable average of daily collections. Also reported was a decrease in percentage of denials.

We know that insufficient documentation has a direct impact on revenue. Nearly half of the codes created in ICD-10 provide for laterality, including specificities of late effects, injury, and sequelae, account for many of the other additions. And codes that more accurately described the seriousness of a condition have been deleted, i.e., neurogenic claudication is no longer viable language in ICD-10, which allows only the pertinent alternative of spinal stenosis. Learning ICD-10 subset expansions to ensure that the disease process is being described and dictated with the same verbiage as the code is not an easy process after years of utilizing other terms. However, being general or trying to get by with only documenting the basics is no longer sufficient to generate income for a practice. Codes should always be listed in the correct order to specify and preserve medical necessity, keeping in mind that documentation must support said coding.

In conclusion, it appears that our practices have seen little impact thus far. Our preliminary analysis was genuinely surprising. There was not a negative financial impact specific to claims processing with the implementation of ICD-10. The intense preparation of implementing ICD-10 has likely increased our productivity and decreased the negative reimbursement consequences. What is not captured in most analysis is the expense that went into preparing for ICD-10. Moving forward, it will behoove our practices’ bottom line to continue performing GAP analyses on key performance indicators. Keeping close watch on these reports will help ensure that any negative impacts to revenue streams are identified and addressed in a timely manner. We must also continue educating and staying current with updates. Neurosurgery is an ever-changing discipline, requiring that its professionals grow, adapt, and apply best practices.

Meanwhile, ICD-11 is under development now, and based on the World Health Organization’s timeline, it is expected to be finalized and released in 2017. Will we have another 27 years to prepare before implementation?

---

Article perspective is outpatient; does not include inpatient (ICD-10-PCS)

---

**NEED TRAUMA CREDITS?**

SANS Neurotrauma is a 100-question online exam covering trauma and neurocritical care.

Visit cns.org/education/trauma and get the trauma credits you need, on your schedule, from the convenience of your computer or tablet!

**Earn up to 10 AMA PRA Category 1 Credits™**

_Institutional License Available_
So far 2016 has been a busy year on the health policy and advocacy front, and the AANS/CNS Washington Committee and Washington Office staff have been working hard to promote policies that benefit neurosurgeons and their patients. Below is a rundown of recent activity.

**CMS Proposes Major Overhaul of Medicare Physician Payment System**

As previously reported, on April 27, 2016, the Centers for Medicare & Medicaid Services (CMS) issued a proposal to overhaul the way Medicare pays physicians. The proposed rule implements key elements of the Medicare Access and CHIP Reauthorization Act (MACRA). This legislation repealed Medicare’s sustainable growth rate (SGR) formula and replaced it with a new payment system. Through a single framework called the “Quality Payment Program,” the new payment paradigm has two paths—the Merit-based Incentive Payment System (MIPS) and the Advanced Alternative Payment Models (APMs). The new program consolidates components of three existing Medicare penalty programs—Physician Quality Reporting System (PQRS), Electronic Health Record (EHR), and Value-based Payment Modifier (VM)—and creates an opportunity for neurosurgeons to earn quality improvement bonus payments.

Initially, most neurosurgeons will likely participate in the Quality Payment Program through MIPS, which will allocate payments based on performance in four categories: quality, advancing care information (formerly EHR meaningful use), clinical practice improvement activities, and cost/resource use. CMS would begin measuring performance for physicians through MIPS in 2017, with payments based on those measures starting in 2019. Neurosurgeons participating to a sufficient extent in risk-based APMs would be exempt from MIPS reporting requirements and qualify for financial bonuses in addition to any shared savings earned through the APMs.

On June 7, 2016, Washington Office staff met with senior staff from CMS, including acting administrator Andy Slavitt, to discuss a number of topics related to the proposed rule. Members of the Neurosurgery Quality Council (NQC) and Washington Office staff developed a detailed comment letter, which was submitted on June 27, 2016. In the letter, organized neurosurgery expressed serious concerns with the new proposed payment rules and urged CMS to make substantial change before finalizing the payment overhaul.

Katie O. Orrico, JD

In a release coinciding with the submission of comments, AANS president Frederick A. Boop, chair of the Department of Neurosurgery at the University of Tennessee, remarked, “MACRA presents an unprecedented opportunity to fix the currently broken and burdensome Medicare quality programs, which have little meaningful impact on quality and have been extremely disruptive to physician practices.”

CNS president Russell R. Lonser, chair of the Department of Neurosurgery at Ohio State University, stated, “CMS should seize this moment and make substantial changes to the proposed rule to ensure that the new quality payment program is patient centered, flexible and meaningful for physicians and patients alike.” Dr. Lonser added, “The AANS and CNS recognize the enormity of the task to overhaul the Medicare physician payment system. Nevertheless, it is essential that CMS establish the programmatic building blocks that will ensure the quality payment program’s success into the future.”

Copies of the press release and letters are available at www.cns.org/MACRA. In the coming weeks and months, the CNS will be publishing a variety of educational materials to ensure that neurosurgeons are “MACRA ready” and can thrive under the new quality payment program.

**CMS Proposes Onerous Global Surgery Data Collection Mandate**

On July 15, 2016, CMS announced a unilateral decision to implement a new sweeping mandate to collect data about global surgery services. According to the proposal, beginning just five months from now on January 1, 2017, neurosurgeons providing 10- and 90-day global surgery services to Medicare patients will be required to report on a whole new set of codes to document the type, level, and number of pre- and postoperative visits furnished during the global period for every global surgery procedure. Under this system, neurosurgeons would be required to use a new set of G-codes to report on each 10-minute increment of services provided.

Previously, on November 13, 2014, CMS had finalized a plan to eliminate 10- and 90-day global surgery services to Medicare patients. We prevented the implementation of this ill-conceived plan by successfully advocating for a provision in the Medicare Access and CHIP Reauthorization Act (MACRA) that thwarted the agency’s efforts.
Opioid Legislation Signed into Law

On Friday, July 8, 2016, the House of Representatives overwhelmingly approved the conference report to S. 524, the Comprehensive Addiction and Recovery Act of 2016 (CARA), by a vote of 407 to 5. On July 13, 2016, the Senate followed suit, passing the conference report by a vote of 92-2, and on July 22, 2016, President Barak Obama signed the bill into law. The new law addresses six pillars of a comprehensive response to addiction: prevention, treatment, recovery support, criminal justice reform, overdose reversal, and law enforcement. Among other things, CARA authorizes grant programs and a task force on pain management; expands prescription drug take-back programs and access to medication-assisted treatments; and includes a provision permitting health insurance plans to limit the number of prescribers and pharmacies available to beneficiaries deemed at risk for opioid addiction.

The CNS joined forces with 76 other organizations in sending a letter to Congress supporting the bipartisan work on CARA. The letter also urged “Congress to continue to build on CARA’s achievements, and to next ensure that appropriate funding is made available in order for providers to have the resources they need to prevent opioid addiction from claiming more lives and causing more devastation to families and communities.”

House Republicans Unveil New Health Care Reform Plan

On June 22, 2016, House Speaker Paul Ryan (R, Wisconsin) revealed a new policy paper titled “A Better Way to Fix Health Care,” which is part of the larger “A Better Way” agenda that the speaker is spearheading. Earlier this year, Speaker Ryan appointed a task force to develop the plan. Members of the task force included:

- House Budget Committee chair, Rep. Tom Price (R, Georgia)
- House Education and the Workforce Committee chair, Rep. John Kline (R, Minnesota)
- House Ways and Means Committee chair, Rep. Kevin Brady (R, Texas)

When unveiling the package, Speaker Ryan stated, “Our plan is about more choices, not more mandates. It’s about putting patients and doctors first. It’s about the freedom and flexibility to choose the care that’s best for you, and the peace of mind that comes with having coverage you can count on and afford.” The final package incorporates several priorities, bills, and concepts endorsed and promoted by neurosurgery, including medical liability reform and repeal of the Independent Payment Advisory Board.

CNS Endorses the EHR Regulatory Relief Act

On July 18, 2016, the CNS and AANS joined the Alliance of Specialty Medicine in endorsing S. 3173, the Electronic Health Record (EHR) Regulatory Relief Act. Sponsored by Sens. John Thune (R, South Dakota), Lamar Alexander (R, Tennessee), Mike Enzi (R, Wyoming), Pat Roberts (R, Kansas), Richard Burr (R, North Carolina) and Bill Cassidy (R, Louisiana), this legislation would provide regulatory flexibility and hardship relief to providers operating under Medicare’s Electronic Health Record (EHR) Incentive Program’s meaningful use (MU) requirements. Importantly, the legislation contains a proposal to move away from the all-or-nothing approach to MU, extends the hardship exemption, and reduces the full-year reporting requirement to 90 days.

In a related development, on July 6, 2016, CMS issued the 2017 Medicare Prospective Payment System (OPPS)/Ambulatory Surgery Center (ASC) proposed rule. In the proposed rule, CMS announced that the agency was streamlining the reporting requirements for hospitals and eligible professionals (EPs) participating in Medicare’s MU program and plans to reduce the 2016 EHR reporting period from a full calendar year to 90 days.

House Advances Sports Medicine Legislation

On July 13, 2016, the House Energy and Commerce Committee passed by voice vote H.R. 921, the Sports Medicine Licensure Clarity Act. Authored by Rep. Brett Guthrie (R, Kentucky), the bill would ensure that sports medicine professionals are covered by their malpractice insurance when providing care to their athletes or teams in states other than where they are licensed. The legislation, endorsed by organized neurosurgery, applies to team physicians who travel as part of their contract to provide services to a team or league.

Alliance of Specialty Medicine Holds Annual Legislative Conference

On July 11-13, 2016, the Alliance of Specialty Medicine, held its annual 2016 Legislative Conference in Washington, DC. Approximately 150 specialty physicians from 33 states attended and took their message to their elected officials. Specialties represented included neurosurgery, cardiology, cataract surgery, dermatology, facial plastic surgery, gastroenterology, plastic surgery, rheumatology, and spine specialists. Neurosurgeons in attendance included Shelly D. Timmons, Moustapha Abou-Samra, and Clemens M. Schirmer.

Conference attendees heard from a variety of key speakers, including elected officials, Congressional staff, Obama administration officials, and political experts:

- Rep. Marsha Blackburn (R, Tennessee), vice-chair, House Energy and Commerce Committee
- Sen. Rand Paul (R, Kentucky), member, Senate Health, Education, Labor and Pensions Committee
- Sen. Chris Murphy (D, Connecticut), member, Senate Health, Education, Labor and Pensions Committee
- Sen. Roy Blunt (R, Missouri), chair, Appropriations Subcommittee on Labor,
Organized Neurosurgery Issues Position Statement on Concurrent and Overlapping Surgery

The topic of concurrent and overlapping surgery has been the focus of significant attention in the media and by state and federal policymakers—in particular, the Boston Globe Spotlight Team and Senate Finance Committee. To help provide clarity about the many facets of this issue, the CNS, AANS, American Board of Neurological Surgery (ABNS), Society of Neurological Surgeons (SNS), and Washington Committee collaborated to produce a position statement addressing the intraoperative responsibility of the primary neurosurgeon. The statement builds on the American College of Surgeons’ “Statements on Principles.”

These guidelines recognize that the primary attending neurosurgeon is personally responsible for the patient’s welfare throughout the operation. In general, the patient’s primary attending neurosurgeon should be in the operating suite or be immediately available for the entire surgical procedure. There are instances consistent with good patient care that are valid exceptions. However, when the primary attending neurosurgeon is not present or immediately available, another attending neurosurgeon should be assigned to be immediately available. Specifically:

• A primary attending neurosurgeon’s involvement in concurrent or simultaneous surgeries on two different patients in two different rooms is not appropriate.
• A primary attending neurosurgeon may be involved in two overlapping surgeries provided that the key or critical elements of the first operation have been completed, and there is no reasonable expectation that there will be a need for the primary attending neurosurgeon to return to that operation.
• The neurosurgeon may delegate part of the operation to qualified practitioners under his or her personal direction, including residents and fellows. However, the primary neurosurgeon must be an active participant throughout the key or critical components of the operation.
• Neurosurgeons must fully inform every patient about his or her illness and the proposed treatment. As part of the pre-operative discussion, patients should be informed of the different types of qualified medical providers that will participate in their surgery (assistant attending neurosurgeon, fellows, resident and interns, physician assistants, nurse practitioners, etc.) and their respective roles explained.

Organized neurosurgery believes these principles strike the appropriate balance of optimizing surgical care and neurosurgical training with informed and safe patient care.

Neurosurgeon Announces Candidacy for AMA Council on Medical Education

Former CNS Executive Committee member Krystal L. Tomei has launched a campaign for a position on the American Medical Association’s (AMA) Council on Medical Education (CME). The CME formulates policy on medical education—including graduate medical education financing, medical student debt, and physician workforce—and is also responsible for recommending the appointments of representatives to medical education organizations, accrediting bodies and certification boards. The election will be held in June 2017.

For more information on these or other health policy issues, please contact Katie O. Orrico, director of the Washington Office, at korrico@neurosurgery.org.
Massive Epistaxis from Cavernous ICA Aneurysm Invading the Sphenoid Sinus

These images demonstrate an aneurysm arising from the cavernous segment of the left internal carotid artery, which has eroded through the sphenoid sinus anterior-inferiorly with a distal daughter sac. This lesion was discovered following multiple episodes of massive epistaxis resulting in airway obstruction from blood clots and hypovolemic shock. The epistaxis was initially managed with nasal packing and embolization of the sphenopalatine arteries with only temporary success. Epistaxis from a true ICA aneurysm is very rare and unlike this case, is usually associated with traumatic injuries, radiation, or infection. The aneurysm was finally treated with placement of a flow diverter and adjuvant coil embolization.

Submitted by:  
Leonardo B. C. Brasiliense, MD  
Division of Neurosurgery, University of Arizona, Tucson, Arizona  
Ricardo A. Hanel, MD, PhD  
Baptist Neurological Institute, Lyerly Neurosurgery, Jacksonville, Florida
"you're only as good as your last craniotomy."

HaBluds

Kathryn Ko, 2016, ink, watercolor on paper #HaBluds