Endovascular Therapy for Cerebrovascular Disorders

Endovascular therapy is a well established treatment modality for a variety of cerebrovascular disorders. The past few decades have witnessed dramatic improvements in the field of neuroendovascular surgery. Neuroendovascular surgical techniques are now used in the treatment of intracranial aneurysms, vascular malformations, carotid stenoses, intracranial vascular stenoses and acute ischemic stroke. In many cases, these procedures provide minimally invasive alternatives to traditional surgery. In addition, neuroendovascular approaches provide treatment options for conditions previously thought to be untreatable. Ongoing device developments and refinements continue to revolutionize the field. These advancements, along with a better understanding of the disease processes, will eventually allow minimally invasive neuroendovascular techniques to be used for a wide spectrum of neurological diseases.

Dr. Aman Patel has led the Neuroendovascular Surgery section within the Neurosurgery Department at The Mount Sinai Medical Center since its inception in July 2001. Since then, the section has experienced continued growth. Dr. Patel is a board certified neurosurgeon who did his neurosurgical and endovascular training at UCLA.

Dr. David Johnson, the other full time faculty member, is a board certified neuroradiologist who was trained in endovascular techniques at The Mount Sinai Hospital.

Neurocritical Care

Neurocritical Care is a relatively new field that developed in the late 1970s and is now coming into its own as a subspecialty neuro-intensive care units develop across the nation. The Neurocritical Care Society, established in 2002, now has 531 members and grows each year. Neurocritical Care, the official journal, began publication in 2004 and was approved for Medline in 2006. The United Council of Neurological Subspecialties (UCNS) recognized neurocritical care as a new neurological subspecialty in 2005, and professional certification, as well as center accreditation for neurocritical care fellowships, are now available.

Specialized intensive care following neurological injury or neurosurgical procedures is crucial to improving outcomes. Admission to a neurological/neurosurgical ICU led by a neuro-intensivist has been associated with improved outcomes, lower mortality rates, shorter length of stay and lower total costs compared with care in a general ICU setting. (1-4)

The dedicated Neuro-Intensive Care Unit at Mount Sinai was opened in April of 1990 with six beds and has expanded to sixteen beds. It is one of only three New York City Neuro-ICUs run by a UCNS board certified neurointensivist. Dr. Jennifer Frontera joined the Mount Sinai faculty as an Assistant Professor of Neurosurgery and Neurology in 2006.
Last year the section performed 756 procedures. Of these, 365 were therapeutic/interventional procedures. The team treated a full spectrum of conditions: cerebral aneurysms, vascular malformations, carotid stenosis, intracranial atherosclerosis, acute cerebral stroke, cranial and spinal tumor embolizations, spinal vascular malformations and vertebral compression fractures.

**Cerebral aneurysms**

The goal of aneurysm therapy is to prevent rupture by excluding the aneurysm from the vessel lumen. Traditionally, this has been accomplished by surgical clipping of the aneurysm. Embolization that utilizes blood vessels as natural channels to reach the aneurysm provides a less invasive approach to treatment. The current treatment involves using detachable platinum coils to occlude the aneurysm lumen while keeping the normal vasculature open. More complex aneurysms may require treatment with coiling with the aid of a micro-stent which allows for filling of the aneurysm while protecting the normal vasculature. We currently have two IRB protocols of two “vascular reconstruction devices” that have HDE approval from the FDA for use in the treatment of cerebral aneurysms. Also, the FDA has recently given HDE approval for the use of Onyx, a liquid embolic agent, in the treatment of aneurysms by filling the aneurysm with liquid glue. We anticipate IRB approval for this protocol in the near future.
Vascular malformations

An arteriovenous malformation (AVM) consists of a nidus of coiled and tortuous vascular channels shunting blood from arterial feeders to draining veins. Successful treatment of brain AVMs requires a multidisciplinary approach. The goal of therapy is complete obliteration of the vascular nidus. Until this is accomplished, the risk of hemorrhage persists. Endovascular embolization, surgical resection, radiosurgery or a combination of these modalities is used in the treatment of these lesions. Recently, the availability of Onyx, an ethyl vinyl alcohol polymer, has allowed for a greater ability to achieve complete occlusion of cerebral AVMs via an endovascular approach. This material allows for a more controlled and complete filling of the nidus with the liquid “glue” which occludes the nidus of the AVM. To date, we have embolized 18 AVMs with Onyx. Treatment has resulted in complete occlusion in five AVMs; in the other 13, embolization with Onyx has rendered microsurgery safer or allowed for the treatment of large AVMs with radiosurgery. We are currently awaiting long-term results on these patients.

Carotid stenosis

Carotid stenosis may cause ischemic events by reducing cerebral blood flow or by acting as a source of thromboemboli. Carotid stenting is a less invasive, percutaneous procedure that is an alternative to the traditional treatment with carotid endarterectomy. Currently, stenting is approved in patients who are deemed high risk for open surgical endarterectomy. We are currently enrolled in two post-market studies [SAPPHIRE and CHOICES] investigating the long-term outcomes in this group of patients. To date, we have performed a total of 172 carotid stenting procedures with a 0.6% major stroke rate (permanent disability) and a 2.9% minor stroke rate (neurological deficit that recovers within 30 days). Our outcomes are favorable compared to published results.

Acute ischemic stroke

The Mount Sinai Medical Center is a JCAHO approved stroke center. We have a full-time capability to offer endovascular options for patients suffering from an acute ischemic stroke. Currently, we have multiple endovascular options including intra-arterial t-PA, MERCI clot retrieval, Pneumabra stroke device and acute angioplasty +/- stenting. In addition, we are involved in several research protocols involving the treatment of acute stroke.

Vertebral compression fractures

Compression fractures of the vertebral bodies from osteoporosis or tumor can often be debilitating secondary to severe pain. In most patients there is not an adequate surgical option for the treatment of this pain. Fortunately, vertebroplasty and kyphoplasty have emerged as minimally invasive procedures for the treatment of compression fractures. Both are percutaneous procedures performed under local anesthesia that result in the filling of fractured vertebrae with bone cement. Both procedures result in a strengthening of the fractured vertebral body and a significant improvement in pain in greater than 90% of patients treated. We are currently treating 70-90 patients a year with vertebroplasty or kyphoplasty.

Training and Academics

A total of seven endovascular fellows have graduated from the Neuroendovascular Surgery Fellowship Program, a collaboration between the Neurosurgery and Radiology Departments. The fellows have come from both the neurosurgical and neuroradiological specialties. The graduates are currently practicing in Australia, Portugal, New York and New Jersey. In addition, neurosurgical residents
She is board certified in Neurology, as well as subspecialty board certified in Vascular Neurology and Stroke (ACGME) and Neurocritical Care (UCNS). After completing medical school at Johns Hopkins University, Dr. Frontera undertook her neurology residency and stroke and neurocritical care fellowships at Columbia Presbyterian Hospital in New York. She is the author of a handbook of neurocritical care, *Decision Making in Neurocritical Care*, to be released in April 2009 (Thieme, New York) and has authored several peer reviewed articles as well as numerous book chapters.

**Dr. Errol Gordon** joined the Mount Sinai Neuro-ICU team as an Assistant Professor of Neurosurgery and Neurology in July 2008. Dr. Gordon is board certified in Neurology and Internal Medicine (ACGME). He completed his residency training at the Medical College of Wisconsin and his fellowship training in Neurocritical Care at Columbia Presbyterian Hospital in New York. He is director of the Neuro-ICU physician assistant program.

Since arriving at Mount Sinai, Drs. Frontera and Gordon have introduced new, state of the art technologies to the NSICU, including brain oxygen and parenchymal ICP monitors, cooling devices for induced normothermia and therapeutic hypothermia, cerebral microdialysis to evaluate metabolic function and health of neurons in severe brain injury, continuous EEG monitoring, multi-modality transcranial Doppler, non-invasive cardiac monitoring and the Bedmaster data collection system.

**Delivering Excellence in Patient Care**

Joining the Neuro-ICU team are medical intensivists, vascular neurologists, endovascular neuro-interventionalists and neurosurgeons. Our multi-disciplinary team provides comprehensive medical and surgical care and treats a variety of illnesses ranging from subarachnoid hemorrhage to intracerebral hemorrhage, malignant stroke to acute brain and spinal cord trauma, status epilepticus to myasthenia gravis and Guillain Barre Syndrome, just to name a few. The neuro-intensive care unit receives referrals from the greater New York area and the 16 hospitals in the Mount Sinai Health System, including Mount Sinai Queens Hospital, Elmhurst Hospital Center, North General Hospital and the Englewood Hospital and Medical Center. Mount Sinai is proud to be a member of NYC Project Hypothermia sponsored by the Greater New York Hospital Association (GNYHA) and the FDNY. As part of this project, Mount Sinai receives direct EMS referrals for patients who suffer a cardiac arrest in the field so that they can undergo therapeutic hypothermia.

Outstanding specialized and compassionate nursing care is the foundation of the Mount Sinai NSICU. Mount Sinai is one of only three Magnet hospitals in New York City, the highest level of recognition awarded for excellence in nursing practice and patient care. As in all critical care units, nurses are on the frontline in patient care. At Mount Sinai we are fortunate to have a dedicated group of nurses: half of the nurses working in the NSICU have worked at Mount Sinai for over twenty years, and a third of the nurses have worked in the NSICU with critically ill neurological patients since its inception. The NSICU is also staffed by highly skilled physician extenders, including overnight physician assistants and a daytime nurse practitioner, who are integral to continuity and quality of care.

Multidisciplinary teamwork and collaboration in the NSICU are integral to providing excellent, seamless patient care. The nursing staff is exemplary in managing many daily postoperative admissions; the nurses participate in many bedside patient procedures and also transfer and transport patients to multiple neuro-diagnostic procedures. In the pursuit of optimum, safe patient care, the NSICU nurses round daily with the physicians, and they also work closely with many other disciplines including nutrition, speech pathology, rehabilitation, pharmacy, and respiratory.

Many of the nurses are certified in critical care, neuroscience and med-surg nursing, and attend ongoing nursing conferences to ensure that they stay abreast of the current trends in nursing and provide the most up-to-date nursing care. The nurses are enthusiastic and committed to using the new state of the art technologies introduced to the NSICU. Many have volunteered to become champions in the use of the varied equipment and devices to ensure excellent patient care, not only in the NSICU but also on other units.

**Mignon Guishard-Pole**, the Clinical Nurse Manager (CNM), has twenty-four hour responsibility for the efficient and excellent running of the unit. **Susan Nevens**, the Nurse Clinician/Educator, supports the CNM’s role and provides high quality core, ongoing education and competencies for the nursing staff. Both encourage the nurses to participate in many unit based and hospital wide committees,
such as the NSICU Journal Club chaired by nurses. Every week, a physician, nurse, drug representative or equipment/device representative lectures on varied topics centered around evidence-based practice and improved patient care. The nurses serve on many committees, including the Peer Review, NDNQI Skin Care, Documentation, Professional Practice and Magnet Champion. The NSICU nurses’ dedication and passion for high quality nursing care extend to the community where several of the nurses serve as officers for the American Association of Critical Care Nurses and participate in community service.

Commitment to Research
Drs. Frontera and Gordon have a special interest in intracranial hemorrhage and are running a variety of clinical research protocols including two ongoing local IRB approved projects: Intracranial Hemorrhage Outcomes Project (IHOP), which is a prospective observational outcome study enrolling neuro-intensive care patients who present with spontaneous subarachnoid hemorrhage, subdural hemorrhage or intracerebral hemorrhage, and the Prediction of Postoperative Recurrence of Subdural Hematoma using CT Perfusion study, which assesses the ability of multi-modality CT imaging to predict post-operative recurrence of subdural hemorrhage. Additionally, the Neuro-ICU team is participating in the NIH funded ARUBA trial (A Randomized Study of Unruptured Brain Arteriovenous Malformations), the 4 BALANCE Beriplex trial (prothrombin complex concentrates for reversal of hemorrhage in coagulopathic patients), the NIH funded safety, feasibility and dose finding MISTIE trial (Minimally Invasive Surgery plus T-PA for Intracerebral Hemorrhage Evacuation), the CLEAR IVH Clot Lysis study, which is an NIH funded Phase III randomized clinical trial using rt-PA to treat subjects with intracerebral hemorrhage (ICH), intraventricular hemorrhage (IVH) and hydrocephalus, and the randomized, open label SAMMPRIS trial (Stenting vs. Aggressive Medical Management for Preventing Recurrent Stroke in Intracranial Stenosis).

Advancing Education
Neurocritical care is viewed as an important educational component in the core curriculum of both neurology and neurosurgery residents. The NSICU at Mount Sinai is currently staffed by a nurse practitioner, nighttime physician assistants and PGY1 surgery residents, including neurosurgery PGY1s. The NSICU has a UCNS track neurocritical care fellowship that will begin in 2009. For more information visit the “fellowships and jobs” section of the Neurocritical Care Society website (http://www.neurocriticalcare.org).

A Grateful Patient
Over the past few years, the NSICU has had many wonderful success stories. One of our patients wrote a particularly touching story of hope.

“I am Crystal Wheeler, a 33-year-old wife, mother, daughter, sister, and friend. Before November 9, 2006, I had long hair, weighed 110 pounds and was teaching in the NYC public school system. On November 9, 2006, without warning, I began having seizures. Little did I know I would be diagnosed with viral encephalitis and status epilepticus, and thanks to my doctors and nurses, I am here to tell you that I survived...When I was admitted to the hospital, the doctors put me into an induced coma to stop the seizure activity. After 40 days, I was taken off my sedation and miraculously began following commands and woke up...After coming out of the coma, it was still a long road ahead...I had a blood clot in my arm from the intravenous lines and tubes. I had to learn to go to the bathroom on my own, talk, breathe, sit up and now walk with bent legs because of the contractures in my legs (which made my knees bend forward). It has not been an easy road at all, but each time I was hit with another blow, I came back swinging harder and harder. Most doctors gave up any chance of recovery. They thought that even with the slim chance of survival, I would not be able to remember anything, spell or even be my former self in any way. However, a year later, I am happy to report that, although I am at times forgetful, most of my memories have come back and, most importantly, my life has been returning. I thank my neurointensivist for being the one doctor to not give up hope on me. If there is anyone reading this, I urge you not to give up hope either. No matter how bad it may seem, you must believe that there is always hope. Once considered the hopeless, I am now the hopeful.”

References
Endovascular Therapy
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and diagnostic neuroradiology fellows acquire basic exposure to this subspecialty. The section currently has a total of seven active IRB approved research protocols involving the treatment of cerebral aneurysms, carotid stenosis, acute stroke and intracranial atherosclerosis. Over the past six years the endovascular section has produced 26 publications, with many additional publications currently in press or preparation.

Participants in and graduates of the fellowship program include:
Kenneth Faulder, MD, an interventional neuroradiologist in Melbourne, Australia;
Henry Rice, MD, an interventional neuroradiologist in Brisbane, Australia;
Simon Edelstein, MD, an interventional neuroradiologist in Sydney, Australia;
David Johnson, MD, Assistant Professor of Radiology and Neurosurgery, Mount Sinai School of Medicine;
Daniel Walzman, MD, Neurosurgeon, North Jersey Brain and Spine, Hackensack, NJ;
Chirag Gandhi, MD, Assistant Professor of Neurosurgery and Radiology, UMDNJ, Newark, NJ;
Isabel Fragata, MD, Staff Neuroradiologist, Lisbon, Portugal.

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Save the Dates

**Research Day**
**Wednesday, June 3, 2009**
7:30 AM - 1:30 PM

Jeannette and Bernard Post, MD, Endowed Lecture: *New Insight into the Biological Basis of Depression*
Eric Nestler, MD, PhD
Director of the Brain Institute and Chairman of Neuroscience
The Mount Sinai School of Medicine

Ved P. Sachdev, MD, Endowed Lecture: *Role of Caspase Cell Death Pathways in Neurologic Diseases*
Robert M. Friedlander, MD
Professor of Neurosurgery, Harvard Medical School
Vice Chairman, Department of Neurosurgery
Director, Neurosurgery Research
Associate Director of Cerebrovascular Surgery
Brigham and Women's Hospital/Harvard Medical School

Kalmon D. Post, MD, Neurosurgery Resident Research Award Presentation

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**Annual Softball Tournament**
**Saturday, June 6, 2009**
Central Park, New York City
9 AM - 7 PM

Endorsed by Mayor Michael R. Bloomberg, this date has been declared *Neurosurgery Charity Softball Tournament Day* in the City of New York. This event has raised nearly $200,000 to date and includes 19 medical centers from around the country. In addition to Mount Sinai's Department of Neurosurgery, tournament participants are neurosurgery departments from Albert Einstein, the Barrow, Cornell, Dartmouth, Duke, Emory, Harvard, Johns Hopkins, Northwestern, NYU, Penn State, Thomas Jefferson, University of Alabama, University of Florida, University of Pennsylvania, University of Utah, Yale and two teams from Columbia.

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**Visiting Professor**
**June 17, 2009**

James Rutka, MD, PhD, FRCS, FACS, FAPP

Dr. Rutka is currently co-director of the Labatt Brain Tumor Research Centre at The Hospital for Sick Children, Professor of Surgery, and Chairman of the Division of Neurosurgery at the University of Toronto.
Joshua Bederson, MD, led the team that rewrote the American Heart Association Guidelines for the Management of Aneurysmal Subarachnoid Hemorrhage. The new guidelines were published on January 22 in *Stroke: Journal of the American Heart Association*. To update the original 1994 recommendations, the guidelines committee conducted a systematic literature review of all relevant randomized clinical trials published between June 30, 1994, and November 1, 2006. The committee’s recommendations were made by applying the American Heart Association’s standard evidence rating scheme to the conclusions put forth in the articles. Aman B. Petel, MD, was a co-author.

Isabelle Germano, MD, was reappointed by the FDA to serve a four year term as a voting member on the Neurological Devices Panel. She was an invited speaker at the Congress of Neurological Surgeons meeting in Orlando, Florida, in September 2008, where she talked on Stereotactic Radiosurgery. In February 2009, Dr. Germano was Visiting Professor at Stanford presenting her clinical and research experience on gene transfer for malignant gliomas.

Dr. Jamie Ullman, representing the Congress of Neurological Surgeons, shared her expertise about trauma on a panel co-hosted by the American Association for the Surgery of Trauma and the Centers for Disease Control held in Chicago in August 2008: *Acute Care Congress on the Future of Emergency Surgical Care in the United States*. In November, as a representative of the CNS as well as the AANS, she was on a panel discussing *Improving US Disaster Medical Response: Expanding the Role of the Trauma System and its Core Components*. The College of Surgeons and the United States Department of Homeland Security sponsored the event. In January 2009, she served on a panel, *Guidelines for the Management of Severe Traumatic Brain Injury*, for the Treatment Algorithm Project, hosted by the Brain Trauma Foundation in New York.

Dr. Arthur L. Jenkins III was among 1,189 initiates from around the world who became Fellows of the American College of Surgeons (ACS) during convocation ceremonies at the College’s 94th annual Clinical Congress in San Francisco in October 2008. Dr. Jenkins, along with Brookhaven labs, received a New York State Spinal Cord Injury Grant; he and Dr. Stanislaw Sobotka in our department are collaborating with Dr. F. Avraham Dilmanian of The Brookhaven National Laboratory/Stony Brook University.

Ron Alterman, MD, presented *Update on Deep Brain Stimulation for Torsion Dystonia* at the 4th Fred J. Epstein Memorial Conference on Pediatric Neurology and Neurosurgery in Eilat, Israel, on March 16.

Dr. Thomas Naidich is the first author of the new book, *Duvernoy’s Atlas of the Human Brain Stem and Cerebellum*, published in 2009 by Springer-Verlag/Wein. This book is an 876 page profusely illustrated presentation of the anatomy and physiology of the brain stem. The text gently teaches the functional connections of the spinal cord, cerebellum and cerebrum to the brain stem, so they may be remembered easily. A review in the *American Journal of Neuroradiology* extols the book: “In a truly remarkable anatomic and MR imaging atlas of the human brain stem and cerebellum, Drs. Thomas Naidich, Henri Duvernoy, Bradley Delman, Gregory Sorensen, Spyros Kollias, and Mark Haacke as editors teamed up with 21 authors to give the neuroscience community a publication that will shortly become a standard in the field of neuroanatomy. The meticulous detail of the ex vivo specimens takes the reader far beyond any previously published work on the MR imaging anatomy of the brain stem, cerebellum, and upper cervical spinal cord. One must see the text firsthand to appreciate the beauty of the specimens and the wealth of knowledge contained in the exact labeling of this complex anatomy.”

Robert Aiken, MD, was selected for inclusion in the 12th edition of Castle Connolly’s Top Doctors: New York Metro Area.

Dr. David M. Johnson lectured on “New Strategies in Vertebral Compression Fractures” at *Update: Brain, Spine, Endovascular & ENT Imaging* on October 19, 2008, and on “Compression Fractures” at the Mount Sinai Course, *Orthopaedics for the Primary Care Provider* on the 31st of the same month. Dr. Johnson gave Grand Rounds for the Rehabilitation Medicine Department of Mount Sinai in November and the Medicine Department of North General Hospital in December.

Dr. Irene Osborn participated in the New York State Society of Anesthesiologists meeting in December. She lectured as part of a panel discussion on *Guidelines for Difficult Airway Management*, presented a focus session on *Anesthesia for Interventional Neuroradiology*, and competed in the annual “Bragging Contest,” presenting an exciting case from the neurosurgery operating room.

Dr. Eliza Geer and husband Matthew Karchmer are the proud parents of Isaac Eitan Karchmer, born on November 18. Isaac joins his three year old sister Noa. Abiash Haridas, MD, PGY4, and his wife Manju welcomed their first child, baby girl Shivan Arya Haridas, on March 12.
Philanthropy

The Department of Neurosurgery is grateful to Drs. Frank Moore, Abe Steinberger and Marc Arginteanu whose generous donation has launched The Neurosurgery Residency Training Fund, which will support our residents for continuing medical education. It will defray costs related to training, including travel, extramural training and reading materials. In addition to growing this important source of support for residency training, the Department also seeks philanthropy for its efforts across a multitude of diseases and disorders of the brain and spinal cord. Contributions can be directed to advance the department’s work in brain tumors, pituitary tumors, Parkinson’s disease and dystonia, spinal column degeneration and spinal cord injury, and stroke, among other neurosurgery subspecialties. There are also a number of established funds to support. Please contact Kim Woodward in the Development Office at (212) 659-1594 or kim.woodward@mountsinai.org for more information.

The 24th annual Mount Sinai Crystal Ball, the yearly black tie benefit for the medical center, which includes the hospital and medical school, will take place on May 7 in the Guggenheim Pavilion. To order tickets, reserve a table, purchase an ad or make a donation, please contact Eileen Solomon at eileen.solomon@mountsinai.org or 212-659-9701.

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Neurosurgery at Mount Sinai is published for colleagues and friends of the Department of Neurosurgery at The Mount Sinai Medical Center. Please contact Debbie Winn (deborah.winn@mountsinai.org) for submissions, suggestions or questions. Visit us at www.mssm.edu/neurosurgery.