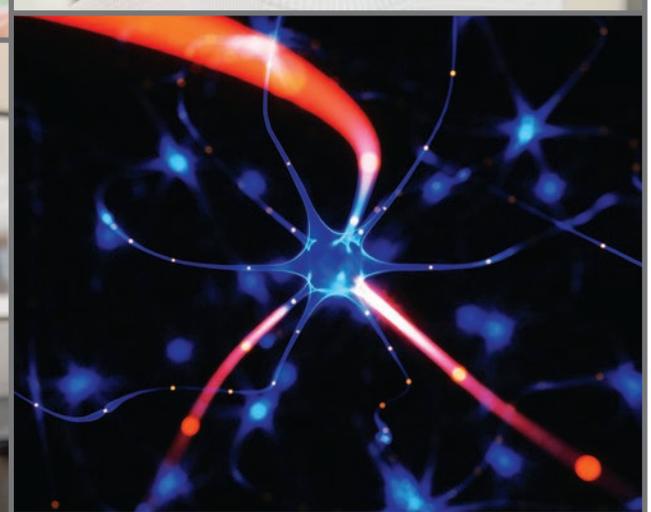
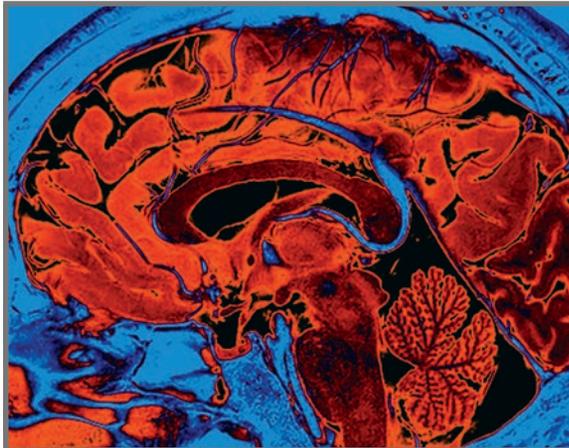


# NewYork-Presbyterian Neurology and Neurosurgery 2017 Report on Clinical and Scientific Innovations



**Weill Cornell  
Medicine**

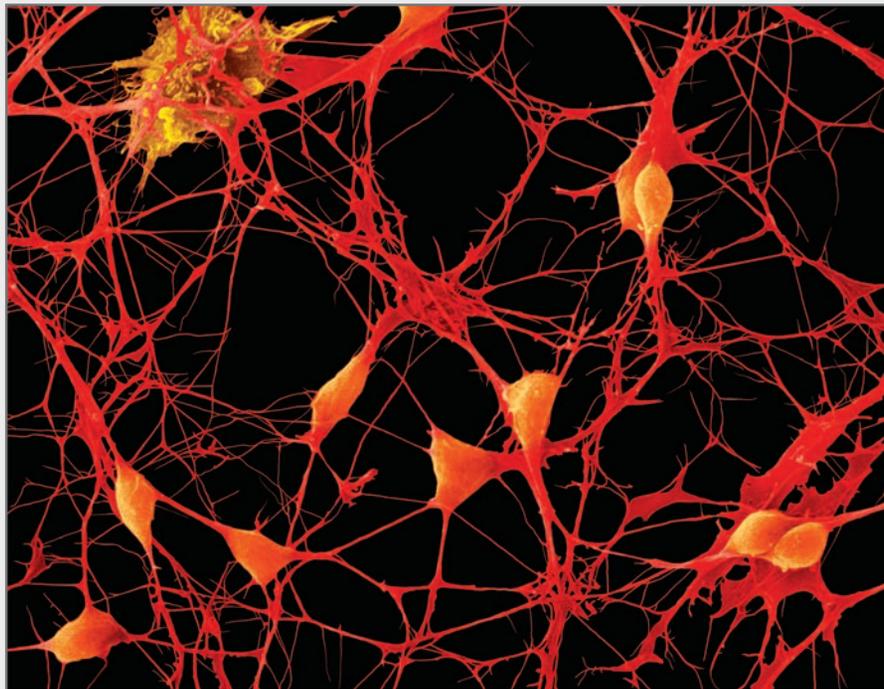
**NewYork-  
Presbyterian**



**COLUMBIA UNIVERSITY  
MEDICAL CENTER**



NewYork-Presbyterian Neurology and Neurosurgery ranks #4 in the nation.



## NewYork-Presbyterian Neurology and Neurosurgery 2017 Report on Clinical and Scientific Innovations

<b>Welcome</b>	<b>1</b>
<b>Measures of Distinction</b>	<b>3</b>
<b>Innovations at a Glance</b>	<b>4</b>
<b>Caring for Complex Cases</b>	<b>5</b>
An Answer for Intractable Seizures	6
Life-Altering Treatment for Headache	8
A Stroke Team Mobilizes into Action	10
Targeting Essential Tremor with Focused Ultrasound	12
Experienced Hands in Pineal Tumor Surgery	14
Transformative Treatment for Subdural Hematoma	16
Novel Design Enhances DBS Therapy	18
Expanding the Boundaries of Brain Tumor Treatment	20
Repairing an Aneurysm with Two Lives in the Balance	22
Timely Stroke Care Saves a Life Twice	24
<b>NewYork-Presbyterian Today</b>	<b>26</b>

**For More Information**  
[nyp.org/amazingadvances](http://nyp.org/amazingadvances)

# Welcome

Dear Colleague:

We are pleased to bring you our *2017 Report on Clinical and Scientific Innovations in Neurology and Neurosurgery*. The strength of our neurology and neurosurgery programs is derived from the exceptional clinical, scientific, and educational resources made possible by the partnership of NewYork-Presbyterian, Columbia University Medical Center, and Weill Cornell Medicine.

In this year's report, you will meet a number of patients who came to NewYork-Presbyterian presenting with critical or chronic neurological conditions that threatened their lives or quality of life. These individuals are among the thousands who come to our institution seeking help and hope for conditions that range from chronic seizures and movement disorders to brain tumors and stroke. Here they find neurologists, neurointerventionalists, critical care specialists, and neurosurgeons applying the latest innovations and advances in their respective fields.

A key component of our programs is the collaborations among our clinicians and scientists that take their work in exciting and sometimes unexpected directions, facilitating new research avenues and novel approaches to care. These may include using focused ultrasound as a novel treatment for essential tremor, refining endovascular devices for clot removal, or developing early intervention strategies to prevent the devastating effects of stroke.

Today, our neuro programs are among the largest recipients of NIH funding, allowing our faculty to continue to pursue greater understanding of neurological disorders and to help more and more patients who face debilitating diseases of the brain and spine. We believe the future of neurological care is full of great promise in the hands of our gifted clinicians and researchers who work tirelessly to achieve the best possible outcomes for patients.

Sincerely,



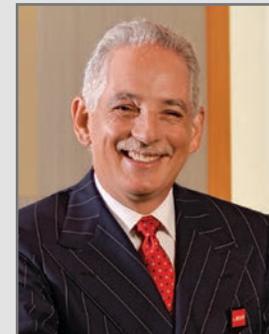
**Steven J. Corwin, MD**  
*President and  
Chief Executive Officer  
NewYork-Presbyterian*



**Lee Goldman, MD**  
*Executive Vice President, Dean of  
the Faculties of Health Sciences  
and Medicine, and Chief Executive  
Columbia University Medical Center*



**Augustine M.K. Choi, MD**  
*Stephen and Suzanne Weiss Dean  
Weill Cornell Medicine*



Dr. Steven J. Corwin

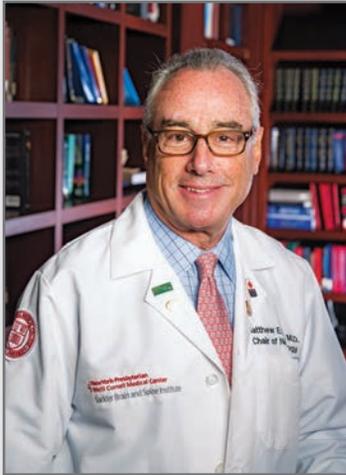


Dr. Lee Goldman

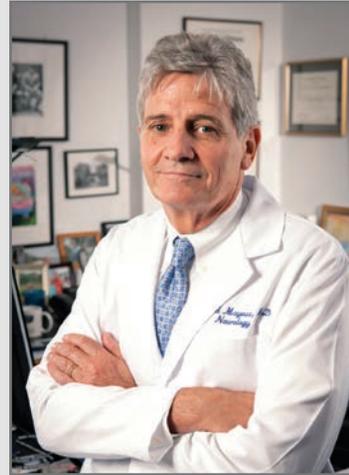


Dr. Augustine M.K. Choi

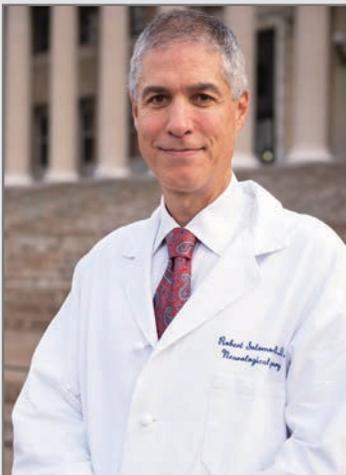
# Welcome



Dr. Matthew E. Fink



Dr. Richard P. Mayeux



Dr. Robert A. Solomon



Dr. Philip E. Stieg

Dear Colleague:

As clinicians and researchers, the innovations we apply to treatment and the hypotheses that we investigate in the laboratory are driven by our prevailing desire to help the patients who come to us for care and those who may benefit in the future.

In this year's *Report on Clinical and Scientific Innovations in Neurology and Neurosurgery*, our patients give voice to the life-changing and life-saving medical and surgical interventions they have experienced when entrusting their health and well-being to NewYork-Presbyterian.

Our faculty continue to pursue greater understanding of the complex nature of disorders of the brain and spine and define newer and more potent techniques and therapies that ease the burden of illness and hopefully effect a cure.

The stories presented on the following pages resonate with us, as we hope they will with you. The courage with which our patients face their neurological challenges and the often physical and emotional demands that accompany their treatments inspire us all.

Sincerely,

**Matthew E. Fink, MD**  
*Neurologist-in-Chief*  
NewYork-Presbyterian/  
Weill Cornell Medical Center

**Richard P. Mayeux, MD, MSc**  
*Neurologist-in-Chief*  
NewYork-Presbyterian/  
Columbia University Medical Center

**Robert A. Solomon, MD**  
*Neurosurgeon-in-Chief*  
NewYork-Presbyterian/  
Columbia University Medical Center

**Philip E. Stieg, PhD, MD**  
*Neurosurgeon-in-Chief*  
NewYork-Presbyterian/  
Weill Cornell Medical Center

# Measures of Distinction

# 10,500

PATIENT HOSPITAL ADMISSIONS

The Neurology and Neurosurgery Departments at NewYork-Presbyterian treated 8,400 adult and 2,100 pediatric inpatients in 2016.

## CLINICAL CARE

Physicians

**172**

Neurologists

**44**

Neurosurgeons

Procedures

**6,400**

Surgical and Endovascular Procedures

Adult and Pediatric Patient Discharges in Key Specialties

**2,112**

Stroke and Cerebrovascular

**1,857**

Epilepsy

**1,423**

Spine

**885**

Neuro-Oncology

Dedicated Neuro Beds

**134**

Inpatient Neuro Beds

**32**

Neuro ICU Beds

**27**

Epilepsy Monitoring Beds

Source: NewYork-Presbyterian 2016

## RECOGNITION

- *U.S. News & World Report* ranks our Neurology and Neurosurgery program **#4** in the nation
- NewYork-Presbyterian is a **Comprehensive Stroke Center**, accredited by The Joint Commission
- The Hospital has **2 Level 4 Comprehensive Epilepsy Centers** as designated by the National Association of Epilepsy Centers

## REACH

In 2016, our Neurology and Neurosurgery Departments treated patients from **44 states** and **27 countries**

## RESEARCH

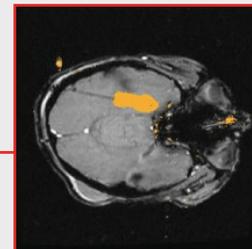
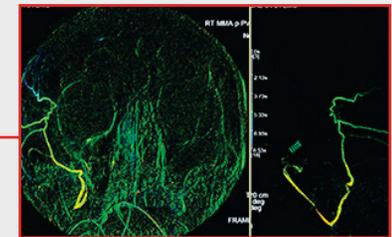
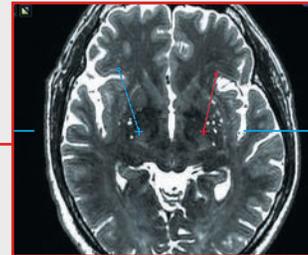
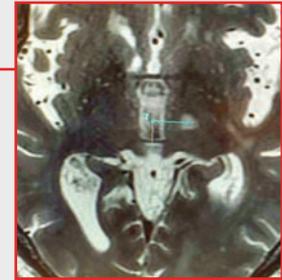
- Received over **\$81 million** from the **National Institutes of Health** and other organizations
- More than **50 researchers** conducted over **250 clinical trials**

## GRADUATE MEDICAL EDUCATION

- **103 residents** participated in our Neurology and Neurosurgery residency programs
- **17 fellows** participated in our fellowship programs

# Innovations at a Glance

- Conducting pioneering work in high-intensity focused ultrasound, which heats and destroys target lesions to eliminate or greatly diminish essential tremor
- Investigators in the largest study of a single institution comparing concussion rates in collegiate athletes, which found that female athletes were more likely than male athletes to experience concussion
- Among the country's foremost experts advancing the application of deep brain stimulation, including the use of diffusion tensor imaging to guide targeting in the OR, to treat symptoms of Parkinson's disease
- Established multidisciplinary brain metastases programs that provide patients with the latest diagnostic and treatment modalities to help address the consequences of metastases and side effects of therapy
- Advancing the use of middle meningeal arterial embolization to treat subdural hematoma, a groundbreaking minimally invasive approach that can spare patients from the risks of open surgery
- One of 28 clinical sites across the country for NeuroNEXT, an NIH-Network for Excellence in Neuroscience Clinical Trials created to expand capabilities for studies of promising new therapies for neurological diseases
- National leaders in the use of MRI-guided laser interstitial thermal ablation therapy for patients with medically intractable focal epilepsy
- Certified by The Joint Commission and the American Heart Association/American Stroke Association as a Comprehensive Stroke Center, recognizing the long-term experience and highly specialized expertise of NewYork-Presbyterian's stroke teams
- Launched the first Mobile Stroke Treatment Unit on the East Coast, bringing specially trained paramedics, a CT technologist, and a neurologist who can administer tPA in the ambulance saving upwards of 30 minutes in time to treatment



# Caring for Complex Cases

The neurology and neurosurgery programs of NewYork-Presbyterian draw patients from all over the world who seek the expertise of physicians practicing at the forefront of their fields. On the pages that follow are 10 patients who presented to us with intractable, debilitating, or life-threatening neurological disorders. They represent the outstanding outcomes that can be achieved through the efforts of highly trained and experienced clinicians, collaborations across specialties, and advanced techniques and applications of novel technologies.





Josh Stabile is no stranger to health challenges. As an infant, he had a double inguinal hernia. At four he was diagnosed with dilated cardiomyopathy, and at six he underwent a heart transplant at NewYork-Presbyterian/Columbia University Medical Center. Within days of the transplant, he had a stroke, followed by years of seizures. In 2012, while in college, he was diagnosed with post-transplant lymphoproliferative disorder for which he

underwent a stem cell transplant in 2014. Mr. Stabile, 27, has met each medical hurdle with grace and determination, buoyed by family and friends and a network of physicians in multiple specialties at NewYork-Presbyterian/Columbia.

“I’ve been told by a number of people that I’m a success story,” says Mr. Stabile, who returned to school, graduating this past spring. “I want to show

people that, yes, it is possible to get through these things. I’ve had a lot of people backing me up.”

All of his health issues had been managed well, save for the intractable epileptic seizures, which led him to neurologist Carl W. Bazil, MD, PhD, Director of the Columbia Comprehensive Epilepsy Center. “I first met Josh in October 2015,” says Dr. Bazil. “My first thought was I hope we can do

better than this because he has made it through incredible health complications and now what's holding him back is refractory epilepsy. For individuals like Josh who have been on a number of medicines and have never been completely controlled, the first thing that we ask is could they be a candidate for epilepsy surgery, such as focused laser thermal ablation. If they are, that approach has by far the best chance of taking somebody who has continued seizures to being seizure free."

Dr. Bazil first wanted to verify that Mr. Stabile did indeed have epilepsy. "There are people not dissimilar to Josh who have had a diagnosis of epilepsy for years and it turns out to be something else, which is why the medicines don't work," he says.

Dr. Bazil and his team recorded several of Mr. Stabile's seizures through video-EEG monitoring and determined they were originating from the right temporal lobe. "We confirmed with MRI that Josh had mesial temporal sclerosis, meaning that the seizures were coming from deep within the temporal lobe, an area of the brain that encodes memory. We have to be very careful verifying the origin of the seizures to be certain that surgery is not going to cause more problems than it is going to fix."

Two things were in Mr. Stabile's favor, notes Dr. Bazil. "The seizures were on his nondominant side and surgery would be much less likely to result in any memory problems that could be perceived. We also had started performing laser ablation at Columbia the year before. Previously the standard operation



Dr. Carl W. Bazil

was to remove the entire temporal lobe to get to those deep structures causing the problem. Our neurosurgeons had been doing it successfully for more than two decades. But, as a neurologist, I know that bad brain is a problem, but good brain, no matter what, you would rather leave intact. So, laser ablation always made sense to me."

Guy M. McKhann II, MD, Director of Epilepsy and Movement Disorder Surgery at NewYork-Presbyterian/Columbia, performed the MRI-guided laser interstitial thermal ablation in June 2016. "Recent advances in this therapy, particularly the ability to monitor the ablation in real time under MRI, have improved the safety and efficacy of this procedure," says Dr. McKhann.

Through a 3-millimeter incision, a laser probe is placed into a seizure focus to destroy the tissues causing the seizures. "We get an updated MRI



Dr. Guy M. McKhann II

image every several seconds that shows the exact temperature of the brain where you are applying the laser," says Dr. McKhann. "Real-time temperature maps allow us to monitor the area being heated and destroy the lesion without damaging the surrounding healthy brain tissue."

"Since my surgery, neurologically I've been just about fine," says Mr. Stabile. "I did have one seizure, but it was after a busy week in the city. I had walked over 10,000 steps, had three doctor appointments, and saw two Broadway shows. We figured I had just gone into overload."

"The laser ablation, which is relatively new and not offered by many epilepsy centers, enabled this young man to have his seizures controlled with limited removal of brain," notes Dr. Bazil. "We have also been able to reduce his medications."



Dr. Susan W. Broner

“The science of migraine has exploded in the last two decades. Not long ago it was considered a disorder of hysterical people. Now we understand the main piece of the pathophysiology of migraine, which is going to help us identify more targeted approaches.”

— Dr. Susan W. Broner

“Headache represents one of the most debilitating conditions in all of medicine,” says Susan W. Broner, MD, Medical Director of the Weill Cornell Medicine Headache Program. “Yet, it remains one of the most underdiagnosed and undertreated.” More than 40 million Americans suffer from severe, disabling headaches.

Dr. Broner, who is dual board certified in both neurology and headache medicine, is internationally recognized for her work in the treatment of headache disorders, including migraine and cluster headaches, as well as a host of unusual headache syndromes.

“Headache is not a diagnosis, it is a symptom that encompasses a group of disorders,” says Dr. Broner. “The cornerstone of treatment is determining the specific diagnosis, such as migraine, trigeminal autonomic cephalalgias, and other disorders. Some patients have more than one of these disorders and these patients can be particularly complex to treat.”

Dr. Broner’s expertise in the field is what prompted a Manhattan neurologist, well known to Dr. Broner, to refer his patient, Joan Gmora Birnbach, who has been plagued by chronic migraines for many years.

“I had headaches even as a little girl and the migraines started probably in college or law school,” says Ms. Gmora Birnbach, an attorney and mother of two. While traveling in Europe at the age of 22, she was diagnosed with a hemiplegic migraine so severe that it left her partially paralyzed. “I was very lucky

and got better, but it took me about a year to get my strength back.”

Over the next two decades she saw a number of neurologists, all very well regarded she says, who managed her migraines with medications, including triptans. These medications, however, sometimes made her nauseous causing prolonged episodes of vomiting. “A couple of times a year, I ended up in the emergency room dehydrated,” she says.

“Throughout this period, Joan was struggling,” says Dr. Broner. “By the time I saw her 10 years ago, her headaches had gotten even worse. She was taking preventative medications that were just not helping.”

“While I had a migraine, I was unable to go on with my life,” says Ms. Gmora Birnbach. “The pain was horrendous. I had two young kids and I couldn’t get up. I couldn’t be vertical long enough to make food and take care of them.”

## Blocking Pain Signals

In managing chronic migraine, Dr. Broner first rules out the possibility of a structural or systemic cause. “I then come to a diagnosis and, together with the patient, develop effective strategies that are well suited to the patient’s lifestyle and other medical conditions she or he may have,” says Dr. Broner. “Our goal is to retrain the brain, altering the firing patterns that lead to pain so that patients start having fewer headaches and are more in control. We intervene on neurotransmission in the brain



through medications, lifestyle factors, and complementary approaches, which all act to change this very complex neurovascular syndrome.”

Dr. Broner treated Ms. Gmora Birnbach with combinations of oral preventatives, which provided some relief with fewer side effects. She then suggested BOTOX®, which had been FDA approved for chronic migraine in 2010. “I had been involved earlier in

clinical trials with BOTOX. The injections worked well from the first or second time for Joan. It has changed her life. When she’s not using the BOTOX, she has headaches every other day.”

The BOTOX regimen calls for 31 injections in the forehead, temple, back of the head, neck, and shoulders every 12 weeks. “We know that BOTOX interferes with acetylcholine release from

nerve terminals that normally allows muscles to contract. In migraine, we believe that BOTOX is working in part by inhibiting the release of pro-inflammatory molecules and neurotransmitters in the periphery, ultimately feeding back onto the brain stem preventing activation of pain pathways,” says Dr. Broner.

“I also have a medication to take when I get a bad migraine and 10 minutes later I can go on with my day,” says Ms. Gmora Birnbach. “The combination of the two has made a huge difference. The migraines don’t interfere with my life any more. I also don’t have the anxiety of fearing what I will do if I get one.”

“I have seen many patients who have tried numerous medications before seeing me,” adds Dr. Broner. “Our comprehensive multidisciplinary approach allows us to introduce new treatment plans to help many of these patients find improvement in their pain. We are excited to be at the forefront of the great breakthroughs that are being made in headache medicine and believe that the new migraine-specific CGRP antagonists coming out this year will provide significant relief for many of those suffering from these painful disorders.”

## Dionisio Robles A STROKE TEAM MOBILIZES INTO ACTION

On January 10, 2017, at about 6 pm, Dionisio Robles had just finished making dinner for his mother's birthday at her home in the Bronx. After eating, as he sat dozing on the couch, his sister noticed something was very wrong.

"I awoke and was talking in a mumble," says Mr. Robles, now 34. "The side of my face was drooping and I also couldn't control my left arm or leg. My sister immediately called 911 and explained the symptoms. When the ambulance arrived, I remember I was mad because I didn't know that something was happening with me. I thought they were joking. Then I saw my mother crying and that's when everything got me worried."

Mr. Robles was taken to the emergency room of NewYork-Presbyterian Allen Hospital, a NewYork-Presbyterian site located at the northern tip of Manhattan, where the stroke page was activated at 7:40 pm, 10 minutes after his arrival. A CT scan was immediately ordered.

"Mr. Robles was confused, slurring his speech, and he had spatial neglect of the left side of his face. His left arm and left leg were also paralyzed," says Olajide A. Williams, MD, Director of Acute Stroke Services at NewYork-Presbyterian/Columbia University Medical Center. On the NIH Stroke Scale, Mr. Robles was rated 11, signaling a significant stroke.

After 5 pm, all acute stroke consultations at NewYork-Presbyterian Allen are performed via telemedicine with NewYork-Presbyterian/Columbia. A Columbia neurologist received the stroke page and logged on remotely. After reviewing the results of the CT scan, he instructed that Mr. Robles be given IV tPA, the first line of treatment to start the clot dissolution process. The time was 8 pm.

The CT scan did not reveal any hemorrhaging or a brain tumor, however, a CT angiogram revealed complete occlusion of the right middle cerebral artery. The interventional team at NewYork-Presbyterian/Columbia, 50 blocks south, was alerted and an ambulance was arranged to take the patient directly to the interventional neuroradiology suite.



“I got the call and our team came rushing in,” says Philip M. Meyers, MD, Clinical Director of the Neuroendovascular Service at NewYork-Presbyterian/Columbia. “It’s a sizeable group. We have an anesthesiologist, a neurointerventional/neurosurgical physician, a neurosurgery fellow or resident on call, an RN, a technologist, and a surgical technician. It’s fairly labor intensive to make all of these things happen quickly. But as soon as they see the large artery blockage, the clock starts ticking. We’re rushing to set up and get ready for the patient.”

“When EMS took me to Columbia at 168th Street they were checking on my legs and it was hard for me to move,” says Mr. Robles. “I was really worried. They made the trip in about six or so minutes. Even the police were helping with traffic.”

### The Neurointerventional Team

Arriving at NewYork-Presbyterian/Columbia by 8:30 pm, Mr. Robles was taken directly to the interventional suite where Dr. Meyers and his team were preparing to perform a thrombectomy with an endovascular stent-based retriever.

“It is unlikely that tPA will actually open a large blood vessel that is blocked,” says Dr. Meyers. “We’ve discovered in a series of clinical trials since 2015 that patients do much better if you pull the clot out and reopen the blood vessel. We plucked out the clot with a stent retriever and the patient’s blood flow was completely restored.”

A year since his stroke, Mr. Robles is feeling well and regaining his strength through regular exercise, including playing in a community basketball league. “The running is great for my circulation,” says Mr. Robles, who was diagnosed with cardiomyopathy, which the physicians believe was responsible for his stroke.

On the advice of his cardiologist he has given up driving an 18-wheel truck that required long periods of sitting. “I decided to return to school to study business administration and spend my time on something positive,” he says.

“We have put together a rigorous and highly coordinated system of stroke care,” notes Dr. Williams. “To see it work so beautifully for a young father of three is a particular source of pride for me and for everybody who was a part of the team. His was destined to be a colossal stroke that would have either killed him or put him in a nursing home. It’s remarkable because Mr. Robles went from being paralyzed and having severe slurring of speech to walking out of the hospital almost as if nothing had happened.”

“We’re constantly refining the system,” continues Dr. Williams. “Our times are getting stronger and stronger. In every case, such as Mr. Robles’, we perform a very detailed, critical analysis of every link in the chain of stroke action. We’re always looking to address any kinks in any of those links.”



Dr. Olajide A. Williams and Dr. Philip M. Meyers

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– Dr. Olajide A. Williams



Katina Ansen knew little about essential tremor when the disorder began to “rear its ugly head” several years ago. “My father and grandfather had both developed tremors in their later years, but mine started in a very slow manner,” says Ms. Ansen, an accomplished artist. “The tremor would wax and wane and initially it was frustrating and

embarrassing. I finally sought help in 2014 because it was progressing and beginning to be a problem in my life and work.”

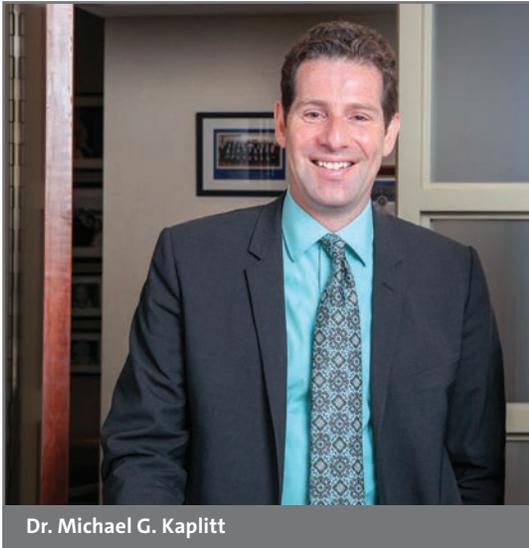
Ms. Ansen was prescribed a beta blocker for a time, but the symptoms only worsened. “Next we tried primidone. I was on the maximum dose and feeling very lethargic and just getting grumpier

and withdrawing a bit. I went back on the beta blocker with the primidone, but it was like a double whammy. I was being plagued by the tremor.”

## An Experimental Treatment

Ms. Ansen was beginning to lose hope that anything would help when her husband heard about Michael G. Kaplitt, MD, PhD, a neurosurgeon and Director of Movement Disorders at the Weill Cornell Brain and Spine Center, and the work he was doing in MR-guided high-intensity focused ultrasound (HIFU). Dr. Kaplitt was the first in New York to perform HIFU, a noninvasive technology approved for use in essential tremor by the FDA in July 2016, and he continues to test this approach in a clinical trial. Focused ultrasound has the potential to transform treatment by gaining access deep within the brain without harming healthy tissue. This enables surgeons to ablate targeted tissue without exposing the brain to the effects of ionizing radiation.

“Historically, we would make a hole in the skull and put a probe in and ablate the VIM nucleus of the thalamus that is central to regulating the control of stability,” says Dr. Kaplitt. “That approach was then supplanted over the years by deep brain stimulation, which we’ve been doing for nearly 18 years at Weill Cornell. Brain stimulation gave us a little bit more flexibility intraoperatively. With focused ultrasound, however, we can actually lesion the abnormally functioning area of the brain



Dr. Michael G. Kaplitt

completely noninvasively with MR thermometry, which allows us to measure the temperature inside the tissue to confirm its accuracy. We are also able to get real-time responses from the patient, so as we send more and more energy to the target, we can see the patient's tremor becoming better."

Prior to her procedure, Dr. Kaplitt asked Ms. Ansen to hold a glass of water to test the severity of her tremor. "There wasn't a drop left – the water just went flying," she recalls. "I was so excited that the day had finally arrived and I was going to get rid of this. And it was a relief knowing that I was doing something that in the future might help my children if they developed this disease. I had a lot of thoughts, but none were about the fear of having the procedure done."

"Tremor is difficult for anyone, but for someone who works with their hands, it can be devastating," says Dr. Kaplitt. "In Katina's case, we were not only able to get her tremor under complete control on the table, but in the more abstract sense, we were getting her back to who she was as a person and to the life she wants. The wonder that Katina showed looking at her hand immediately after the procedure, and her amazement that her hand was now her hand again, was incredibly gratifying."

"After each ablation, Dr. Kaplitt asked me to write on a tablet and it was remarkable to see my hand come under control during the whole process," says Ms. Ansen, whose art has flourished again since her treatment. "I'm going full throttle. I've been in a show and have had many commissions. I can paint. I can draw. I can sign my name. I'm particularly indebted to Dr. Kaplitt. He's my superhero. I'm so happy because I'm me again."

One of the first things Ms. Ansen did after her procedure was to create and give Dr. Kaplitt several pieces of her amazingly beautiful and intricate art. "To have these physical mementos of how well she did shows the kind of impact you can have on someone's life," says Dr. Kaplitt.

## Expanding Applications for HIFU

Dr. Kaplitt and his Weill Cornell colleagues are currently seeking to expand applications for focused ultrasound. "There is a lot of interest in trying this for Parkinson's and epilepsy," he says. "There are going to be limitations to the technique for some patients because of certain physical characteristics of their skull that make it difficult to perform the procedure. Some patients may need it done on both sides of the brain, including the majority of Parkinson's patients, and we don't yet know if this is safe. It's only approved for one side now."

Weill Cornell is about to begin a clinical study of HIFU for patients with Parkinson's whose symptoms are predominantly on one side of the body. "Deep brain stimulation therapy will still be a very valuable adjunct to Parkinson's patients who have symptoms on both sides," says Dr. Kaplitt.

Weill Cornell researchers are also using ultrasound experimentally in the laboratory to temporarily open the blood-brain barrier to deliver viral gene therapy agents into the brain. "I think over time as we understand more about ultrasound that this is where our field is going," adds Dr. Kaplitt. "The idea that we can move toward less-invasive surgical procedures for patients and they can get the same result without having their brain penetrated is obviously very attractive to them."

## Justin Stone EXPERIENCED HANDS IN PINEAL TUMOR SURGERY



For years, Justin Stone, 25, would often complain of headaches and vision problems. It was suggested that computer work may have contributed to these issues, and so the generally healthy young man continued on with his life until one day last March. “I was at work sitting at my desk, not feeling that great, and thinking, ‘Is someone dimming the lights? I didn’t think they could dim the lights in here.’ The next thing I knew I was being picked up off the floor,” says Mr. Stone. “I went home and later that day had a grand mal seizure.”

A local hospital diagnosed Mr. Stone with a tumor in the pineal region of his brain. Pineal tumors are rare, accounting for less than 1 percent of human brain tumors. Understanding the gravity of the situation, his parents quickly sought a referral to a major medical center. They were ultimately led to Jeffrey N. Bruce, Co-Director of the Brain Tumor Center and Director of Skull Base Surgery at NewYork-Presbyterian/Columbia University Medical Center. A leading authority on complex tumors of the skull base, with particular expertise in pineal tumors, Dr. Bruce has performed more than 200 of these surgeries, which rank among the most difficult neurosurgical operations.

“While tumors in the pineal region are rare, Justin’s was an epidermoid tumor, which is even more rare,” says Dr. Bruce. “This benign, slow-growing tumor had likely been there for years until it reached a point where it was causing a blockage of the spinal fluid and irritating his brain, which led to his seizure.”



Dr. Jeffrey N. Bruce

Dr. Bruce first developed an interest in pineal tumors during his residency at Columbia. “The chairman of Neurosurgery at the time, Dr. Ben Stein, had basically reinvented the approach for these tumors, which were considered inoperable back in the day,” says Dr. Bruce. “Patients did very poorly and many of them died. However, once the operating microscope came into being in the late ‘70s, Dr. Stein thought maybe it was time to rethink whether these tumors were inoperable or not. He pioneered some of the surgical techniques and taught them to me before he retired in 1996.” Since that time, Dr. Bruce has become one of the highest performing surgeons of this procedure in the world.

Transferred to New York-Presbyterian/Columbia in a life-threatening condition, Mr. Stone first underwent an endoscopic ventriculostomy to address the hydrocephalus by creating a small hole in the bottom of the brain to relieve the pressure on his brain. Without this first procedure, it would have been very difficult to remove the pineal tumor because of the high pressure in the brain. Two days later, with the brain now relaxed, Dr. Bruce performed the second surgery.

“This is all done through a craniotomy,” explains Dr. Bruce. “We open the skull and enter between the two halves of the brain, and then complete the remaining part of the surgery under a microscope. It’s very important that the initial surgery be done correctly or you can doom the patient to further problems with the tumor if all of it is not removed.”

During the eight-hour surgery, Mr. Stone’s family waited anxiously for news. “After Dr. Bruce came out, we couldn’t have written a script any better than what he said – that it was successful and that he had removed 99.9 percent of the tumor,” recall Helen and Richard Stone. “We weathered the storm together, but Justin was incredible. As we reflect back upon it now, we each needed strength from each other, but he was the nucleus of the strength.”

“My memory of the first couple of weeks following surgery is very scattered,” says Mr. Stone. “I did have

bad double vision and it took a few months for that to resolve. I also had physical and occupational therapy, and that all went very well.”

“I have to say, Justin’s whole outlook on life, not unexpectedly, has changed since his surgery. He told me he’s never felt better,” says Mrs. Stone. “We are beyond grateful. I look forward to all the things that he’s going to get to enjoy and experience in life and that’s because of Dr. Bruce and his team.”

“My goal right now is to get myself in good shape,” says Mr. Stone. “I’m working and enjoying my music, which is what I’m truly passionate about, and now I can actually focus on it. I don’t have any reason to be negative after everything else that’s happened to me.”

Dr. Bruce is also pleased with the result of the surgery. “Justin made a very nice recovery and his prognosis is excellent – he should live to be 100!”

Presently, Dr. Bruce is gathering data on the pineal tumor surgeries he has performed to date. “This is the largest series in the world. We’re trying to hone in on how the surgery affects patients’ outcomes. For example, we’re looking at how much of the tumor is removed in each patient and how well that correlates with outcome,” he says. “I’m hoping it will be the definitive paper on how to best manage these rare tumors and that it will provide an in-depth analysis of the risks and benefits of this complex surgery.”

Last December, while vacationing with family in the Caribbean, Harold Tanner tripped and fell, hitting his head. His son David, concerned because his father was taking Coumadin, called his father's cardiologist at NewYork-Presbyterian/Weill Cornell Medical Center, Dr. David S. Blumenthal, for guidance.

"Even though it was Christmas Day, Dr. Blumenthal took the call," says Harold Tanner. Dr. Blumenthal advised him to discontinue the Coumadin and quickly get to a facility where he could be given fresh frozen plasma and intravenous vitamin K to promote clotting.

"Harold received an MRI and the intravenous K in Anguilla, was then flown to St. Maarten and from there airlifted back to New York," recounted Mrs. Nicki Tanner, wife of Harold Tanner.

"Dr. Blumenthal arranged for an ambulance that took us directly to the medical team waiting at NewYork-Presbyterian/Weill Cornell."

After several weeks of intensive care at the hospital and Burke Rehabilitation Hospital, Mr. Tanner returned home, continuing rehab as an outpatient. "My personal trainer noticed that I was tilting to the left and dragging my foot," recalls Mr. Tanner. "I went back to NewYork-Presbyterian/Weill Cornell Medical Center for another MRI, which showed a subdural hematoma. In consultation with Dr. Blumenthal, I agreed to a new procedure developed by Dr. Jared Knopman to drain the bleeding in my head."



Dr. Jared Knopman

## Intervening with MMA Embolization

"Essentially, the way we've treated subdural hematoma for the last half century is through a craniotomy where we drain the blood to relieve pressure on the brain," says Dr. Knopman, a neurosurgeon and interventional neuroradiologist with the Weill Cornell Brain and Spine Center. "But I had started investigating a new and innovative procedure to treat it without open surgery."

As Dr. Knopman explains, "Whenever we take out a subdural hematoma in the OR we notice that the membrane that surrounds it is very friable and oozy. There is an inflammatory process where the hematoma can keep bleeding and re-bleeding. You have to stop this vicious cycle."

In an open procedure, the surgeon removes the hematoma and cauterizes the membranes to stop the bleeding. "But we can only cauterize the membrane that we see," says Dr. Knopman. "A subdural hematoma can encompass half of the skull, and we only open up a small part to drain the blood. Also, 15 percent will recur because these membranes continue to ooze in the area that you can't shut down."

Three years ago, Dr. Knopman read a case report from physicians in Asia who endovascularly embolized the middle meningeal artery (MMA) in a patient who had subdural hematoma that kept recurring after multiple surgeries to drain the blood. "It was a last-ditch effort to stop the bleeding and it worked," he says.

Dr. Knopman built upon that concept and devised a procedure as an upfront alternative for patients who have subdural hematomas that would traditionally require surgery as a first-line treatment. He is the first physician worldwide to implement this.

"This is the procedure that I offered Mr. Tanner. We've done it in dozens of patients since. Instead of going to surgery as a first step, in a select group of patients, we embolize the MMA to see if the hematoma will disappear on its own."



The reason why subdural hematoma is safe and amenable to treat with this approach, notes Dr. Knopman, is that the symptoms for many of these, like Mr. Tanner's, are mild to moderate. Patients may have headaches, gait instability, some weakness, or even a seizure. "However, they are not decompensating in a rapid fashion, so you have the opportunity

to do something less invasive and with no anesthesia," he says. "Even though embolizing the MMA doesn't drain the blood immediately, if it interrupts that vicious cycle it can allow the brain to organically reabsorb the blood. Mr. Tanner was among the first five patients in the world on whom I had performed this procedure for that indication."

Dr. Knopman is the principal investigator in the only national trial currently underway to prove the efficacy of this approach in a larger cohort of patients. He has thus far performed it on some 50 patients who have had a subdural hematoma after surgery, and he has avoided open surgery in over 90 percent of patients who would have traditionally met the criteria for a craniotomy. Dr. Knopman says, "I believe this technique has the potential to change the standard of care for how we treat subdural hematoma in the future."

"Dr. Knopman is the 'wave of the future' in that he's one of many doctors who are looking for the least invasive way to achieve a better result," says Mrs. Tanner. "I praise the hospital and Dr. Blumenthal for being accessible and being up on these latest innovations. And I certainly praise Dr. Knopman for what he's doing. It's just a miracle that this can be done noninvasively."

"Mr. Tanner has given much to the Weill Cornell community," adds Dr. Knopman. "For him to have benefitted from the procedure that was conceived within these walls is just an amazing thing. It comes full circle."

Mr. Tanner is a Life Overseer on the Weill Cornell Medicine Board of Overseers.



At first the signs were subtle. Lucy Shnyder, then in her early 40s and an IT specialist, would often go to the gym at lunchtime. “I had a personal trainer and during the sessions he asked me, ‘What’s with your right hand? When you raise it or when you walk, it doesn’t move or extend as

much as your left hand,’” recalls Ms. Shnyder, now 55. “I had never noticed that and had never felt anything. Every once in a while when I was driving I had a tremor or shaking in my pinky, which I also didn’t pay much attention to.”

Ms. Shnyder did suffer from periods of vertigo, which had been getting worse, and it was then when her doctor suggested she see a neurologist. “I walked in with vertigo and walked out with Parkinson’s disease,” she says. “I was shocked. I didn’t expect anything like that. I had heard of Parkinson’s, but I never knew what it was about.”

Ms. Shnyder was referred to Cheryl H. Waters, MD, a neurologist at NewYork-Presbyterian/Columbia University Medical Center. “Dr. Waters is brilliant and I have been her patient for 11 years,” says Ms. Shnyder. “When the disease first started, it wasn’t that bad. But as the years went by, it became more advanced and I was forced to stop working. I was taking so many medications and feeling so bad that, to tell the truth, in my mind I felt like I was dying. It was a sad time.”

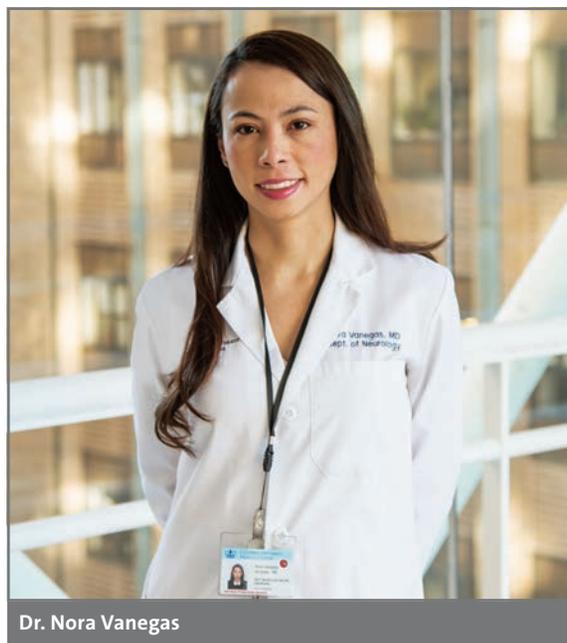
### **The Next Step: Deep Brain Stimulation**

Dr. Waters suggested she see Columbia neurologist Nora Vanegas, MD, a specialist in deep brain stimulation (DBS). “I had participated in a number of clinical studies with Dr. Waters for which I am grateful,” says Ms. Shnyder. “She never pushed me to have the DBS. I guess she was waiting for me to be ready for it. I think it’s better that the patient herself is in control and decides when, why, and how. At the same time, you go into it not knowing whether it will help or hurt you. But I thought I would take the risk because if it didn’t help me, it might benefit someone else down the road.”

“Lucy had been managed primarily with medication for more than 12 years,” says Dr. Vanegas. “But she got to the point where her disease was so severe that we were not able to control all of her symptoms with medication, predominantly tremor and dystonia, and she had persistent side effects, including anxiety and dyskinesias.”

NewYork-Presbyterian was one of the first centers in the country to utilize DBS, the most important therapeutic advance in the treatment of Parkinson’s disease in the past 20 years. While DBS is not a cure for Parkinson’s, it effectively treats several symptoms that cannot be resolved with pharmacotherapy. There are two main DBS targets for the treatment of Parkinson’s disease, each with specific benefit profiles and therefore selected according to the predominant issues of each patient. Placing electrodes deep within the brain without incurring complications requires high quality imaging and careful surgical targeting.

“In the first stage of her treatment, Lucy was implanted with a new type of electrode that allows a more tailored DBS programming,” explains Dr. Vanegas. The latest generation of DBS devices enables physicians to precisely steer electrical stimulation in one specific direction. The novel leads also have the advantage of allowing the use of individual stimulation frequencies for each hemisphere using a single battery.



“Steering technology basically involves ring electrodes divided into segments that allow the physician to exactly navigate the current through just one segment, potentially reducing side effects,” says Dr. Vanegas.

A week after implantation of the electrodes, Ms. Shnyder returned to the hospital to have the pulse generator implanted. “A month later Lucy came in to have the DBS turned on and be programmed,” says Dr. Vanegas. “The programming session involves a very thorough screening of every DBS contact to determine what benefits or side

effects it will provide. At the end of the visit, we selected what was more beneficial for her during the screening session.”

“After a few weeks we did run into the difficulty of worsening Lucy’s dystonia and had to troubleshoot on that side of her brain,” continues Dr. Vanegas. “We were able to successfully do that due to the new technology.”

### Life After DBS

Ms. Shnyder underwent DBS in September 2017. “Dystonia was one of the most difficult symptoms to treat, and for me it was the worst of the symptoms,” says Ms. Shnyder. “It was also the first symptom to improve after my surgery.”

“The disease is still there and I still have to take medication, but a lot less,” she adds. “However, my quality of life is so much better. I started going back to my yoga classes. I started driving again and going places and seeing people. It is incredible what the whole team at Columbia has done for me. It’s literally like I am born again. When I talk about it, I get tears.”

In May 2017, Nkiru Amaefuna, a young lawyer practicing in Abuja, Nigeria, began experiencing numbness and weakness in her right leg and intermittent shaking. An MRI showed what appeared to be an astrocytoma located quite close to her motor cortex, however, she was not offered surgery.

“I couldn’t walk properly and my symptoms were getting worse,” says Ms. Amaefuna, 25, who then traveled to New York to visit her aunt. During the visit, she had a focal seizure that sent her to the Emergency Department at NewYork-Presbyterian/Weill Cornell Medical Center and to the care of Babacar Cisse, MD, PhD, a neurosurgeon with the Weill Cornell Brain and Spine Center.

“Nkiru had developed acute weakness and was unable to walk,” says Dr. Cisse. “A CT scan and MRI confirmed there was, indeed, a frontal parietal lesion, mostly parietal but actually deeper and with corticospinal tract infiltration.”

Lesions presenting in close proximity to eloquent cortex pose unique challenges. “The lesion was at least an intermediate grade primary glial neoplasm,” says Dr. Cisse. “We needed to have tissue to be sure what we were dealing with. Then with subcortical mapping, we decided we would be able to safely resect the tumor and spare her motor fibers.”

Neuronavigational systems in combination with anatomic and functional imaging advances have greatly advanced the neurosurgeon’s ability to effectively and safely resect lesions. “When the tumor is so low grade, it is very difficult to tell

tumor from normal brain and whether it is white matter or not,” says Dr. Cisse. “If the tumor is in a region that can be mapped, we rely on motor or language mapping. With Nkiru, we were worried about the fibers coming from the motor cortex and going down through the brain stem to the spinal cord. If we were to damage those fibers, she would be permanently plegic.”

Neurologist Steven C. Karceski, MD, Director of Clinical Trials at the Weill Cornell Epilepsy Center, oversaw the intraoperative monitoring. “We conducted very detailed testing,” says Dr. Karceski. “While the surgeon is working on taking out the brain tumor, we simultaneously monitor her brain

and nervous system for any signs that we are getting close to areas that must be preserved. There is constant communication between myself and Babacar as we work together to determine where to draw the line.”

The computer-assisted technologies in neuro-navigation go beyond cortical mapping that look for motor movements, notes Dr. Karceski. “We continuously test the motor system, arm and leg, and face during surgery. An electrical impulse is sent every one to two seconds. If we see a change in our measurements, we can alert the surgeon that we are getting very close to the motor region. In combination with other tests, it is a very sensitive warning system.”



Dr. Babacar Cisse



Dr. Steven C. Karceski



The Weill Cornell team also used high-definition fiber tractography, an advanced MRI-based imaging technique, with diffusion tensor imaging enabling them to track the fibers. “As I was resecting the tumor, I was using mapping as well as ultrasound,” says Dr. Cisse. “Before I got close to the motor fibers and the cortical spinal tract, I used a cortical stimulator and saw we were only a few millimeters from these fibers. This is another technology that enables the surgeon to maximize the resection while not risking critical structures.”

“The overall structure of the brain is essentially the same from one person to another, but the differences come in when we’re talking about millimeters,” says Dr. Karceski. “We test in order to know – within millimeters – where critical functions exist. In that way, we can get the most tumor out and give that person the absolute best possible outcome and response. That’s what the technology allows us to do.”

“Before I got close to the motor fibers and the cortical spinal tract, I used a cortical stimulator and saw we were only a few millimeters from these fibers. This is another technology that enables the surgeon to maximize the resection while not risking critical structures.”

– Dr. Babacar Cisse

“We safely resected close to 98 percent of the tumor,” says Dr. Cisse. “Part of the problem with these tumors is that when they infiltrate, they can grow beyond what is seen on MRI or ultrasound. You want to have a very good margin. In Nkiru’s case, we were limited when we discovered we were within less than five millimeters from her cortical spinal tract.”

Ms. Amaefuna and her family are presently in New York while she undergoes chemotherapy and radiation. “Initially, I could barely have a serious conversation and I was having memory problems,” she says. “Now it’s getting a lot better.”

Ms. Amaefuna says she is grateful that she received treatment at NewYork-Presbyterian. “I couldn’t have imagined having it anywhere else. After surgery, I read online how some people recover from this treatment, their complications and the rest. I realized that mine was very smooth.”



On August 1, 2016, just six weeks away from delivering her second child, Katarzyna Chomiak developed a severe headache. “It was Sunday and we were relaxing,” recalls Mrs. Chomiak, 41. “I told my husband Peter something was going wrong. I had migraines sometimes, but never this bad. And I started seeing lights and began to vomit.”

As his wife got dressed, Mr. Chomiak quickly texted Joshua B. Holden, MD, her obstetrician at NewYork-Presbyterian/Columbia University Medical Center, who directed the couple to get to Columbia as soon as possible. “At the hospital, I was given something for the pain, which was still enormous,” says Mrs. Chomiak, who was then sent for testing.

“An MRI showed no evidence of an aneurysm, and the neurological team initially thought that this was a cortical vein thrombosis with a hemorrhagic conversion of the stroke in the right frontal lobe,” says E. Sander Connolly, Jr., MD, Surgical Director of the Neuro-Intensive Care Unit at NewYork-Presbyterian/Columbia. “However, because of the atypical appearance of that finding, the neuro team persisted with imaging. A repeat MRI on August 4 showed extensive bleeding and a possible aneurysm on the right middle cerebral artery. So, what had

initially been seen as negative for an aneurysm turned out to be positive for an aneurysm, and the whole workup took off. There is a lesson here that when things don’t quite make sense, you should keep looking and make them make sense.”

That same day, Alexander M. Friedman, MD, MPH, a Columbia maternal and fetal medicine specialist, joined Mrs. Chomiak’s healthcare team. “Our plan was to deliver the baby by caesarean section the day after her neurosurgical intervention,” says Dr. Friedman. “This was definitely an unusual scenario. Close communication among the neonatologists, neurologists, neurosurgeon, and anesthesiologist was critical in determining when it would be safe for her baby to be delivered. Having everyone on board and able to vocalize their concerns would be necessary to have a safe delivery, both for the mom and her baby.”

On August 5, Philip M. Meyers, MD, Clinical Director of the Neuroendovascular Service at NewYork-Presbyterian/Columbia, performed a preoperative angiogram that confirmed a subarachnoid hemorrhage and an intraventricular hemorrhage caused by a ruptured brain aneurysm. Mrs. Chomiak was immediately sent to the operating room where Dr. Connolly performed microsurgical clipping of the aneurysm.



Dr. E. Sander Connolly, Jr.

“The location and anatomy of this type of aneurysm is almost always better for microsurgical repair,” says Dr. Connolly. Over his 20-year career, he has seen this condition occur several times in patients in the last trimester of pregnancy. “The highest concern is the life of the mother. Usually the babies tolerate the general anesthesia for the repair just fine as long as the mother is supine and the obstetric team helps to position her so that there is no weight on the vena cava. They also closely monitor the baby throughout the procedure.”

### Concern for Vasospasm

After an aneurysm is repaired, notes Dr. Connolly, patients can experience some degree of arterial vasospasm. “The blood that has been already spilled irritates the brain’s blood vessels,” he says. “Between four to 21 days after the bleed there is a period where the vessels squeeze down. It happens in about 90 percent of patients, but it’s not symptomatic in every patient and only in a minority does it lead to stroke. Vasospasm is generally treated with volume expansion, which a pregnant woman can easily tolerate. However, induced hypertension can cause vasoconstriction in the periphery and one of those arterial beds is the placenta, so it is a difficult balancing act.”

The neurosurgical team reasoned that if medications were ineffective, Dr. Meyers would be able to administer vasodilating medicine directly into the brain through angioplasty. “Vasodilating medicines have a short period of activity and are not a long-term solution and angioplasty can only reach certain areas,” says Dr. Connolly. “The situation was not without concern, however, in Mrs. Chomiak’s case, we all felt that the baby was old enough and lung maturity was good so that it was safe to proceed with the C-section.”

“After we decided with Dr. Friedman to have the caesarean, it was a very emotional moment for my husband and me,” says Mrs. Chomiak. “I think we realized how serious it could be.” On August 6, their daughter, Victoria, was delivered with no complications by Dr. Friedman and Cassandra Duffy, MD.

Throughout their ordeal, the Chomiaks received support through texts, emails, and phone calls from family and friends, here and in their native Poland. “We got such peace and strength that we were not worried,” says Mr. Chomiak. “We knew that the doctors were great and that Dr. Connolly is one of the best. We also knew we were at the right hospital at the right time with good and dedicated people in whom we had a lot of faith. We can’t thank them enough.”

According to the Brain Aneurysm Foundation, there is a 40 percent chance that a ruptured aneurysm will be fatal, and of those individuals who survive, 66 percent will likely suffer some permanent neurological deficit.

“Mrs. Chomiak is alive today and living a completely normal life without any neurological deficits, thanks to the seamless collaboration of our obstetrics team and neurological and neurosurgical specialists,” says Dr. Connolly. And now 15 months old, Victoria is an active, healthy toddler.



Alan Lichtenstein is trim, exercises frequently, eats well, and had no inkling that he was having a stroke. However, the events leading up to his stroke have since provided some clues. Prior to that day, Mr. Lichtenstein had developed a mild case of shingles, and on May 17, 2017, respiratory problems sent him to his primary care doctor. “A cardiologist

who was brought in diagnosed me with severe pericarditis,” says Mr. Lichtenstein, a manager of musical artists who lives with his wife and two sons in Manhattan. “A week later, I was home and managing the pericarditis. I was feeling better and had been invited to a Mets game. It was about 4 pm.”

## The First Stroke

Suddenly Mr. Lichtenstein felt dizzy and noticed he was having trouble navigating his mouse at the computer. He remembers dropping his phone in the kitchen and thinking that was odd. “I didn’t feel right and thought this was all related to the pericarditis. When you’re dealing with one thing you don’t think it’s anything else.”

When Mr. Lichtenstein couldn’t figure out how to use his phone, he called to his son Ethan for help. Ethan called his mother who immediately dialed 911. The NewYork-Presbyterian Mobile Stroke Treatment Unit (MSTU), on call this day at NewYork-Presbyterian/Weill Cornell Medical Center, responded, arriving at 4:30 pm.

Launched in 2016, the MSTU brings a neurologist and the advanced capabilities of an emergency department directly to the patient, providing neurological care that can be performed on the way to the ED. Developed in collaboration with the Fire Department of New York, the program is the first of its kind on the East Coast.

“I was riding in the ambulance along with a nurse and CT tech,” says Alexander E. Merkler, MD, a neurologist at Weill Cornell. “Mr. Lichtenstein’s exam was consistent with a probable stroke as he had both difficulty speaking and difficulty understanding what I was saying. On the way to the hospital, we scanned his head. The CT did not show any blood, so I administered IV tPA, the ‘clot buster,’ and he started to improve. By the time

we reached Weill Cornell, he only had some minor difficulty speaking.”

## The Second Stroke

Four hours later in the ICU, however, Mr. Lichtenstein’s condition deteriorated rapidly. “I remember thinking that my vision on the right side was awfully strange. I went to put my hand up and my arm was going limp. Clearly, I was taking a turn for the worse,” he says.

A rescan indicated a piece of clot had lodged in one of the arteries in his brain. The neuro team then paged Athos Patsalides, MD, MPH, an interventional neuroradiologist at Weill Cornell, who was on call

that evening. “I was having dinner with my team when we got the call,” says Dr. Patsalides. “We started to review the patient’s images on our phones as we hopped in a cab. We arrived at the hospital about 15 minutes later.”

Mr. Lichtenstein was taken to the interventional neuroradiology suite where Dr. Patsalides and his team were waiting. “The clot was more distal than we typically see and treat. But this was a young patient at risk for severe disability if we hadn’t intervened,” explains Dr. Patsalides. “Given the patient’s cardiac history, we believe he had a second event and that the clot had formed in the heart and moved to the brain.”

Dr. Patsalides performed a thrombectomy, inserting a tiny catheter with a stent retriever into the small artery of his brain. “We witnessed what’s called the ‘Lazarus effect,’” says Dr. Patsalides. “Thirty seconds after we pulled out the clot, I turned and asked the patient his name. He told me his name. I asked him how he was feeling. He told me he was feeling great. We started to have a conversation and about two minutes later he was completely normal. His arm was strong and his speech was intact. Within seconds, he went from being half-paralyzed and aphasic to where it was as if nothing had ever happened. It was very gratifying.”

“This is a remarkable story for two reasons,” adds Dr. Patsalides. “One is that he suffered two strokes in one day. But Mr. Lichtenstein was also very fortunate because the first stroke was successfully treated by the quick intervention of the Mobile Stroke Treatment Unit. And the second stroke occurred in a hospital with interventional neuro-radiology capabilities and a team of experts available to respond and proceed to surgery within 30 minutes of being called.”

“Time is of the essence, and that’s the beauty of the mobile stroke team,” says Mr. Lichtenstein. “They are able to give the immediate attention that can make the difference between someone like me who ends up in great shape versus those who may spend the rest of their lives in a wheelchair. The most important thing that I can do now is to raise awareness of what a stroke is and how important it is to deal with it in a timely fashion.”



Dr. Alexander E. Merkler



Dr. Athos Patsalides



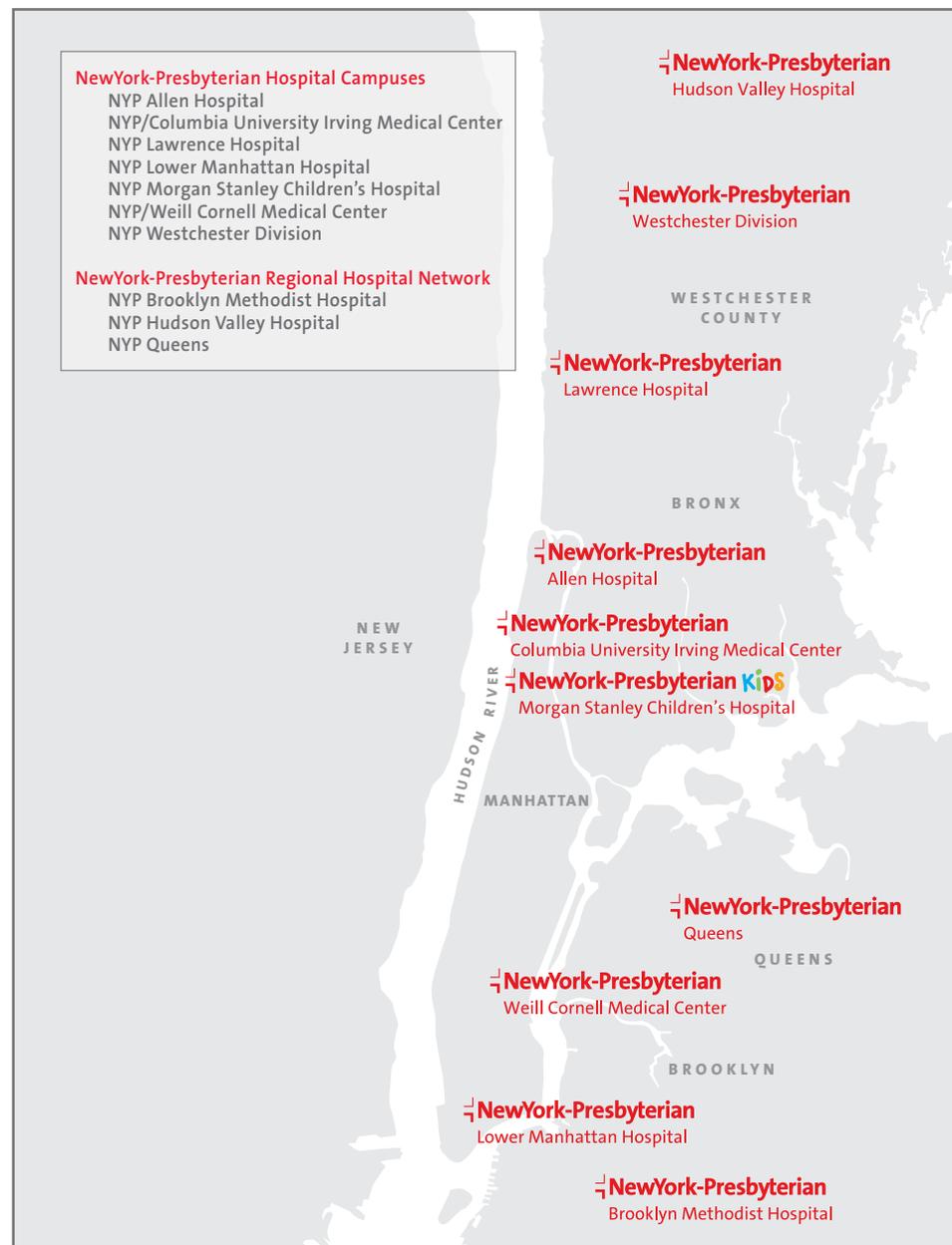
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