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Patient Care • Teaching • Research

Neuromag® magnetoencephalography (MEG) allows unique view of brain activity

by Robert J. Sclabassi, MD, PhD
Professor of Neurological Surgery

A state-of-the-art neuromagnetic recording system, the Neuromag®, has been installed at the Department of Neurological Surgery, in conjunction with the University of Pittsburgh Medical Center (UPMC). Manufactured by Elekta—in collaboration with Helsinki Technical University—this system is capable of non-invasively recording magnetic fields produced by neuronal activity occurring within the brain. This observed data is called the magnetoencephalogram (MEG) and is analogous to the electroencephalogram (EEG) but represents the magnetic fields produced by ion flow associated with neuronal activity rather than the electric potentials measured in the EEG.

What MEG offers...

- **A direct measure of brain function.** Other brain functional imaging techniques such as fMRI, PET and SPECT are secondary measures of brain function reflecting brain metabolism.
- **A very high temporal resolution device.** Events with time scales on the order of msecs can be resolved, differentiating MEG from fMRI, PET and SPECT, which have much longer time scales.
- **Excellent spatial resolution and accuracy.** Sources can be localized with an accuracy of millimeters.
- **Completely non-invasive.** Injection of isotopes or exposure to X-rays or magnetic fields is not required. Children and infants can be studied and repeated tests done.

This system is designed to 1) enhance pre-surgical planning by non-invasively localizing eloquent areas within the brain, 2) enhance localization of seizure foci by mapping sources of spiking activity, and 3) assess distributions of brain activity related to cognitive function.

Magnetic fields are found whenever there is charge flow (current), whether in a wire or neuronal tissue. The illustration on page 4 demonstrates the basic principles of MEG where magnetic fields are produced by the ion flow associated with synaptic activity of groups of neurons. The orientation of the magnetic field is governed by the right hand rule which essentially constrains the MEG system to sensing magnetic fields produced by groups of neurons located tangentially to the cortical surface.

The magnetic field passes unaffected through brain tissues and the skull, so it can be recorded outside the head by the Neuromag system.

The Neuromag system installed at UPMC contains 306 superconducting sensors mounted within a low temperature container (called a dewar) shaped to allow the head to be placed adjacent to the sensors. Thus 306 separate recordings of magnetic activity may be simultaneously made. The spatial distributions of the magnetic fields sensed by n these sensors are then computationally analyzed to localize the sources of the activity within the brain.

The most frequently used computational model is that of a current dipole. The computed locations of the sources are than superimposed on anatomical images, such as MRIs or CTs, to provide information about the relationship between structure and function in the brain. Not all studies require the merging of anatomical and MEG data to be useful. For example, predictive information about recovery from brain concussions may be obtained without merging the data.

MEG Laboratory

With MEG, signals are extremely small, on the order of 10^{-14} Tesla, which are several orders of magnitude smaller than other signals in the environment. These stray magnetic signals can obscure the brain signals even with signal processing. Thus, the Neuromag system is installed in a specialized magnetically shielded room (MSR) to eliminate the magnetic interference.

The electronics system necessary for recording the magnetic activity from a patient are located outside the MSR. These systems include the MEG amplification and data-acquisition system, a 128 channel EEG recording system, and electrical, visual and auditory stimulation system controllers.

Also located outside the MSR is the computer console used to perform a study and the various computer workstations for analyzing the data.

*(see **MEG** on page 4)*

MEG unit with chair option.

CHAIRMAN'S LETTER

Annals of malpractice observations from 2005

The medical litigation era continues to evolve in Pennsylvania, and during the past calendar year, I have been able to participate in several ways in this challenging environment.

First, I successfully defended myself from a claim brought more than five years ago by a patient who had been cured of a highly aggressive tumor. Recently, I have participated in a trial in Minnesota for the defense against a prominent academic medical center. Thirdly, I have served as the only other physician member of the Tri-Century Malpractice Company of UPMC. I would like to provide you with a few observations as I look back on this past year.

Observation One

Physicians must aggressively defend themselves before and during medical litigation proceedings. There are many excellent defense attorneys, and unfortunately some very successful plaintiff's attorney. Attorneys know the law, but they do not know medicine. Physicians who are unwilling to work aggressively with their legal representation to define the issues, to select appropriate expert witnesses, and to guide the proceedings on their own behalf as well as that of the hospitals where they work, are doomed to lose. Medical litigation is not going away. Certainly medical injuries occur, but successful prosecution of a malpractice claim requires physician negligence and harm suffered by the patient. In Pennsylvania, a physician of your own "specialty" must provide an affidavit that there is ample concern relative to an event not meeting the standard of care. In my case, the expert witness was a pediatric hematologist, not a neurosurgeon. The expert witness requirement "within your own specialty" is widely and wildly ignored by both the plaintiff's attorneys and the court. Many of the aspects of a legal proceeding bring new frustrations, and bewilderment to neurosurgeons not accustomed to spending days in a courtroom. The proceedings are slow, tedious, contentious, largely irrelevant, and full of tricks. I was amazed that a plaintiff's attorney could take my academic writings from peer-reviewed journals, selectively misquote them, and try to turn them against me as a defendant. The plaintiff's expert witness, an unknown who had written nothing, appeared to have his word taken at face value as if he were really an "expert." I won my case, but I spent weeks of time preparing for this with my lawyers, reviewing data, references, and trying to understand the nature of this patient's complaint. Before the jury announced its verdict (11 to 1 in favor of the defendant), I had the feeling that it was really a crapshoot. I did not think there were any winners at the outcome, and certainly the hours that I had to spend in preparation for this case would have been better served in the care of many other patients. The moral of the story is "aggressively pursue your own defense."

Observation Two

Our department has worked aggressively with UPMC to develop informed consent protocols for a number of high volume surgical procedures including spine, image-guided neurosurgery, and spinal cord stimulation cases. The goal is to provide additional documentation of a full discussion of risks and benefits with patients and their families. Will it help? Only time will tell, since many years elapse between the introduction of such an approach and the ability to look back and see whether it has reduced the number of complaints related to "failure of informed consent." Our department every quarter monitors new suit filings and the status of on-going suits (which often take many years to resolve). We want to be able to identify expert witnesses, review cases

*(see **malpractice** on page 6)*

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Editor: Douglas Kondziolka, MD • **Production Editor:** Paul Stanick
Phone and Patient Referral Information: (412) 647-3685 • **e-mail:** neuroinfo@upmc.edu

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A world outside of residency

Rotation at CURE Hospital in Uganda provides resident with a different perspective on learning

by Pedro Aguilar, MD
Neurological Surgery 6th-Year Resident

There is a world outside of a neurosurgery residency. I've always been curious as to what that world looked like. That's why when an attending approached me in the fall of 2004 and offered me an opportunity to spend a neurosurgical rotation in Uganda, I took a deep breath. Okay, enough talking.

The rotation would take place at the CURE Hospital in Mbale. With an interest in pediatric neurosurgery for the past few years, the trip made sense. I would be training under the supervision of Ben Warf, MD. An extraordinary human being in his own right, Dr. Warf has pioneered the endoscopic third ventriculostomy (ETV) as a treatment for all types of childhood hydrocephalus.

With the rotation set for July of 2005 and my wedding scheduled a few months later in October, I was initially very uneasy on traveling alone to Uganda. And while my fiancé's support of me made the trip possible, I could tell it weighed heavily on her mind.

Was a neurosurgical rotation half-way around the world worth the risk? It didn't take long before we began picturing worse case scenarios of myself sweating out yet another malaria-induced fever surrounded by a mob of angry American-hating Ugandans. That was my perception of Uganda on the evening of June 30, 2005.

The reality of Uganda, however, was very different. Nothing could have prepared me for those first few days in the country.

My eyes slowly acclimated to the bright, blue sky whose equatorial clouds appeared to be within an arms length grasp. Smells of burnt fields and sounds of all kind of roaming cattle filled the air. Topographically speaking, aside from residing on the planet Earth, Pennsylvania and Uganda had nothing in common.

In a month, I was involved in 35 cases. The great majority were ETVs and ventriculoperitoneal shunts, with a handful of myelomengoceles. For a resident in training, the anatomical exercise of locating the space between the basilar artery and dorsum sella within an infant's brain, ravaged by infection was, itself, worth the trip. I had never seen pus line septal veins nor had I seen choroid plexus matted down with scar.

In the states, informed consent can be a challenge with any patient. Try consenting a non-English speaking Ugandan.

First, get the language straight. Your interpreter starts speaking phrases in one of the seven languages he or she knows until he or she hits the right one. Failure to connect results from the patient belonging to one of the other 7-10 tribes he didn't cover. Think of that the next time you pat yourself on the back for remembering the French you picked up in twelfth grade.

Once you've got the language dilemma solved, try to explain to a mother why her child's head won't stop growing and what you're planning to do during an endoscopic third ventriculostomy. One of the challenges in our field is translating the science of medicine to our particular patient. I soon saw how for granted I'd taken my ability to communicate with patients in the states.

My fondest memory in Uganda was our drive north to the town of Lira. A satellite clinic had just opened adjacent to one of the refugee camps (Internally Displaced Camps or IDC to be more specific.) My resident's view on clinic changed dramatically when surrounded by displaced Sudanese/Northern Ugandan families, many being seen by a physician for the first time.

After clinic, our team was invited to tour the camp. This was not the camp I had envisioned. Children laughing, smiling, enamored with the digital camera, always asking for another picture. I walked alongside parents showing me their camp with the pride of new homeowners. No begging, no complaining, no tears, just gratitude.

Was a neurosurgical rotation half way around the world worth it? Absolutely. Worth all of the risk had the risk been doubled. Aside from the surgical experience, I took home a different global perspective. I glimpsed a people whose shear will to survive is as real as their peril. I learned that, for as different as Uganda is, the fundamental relationship between a doctor and his or her patient crosses all borders and oceans.

So if you're a neurosurgery resident and you find yourself bogged down...if you can't see the tunnel let alone the light at the end of it...if you are curious with how neurosurgery works around the world, please don't take my word for it. Go to a globe, spin it a few times and stop it with one finger. That's how your own journey may very well begin. •

MEG unit available at UPMC Presbyterian

State-of-the-art magnetoencephalography allows unique view of brain's neuronal activity

(continued from page 1)

Housed in the MSR is the MEG sensor, which is comprised of an array of detector coils cooled with liquid helium (-269° C) and contained within an insulating dewar . All devices and materials within the dewar must be non-magnetic and must not produce magnetic fields that can interfere with the recordings.

The interior of the MSR is lit and has a quiet, soothing atmosphere. During an MEG study, the patient is comfortably positioned within the MSR on a patient support system, in either a seated or supine position. While in the MSR, the patient is monitored by closed circuit monitor and intercom at all times.

For most clinical studies, the support system is configured as a bed, and the patient lies on the bed in a supine position. The sensor is rotated into position such that the detector array surrounds the patient's head. A head and neck support further insures patient comfort.

Stimulators

A comprehensive array of highly effective stimulus components are available for visual, auditory, and somatosensory stimulation. These stimulus devices are non-magnetic, thus do not interfere with the extremely sensitive magnetic measurements of MEG. Complex stimulus patterns may be generated to support both clinical and research studies.

The magnetically-silent visual stimulus delivery system consist of a high-performance commercial projector capable of projecting high-resolution images through an opening in the MSR wall, thereby eliminating electromagnetic interference. The image can be viewed from either the seated or supine position.

A non-magnetic auditory amplification and stimulus delivery system is provided by way of an amplifier, attenuator and electromechanical transducer located outside the MSR. The non-magnetic somatosensory stimulator applies tactile stimuli through electrical stimulation. The timing of the stimuli can be controlled through either external or internal timing signals. Four stimulus-output channels are provided, and can be activated either individually or in pairs.

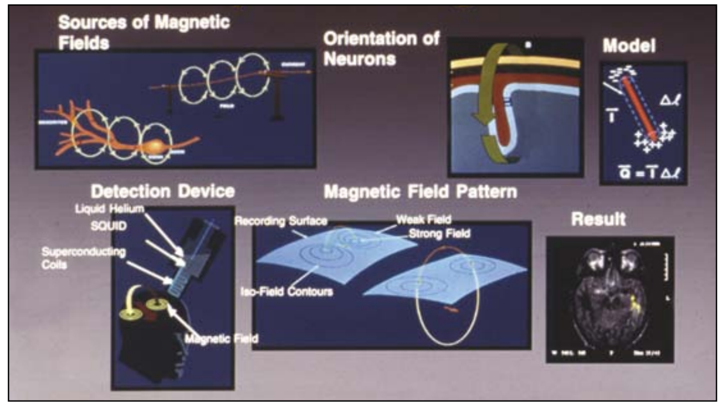

Illustration courtesy of Gary Carter.

Head Localization

During the MEG examination marker coils are placed on the patient's head to record the position of the head during the exam. The nasion and the pre-auricular points are marked for identification during the digitization process. This information is later used to register the MEG source localization with the patient's MRI.

EEG electrodes are also attached for epilepsy studies or to monitor heart rate, eye blinks or EMG. The location of the coils (and EEG electrodes if desired) are digitized. The process defines the head frame of reference. Then the shape of the patient's head is digitized for the localization process.

The patient is then placed in the MEG system and made comfortable. Staff can monitor the patient via an intercom system and video monitor. During this completely painless and non-invasive exam the staff can view the real time MEG data long with the EEG data. A somatosensory, visual or auditory mapping study takes about an hour and a half to complete and an epilepsy exam about two to three hours. Once the study is completed, all of the coils are removed and the patient can leave with no restrictions. MEG source localizations are then overlaid onto the patient's MRI and a report is generated for the referring physician.

For more information on the Neuromag,
or to schedule an appointment,
call (412) 647-3450 •

(below), Chief neurotechnologist, Anna Haridis, attends to patient in MEG supine setup; (right) Physician analyzes data obtained continuously from MEG. Shown on left screen is raw data, analysis control screen and topographic maps of activity. Shown on right screen are MRI scans on which MEG results are superimposed.

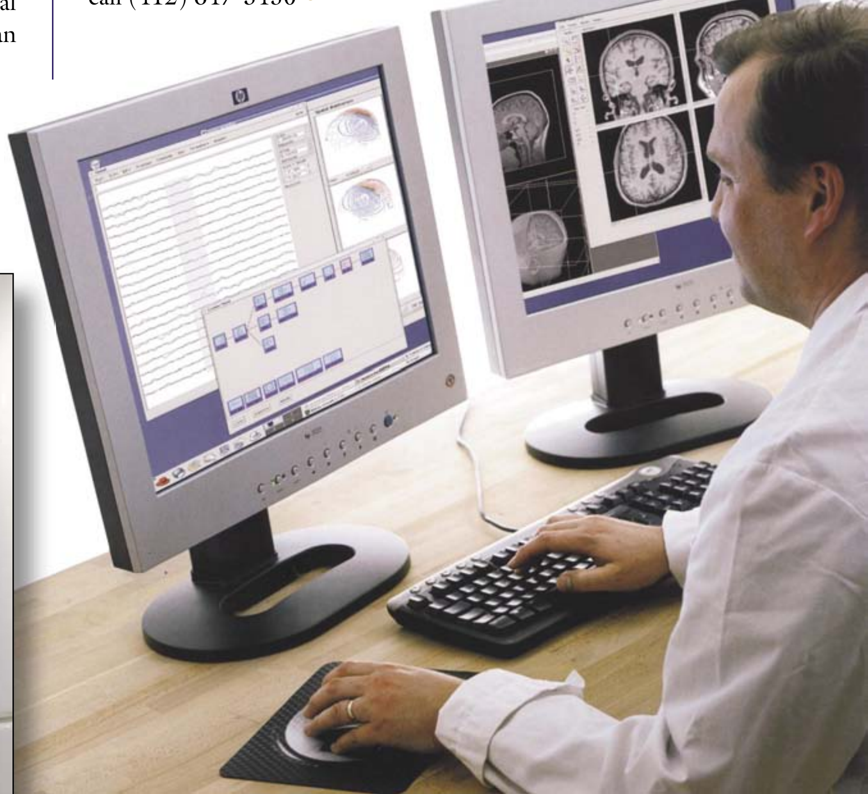

Photo courtesy of Elekta Instruments.

First known transnasal aneurysm trapping and aneurysmorraphy performed

by Arlan Mintz, MD
Assistant Professor of Neurological Surgery

The Minimally Invasive endoNeurosurgery Center (MINC) at the University of Pittsburgh Medical Center continues to advance the field of endoscopic transnasal surgery. The new endoscopic operating room at UPMC Presbyterian has been operational for several months and has spawned several exciting new breakthroughs. This past November, a transnasal-endoscopically-treated aneurysm procedure was performed—a first to our knowledge.

A 51-year-old woman presented with progressive clumsiness and weakness as well as sensory alteration. A cerebral angiogram revealed a large right vertebral artery aneurysm (figure 1) that could be seen on the axial MRI compressing the medulla (figure 2). Michael Horowitz, MD, associate professor of neurological surgery, was able to trap this aneurysm endovascularly with GDC coils placed in the vertebral artery above and below the fusiform aneurysm. However, there were concerns about continued mass effect on the brainstem. To relieve this mass effect, a decompressive procedure was required. Direct surgical approaches to this region are surgically challenging skull base approaches.

Recent advances in endoscopic transnasal surgery at UPMC allowed Amin Kassam, MD, associate professor of neurological surgery, and Carl Snyderman, MD, associate professor of otolaryngology and neurological surgery—MINC co-directors—to approach the aneurysm transnasally via a transclival intradural route (figures 3, 4). Aneurysm clips were placed above and below the aneurysm to ensure there was no further filling (figure 5) and an aneurysmorraphy was completed to resect the thrombus and relieve the mass effect. Post-operative improvement in motor function, incoordination and sensory symptoms were noted. Post-operative CT scans and cervical flexion-extension views confirmed craniocervical stability.

The role of endoneurosurgery for the treatment of cerebrovascular diseases will likely augment currently available therapies and prove most valuable for lesions in the posterior fossa along the clivus that prove difficult for access via conventional techniques. •

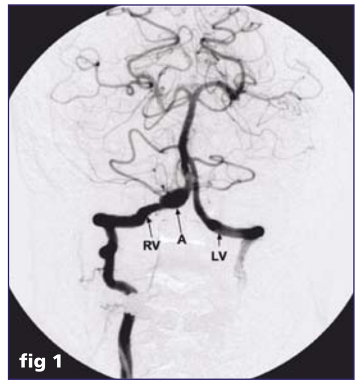

fig 1

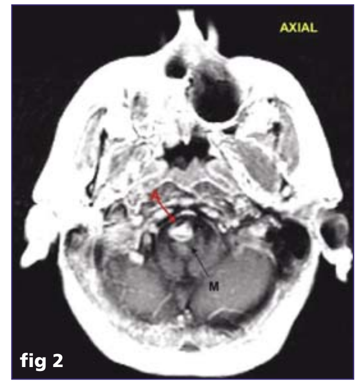

fig 2

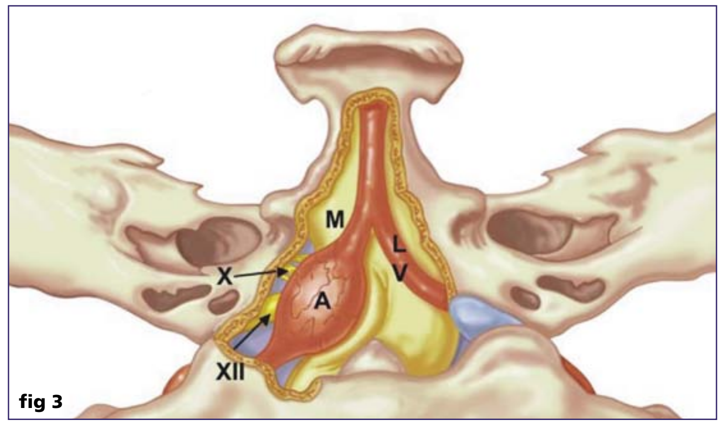

fig 3

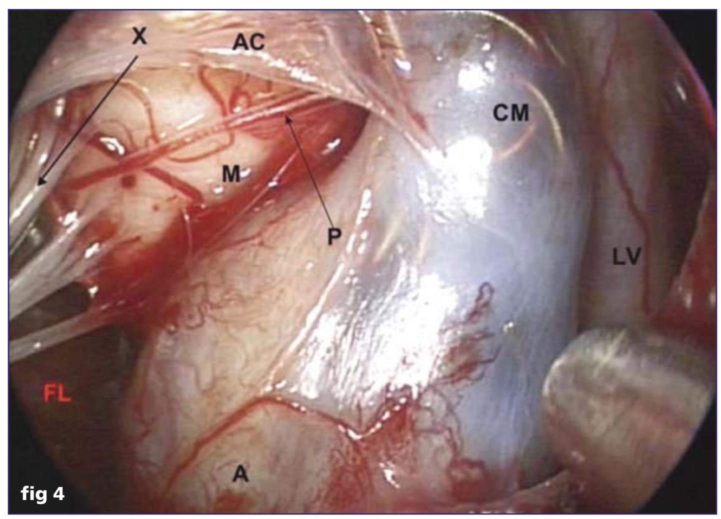

fig 4

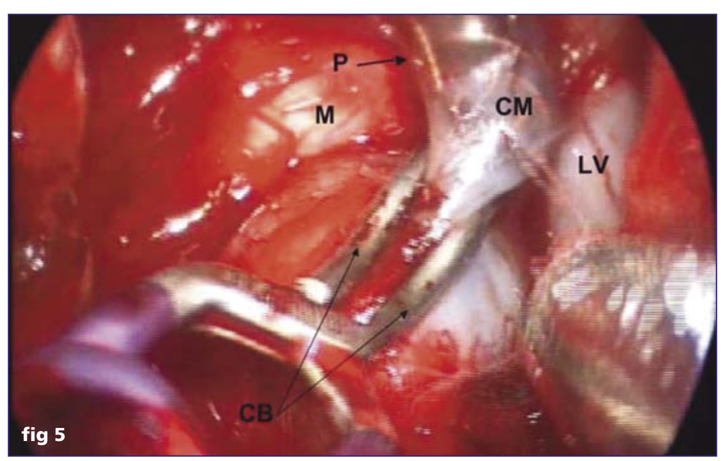

fig 5

Right: (*fig. 1*) Posterior circulation cerebral angiogram demonstrates a fusiform aneurysm (A) incorporating the right vertebral (RV) artery along its intradural course. The left vertebral artery (LV) is unaffected with excellent fill of the basilar artery; *(fig. 2*) Post contrast magnetic resonance imaging coronal and sagittal views demonstrating the thrombus within the aneurysm (A). Note the compression of the medulla (M); (fig. 3) Schematic view following opening of the dura. The intervening fusiform aneurysm (A) can be seen as the right vertebral artery enters the dura proximally and travels distally to meet the left vertebral artery (LV) forming the vertebrobasilar junction. The aneurysm compresses the medulla (M) and lies ventral to the to the origin of the vagus (X) and hypoglossal (XII) nerves that then course laterally directly deep to the aneurysm; (*fig. 4*) Intraoperative endoscopic endonasal view using a 45˚ scope. The distal right vertebral artery with the coil mass (CM) and the left vertebral artery (LV) travel distally to form the vertobrobasialar junction. The aneurysm can be seen compressing the underlying medulla. A small perforator (P) emerging from the distal right vertebral artery traveling across the medullary cistern (AC) can be seen. The origin of the vagus nerve (X) from the brainstem at the level of the outlet of the fourth ventricle and foramen Lushka (FL) are located along the lateral border of the aneurysm; (*fig. 5*) Intraoperative endoscopic endonasal view using a 45˚ scope to inspect the position of the distal clip blades. Note the perforator origin (P) is preserved and the right blade has completed occluded the distal ispsilateral VA while preserving the contralateral LV.

1st World Endoscopic Congress big success

The first World Congress of Endoscopic Surgery of the Brain, Skull and Spine this past fall proved an enormous success attracting 350 participants from over 30 countries. The three-day event, co-sponsored by the Department of Neurological Surgery's Minimally Invasive endoNeurosurgery Center, featured an international faculty of experts in neurosurgery, otolaryngology, plastic surgery and ophthalmology covering a wide variety of intracranial and spinal topics. Technology and education was the focus of the congress that also included hands-on booths provided by industry partners. Course co-directors for the congress were Drs. Carl Snyderman, Amin Kassam, Joseph Maroon, Ricardo Carrau and Richard Spiro. •

Photos courtesy of Donald Koch, UPMC Medical Media.

Recent donations to the department

(All amounts: Up to $1,000, except as noted.)

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• $25,000 to $50,000:
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Mr. Michael Patrick Vincent
Kwasi Yirenkyi, PhD

Malpractice observations

(continued from page 2)

or complaints early in the ball game and attempt to forestall future events. There is no question unfortunate events occur during the delivery of high technology health care to patients with complex neurological problems. Unfortunately in medicine, there are no warranties, and the risks are much greater. At the same time, our patient's expectations have continued to rise, as they now believe that they will be better and that there is no price to pay. By monitoring the new suit filings, and tracking the progress of on-going cases, we hope to expedite resolution of these cases. Recently, we had success in forcing a case to come to trial where a writ had been issued many years before. This case was successfully defended as well.

Observation Three

While the number of cases being filed and the complexity of the allegations continues to increase, the only bright light that I have seen over this year may be the pursuit of early mediation. This approach has been offered in selected cases by the outstanding legal group now housed internally at UPMC. Since there is full recognition that issues develop, outcomes can be affected and injuries may occur, the early recognition and confrontation of these issues may facilitate early settlement. An excellent group of mediators has been quite successful across the state in helping to settle cases early in their history, undoubtedly saving significant litigation and payment costs, and successfully getting rid of the potential for outlandish jury awards. I believe that early mediation may be the single positive event that may likely influence the quick resolution and equitable settlement of many malpractice allegations. Physicians must work aggressively with the defendant attorneys with the help of mediators to come to an early settlement. It is likely that this approach (which might unfortunately feed the filing of even more malpractice cases) may save money and yet provide a negotiated payment to those who may have suffered injuries. •

L. Dade Lunsford, MD
Lars Leksell Professor
Chairman, Department of Neurological Surgery

news & NOTES

Department Inaugurates Speakers Bureau

The University of Pittsburgh Department of Neurological Surgery is now offering a speakers bureau service for regional hospitals, physician groups and other organizations interested in keeping abreast with the latest advances and techniques in the field of neurological surgery.

This service will offer the background and insight of some the most talented and respected surgeons in their specialty. Our physicians and researchers are world-renown for their work in their field, with many pioneering unique and innovative approaches, treatments and studies. Their work has been widely published in many medical and technical journals and has been reported in numerous mainstream national media. The preeminence of their work has led many of our faculty to lecture around the world on their techniques and experiences.

Some of the speakers available for this service include **Drs. P. David Adelson, Peter Gerszten, Larry Jenkins, Amin Kassam, Douglas Kondziolka, L. Dade Lunsford, Michael Rutigliano, Richard Spiro, Kevin Walter** and **William Welch**.

Some of the topics available include acoustic neuroma, brain tumor, minimally invasive brain and spine surgery, neuro-oncology, spine reconstruction, traumatic brain injury, trigeminal neuralgia and many others.

For more information about this service, contact Paul Stanick at (412) 647-7931. This service is also available through the University of Pittsburgh's Center for Continuing Education. To schedule through this office, call Melinda Splane at (412) 647-8152. You can also arrange for one of our speakers through UPMC's Office of Physician Relations by calling (412) 647-7885.

Hadjipanayis Lecture Selected as Best at Inaugural Stuart Rowe Lectureship

Chief resident **Costas Hadjipanayis, MD, PhD**, received the best presentation award in the inaugural Department of Neurological Surgery Stuart Rowe Society Lectureship and Resident Research Day held on December 7. Hadjipanayis' presentation on DNA repair was one of 10 research lectures presented by department residents during the day honoring Stuart Niles Rowe, the department's first chairman and an early advocate of broad neurosurgical training.

The award was chosen and presented by the lectureship's honored guest, **Gary Steinberg, MD, PhD**, professor and chairman of Stanford University's Department of Neurological Surgery and co-director of the Stanford Brain Research Center. Steinberg, an acknowledged leader in the management of complex vascular malformations and cerebral aneurysms, also presented two talks during the day's activities.

The Stuart Rowe Society Lectureship and Resident Research Day is designed to showcase research activities in the field of neurological surgery and provide a forum for discussion—carrying on the principles first emphasized by Rowe. Rowe believed that neurosurgery training should not only teach exceptional technique, but also the critical clinical decision-making skills necessary to succeed. He preached the underlying need for thorough literature review and independent research as a means for broadening clinical knowledge.

The lectureship and research day is planned as an annual event with the next scheduled for December 2006.

New Research Grants

• "Impact of Housing Relocation Initiatives on Community-Level Violence." **Anthony Fabio, RD, MPH, PhD**, (Jackie Cohen, Carnegie Mellon University, principal investigator), Centers for Disease Control and Prevention ($1,055,738).

• "Steering Flexible Needles to Access Deep Brain Tumors for Resection." **Johnathan Engh, MD**, The Pittsburgh Foundation ($51,450).

Prominent Guest Lectures

• **Dr. Gerszten**, was the invited guest speaker of the 11th Brazilian Academy of Neurosurgery Congress in Brazil, November 5. He spoke on percutaneous discectomy procedures.

Announcements

• **Dr. Kondziolka**, was named recipient of the Peter J. Jannetta Chair in neurosurgery at the University of Pittsburgh.

• **Dr. Gerszten**, was elected to serve on the Phipps Conservatory and Botanical Gardens board of directors.

• **Eveline Shue**, won the American Brain Tumor Association (ABTA) Lucien J. Rubenstein Award for her project "Characterization of the Role of Plasmalemmal Vesicle Associated Protein 1 (PV-1) in Brain Tumor Angiogenesis." The Rubenstein Award is a national award presented annually to the best summer research project by a medical student in the field in neuro-oncology funded by the ABTA. Shue, a second-year University of Pittsburgh medical student, completed her project while working in the Molecular Biology Core Laboratory, directed by Eleanor Carson-Walter, PhD.

Promotion

• **Dr. Gerszten** was promoted to associate professor of neurological surgery.

New Employees

Paul Sullivan, physician assistant for Gamma Knife; **Nancy Schaffman**, neurophysiology secretary; **Dana Vanino**, research assistant for Dr. Adelson; **Patricia Williams**, nurse coordinator for Dr. Kassam; **Tracey Reed Armant, PhD**, health educator for CIRCL; **Christina Hughes**, Tri-State RN; **Diane Hester**, Tri-State RN; **Bethany Winans**, Molecular Biology Core Laboratory research assistant; **Sally Jarvela, MD**, Molecular Biology Core Laboratory research assistant; **Erin Sauber**, researcher for CIRCL.

Congratulations

• Baby girl (Isabelle Christine, November 28) to **Elizabeth Tyler-Kabara, MD, PhD**, and husband Joe.

• The staff of the Department of Neurological Surgery was recognized in November as an 'honor roll recipient' in UPMC's 'Above and Beyond' Awards. The awards recognize employees who exceed standards in the treatment of patients.

Upcoming Events

• March 13-17: **Principles and Practice of Gamma Knife Radiosurgery.** Additional course dates are May 15-19 and June 5-9. Contact Charlene Baker at (412) 647-7744 for more information.

• June 2-3: **Minimally Invasive Endoscopic Surgery of the Cranial Base and Pituitary Fossa Course**. Future course date is September 22-23. Contact Monique Critten at (412) 647-6358 for more information. •

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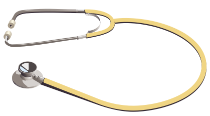
neurosurgerynews

Department of Neurological Surgery
University of Pittsburgh Medical Center
UPMC Presbyterian/Suite B-400
200 Lothrop Street
Pittsburgh, PA 15213
(412) 647-3685
neuroinfo@upmc.edu

www.neurosurgery.pitt.edu



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Brain stimulation study may help stroke survivors with use of arms and hands

by Frank Raczkiewicz
UPMC News Bureau Associate Director

Physicians at the University of Pittsburgh Medical Center are participating in a multicenter study that may help stroke survivors gain greater use of their arms and hands by electrically stimulating the brain during physical rehabilitation. Previous pilot studies have shown that such a combination is safe and enhances motor function to a greater degree than rehabilitation alone. The electrical stimulation is provided by the temporary surgical placement of an electrode on the covering of the brain.

"The most common neurological deficit among stroke survivors, and a substantial contributor to post-stroke disability, is motor weakness on one side of the body. Presently, the only treatment available for patients with such deficits is rehabilitative therapy. However, many patients are not responsive to standard therapy or they achieve a less than satisfactory improvement in function," said Douglas Kondziolka, MD, Peter J. Jannetta Professor of Neurological Surgery and vice chairman of education for the Department of Neurological Surgery.

Following a stroke, many patients show some spontaneous neurologic improvement. The brain's cerebral cortex, with its extensive network of interconnected neurons, is thought to be an important site for neuroplasticity. It is this area of the brain that will be stimulated during the study.

Participants in the study will have an electrode surgically placed on the membrane, called the dura, which covers the brain. A wire from the electrode will be tunneled under the skin to a stimulating device, which is about the size of a pacemaker that will be placed under the skin near the collarbone. The stimulator will be turned on just before the start of the daily rehab session and will be turned off when the rehab session is over. The stimulation should not interfere with the rehabilitation session by causing involuntary movement or a sensation perceived by the participant. The rehab portion of the study will be six weeks. The electrode and stimulator will be removed about eight weeks after the completion of the rehab period. Participants will be followed closely for improvements for six months and will be compared to a control group, which will undergo rehabilitation only.

Nationwide the study, which is called EVEREST, will enroll 174 participants. The study will include people age 21 years or older who have had an ischemic stroke at least four months prior to screening and suffered resulting weakness in one hand and/or arm. Participants will be randomized to either stimulation with rehabilitation or rehabilitation alone. It is sponsored by Northstar Neuroscience of Seattle, Washington, which developed the technology.

For additional information on the study, please call 412-647-4994. •