Progressive Neuroscience
A publication for physicians produced by the Institute for Neurosciences at Winthrop-University Hospital

- The Role of Glucose in Peripheral Nerve Injury
- Transcranial Doppler Ultrasound Important to Assessment of Cerebrovascular Disease
- The Use of Customized Cranioplasty after Major Stroke
To Our Colleagues:

The breadth and depth of sophisticated, multifaceted programs and services offered at Winthrop-University Hospital’s Institute for Neurosciences continue to expand.

Daily, our patients benefit from the very latest diagnostic technologies and techniques, as well as from the most current, innovative therapies.

And, daily, our multidisciplinary staff rigorously seeks and employs new ways to improve care, dedicated not only to meeting current standards of excellence, but also to establishing new and distinctive yardsticks of quality treatment in neurology and neurosurgery.

The current issue of Progressive Neuroscience reflects their notable, unending efforts with articles highlighting:

- Cutting-edge research into the role of glucose in peripheral nerve injury
- The impact of transcranial Doppler ultrasound on the diagnosis of cerebrovascular disease
- The use of customized cranioplasty after major stroke
- The management of cerebral vasospasm in the NeuroICU after stroke
- The use of neurostimulation to relieve chronic pelvic pain
- The effect of conflict and stress among healthcare workers on patient care

We consider it a privilege to treat the patients you refer to us and value our continuing partnership in their care.

Mark M. Stecker, MD, PhD
Chairman
Department of Neuroscience

Michael H. Brisman, MD
Chief
Division of Neurosurgery
Co-Director
Institute for Neurosciences
Glucose as a Toxin to Peripheral Nerve

Case Report
Customized Cranioplasty after Major Stroke

Inter-Provider Conflicts
and Stress in Healthcare Workers

Neurostimulation Can Relieve
Chronic Pelvic Pain

Managing Cerebral Vasospasm
in the NeuroICU

Transcranial Doppler Ultrasound
Important to Assessment
of Cerebrovascular Disease

Contributing Clinicians
Diabetes, which affects more than 370 million people, is associated with a host of comorbidities, including those involving the nervous system. Neuropathy, seen in up to 50% of diabetes patients, can lead to severe pain, injuries, problems with walking and poor wound healing.

Despite extensive research, the root cause of the nerve injury remains elusive. Additionally, no known therapy is known to prevent, reduce or improve the degree of nerve injury, except for improved glucose control. However, a recent review suggests that the effect of improved glucose control is moderate and may lead to other problems, such as hypoglycemia.

Because this problem is so significant, further study of the effect of glucose on the peripheral nerve is important. The critical question is: What determines the optimal range of glucose levels? For the brain, glucose below 40mg/dl is associated with altered mental status and seizures. Severe hyperglycemia (>400mg/dl) in the absence of ketoacidosis is also associated with seizures.

Because this problem is so significant, further study of the effect of glucose on the peripheral nerve is important.

Since it is known that patients develop neuropathy in diabetes, it is interesting to define the effect of glucose level on the peripheral nerve.

One means of quantifying this is through the study of the nerve action potential (NAP) in rat sciatic nerve in a perfusion apparatus as it is exposed to varying concentrations of glucose.
Changes in the NAP Over Time During an Experiment Involving Intermittent Anoxia

Figure 1 shows the perfusion apparatus that allows control of the temperature and oxygen concentration to which the nerve is exposed during continuous recording of the NAP.

Figure 2a shows the typical NAP waveform that is recorded. Figure 2b shows an example of the changes in the NAP during an experiment in which the nerve is made intermittently anoxic for 90-minute periods. It is clear that with the onset of anoxia, the amplitude of the NAP drops gradually, and latency increases. With re-oxygenation, the NAP begins to return toward baseline but generally has lower amplitude and increased latencies compared to the pre-anoxia NAP.

Figure 3a shows that the amplitude of the NAP declines over time in the fully oxygenated experiments at normal (100mg/dl) and high glucose (1000mg/dl). Figure 3b shows the NAP amplitude over time under the condition of intermittent anoxia.

Figure 4 shows the amplitude of the NAP at the end of an experiment as a function of glucose concentration for normal and anoxic conditions.

Clearly, solutions containing high glucose concentrations are associated with low amplitude NAPs when the nerve remains fully oxygenated, but the negative effects of hyperglycemia are much more evident in the setting of intermittent anoxia.

This is an important principle. Metabolic problems, such as hyperglycemia, may have completely different effects under different conditions. In the peripheral nervous system, this is seen with critical polyneuropathy, where patients develop multiple occlusions in the small blood vessels of the peripheral nervous system.

Ischemic lesions act very much like the anoxic injuries studied in the in vitro model. In particular, the degree of peripheral nerve injury is worse with higher glucose concentrations.5-8

Because it has been suggested that diabetic polyneuropathy may be related to anoxic vascular injury,9-11 this principle, or a variant, may be helpful in managing and preventing diabetic neuropathy, although we are currently lacking effective treatments.

For more information call the Institute for Neurosciences at 1-866NEURO-RX or visit www.winthrop.org.

REFERENCES
A young, very active athletic man presented in Winthrop-University Hospital with acute right-sided weakness and aphasia. CT and MRI scans showed a left middle cerebral artery (MCA) infarct, and a CT angiogram (CTA) revealed a possible left-sided internal carotid artery (ICA) dissection, which could not be recanalized.

The morning following admission, his mental status declined, he was increasingly sleepy, and he exhibited dense right-sided hemiparesis. Serial CTs showed an evolving infarct, with a 5mm midline shift. Given his brain edema and deteriorating condition, the patient was taken emergently to the operating room, where Lee Tessler, MD, Winthrop’s Chief of Neurotrauma, performed a 20cm x 13cm left decompressive hemicraniectomy and duroplasty to reduce the mounting intracranial pressure (ICP) and prevent secondary neurological injury.

With the patient under general anesthesia, the scalp was clipped, prepped and draped. A large trauma flap-type incision was made from the root of the left zygoma posteriorly and then anteriorly across the midline. After reflecting the temporalis muscle and skin flap anteriorly as a single flap, Dr. Tessler drilled multiple burr holes and the bone flap was elevated. “The brain showed small old petechial hemorrhages and was under pressure,” he reported. “A periosteal graft was harvested and sewn into place, allowing for a generous duraplasty.”

Postoperatively, the patient was transferred to the Hospital’s Neuroscience Intensive Care Unit, where he was monitored vigilantly. As the swelling decreased and his mental status improved, he grew more awake and alert until he could answer simple questions and follow commands. Serial CAT scans showed resolution of the shift and, as the ICP eased, the flap sank in.

While small cranial defects often heal naturally, larger ones, such as this one, require reconstructive surgery. One month later, the decision was made to perform a cranioplasty to...
reshape the irregularities in the patient’s skull — not only for aesthetic reasons, but also to minimize the psychological ramifications that can accompany living with a misshapen skull, and improve quality of life.

**Cranioplasty**

The use of cranioplasty to repair and reshape skull imperfections and irregularities dates back to 7000 BC, when crude inorganic materials were used; autologous bone was not used until the 19th Century.

An autologous implant requires using either the cranium bone removed during the craniectomy or harvesting grafts from other sites, such as the ribs, tibia and scapula.

“The major consideration when using the cranium is to keep the bone flap ‘alive’ during the waiting period,” Dr. Tessler said. “We can preserve it within the abdomen, but this process has some drawbacks. The bone can erode into the peritoneum and cause infection. Its position in the abdomen can hamper physical therapy and it can be reabsorbed over time so that it doesn’t fit exactly when reimplanted.”

With large craniectomies, such as the one required by this patient, the use of synthetic cranial prostheses offers an excellent alternative to standard autologous implants. Biomedical advances have made available several materials, including titanium and high-performance polymer plastics, such as PEEK and PMMA. “However,” cautions Dr. Tessler, “there is still no perfect material for cranioplasty.”

**Ideally, the substance used to create an implant should:**

- Achieve complete closure of the cranial defect
- Be shapeable
- Be radiolucent
- Have low infection rates
- Show low heat conduction
- Be capable of supporting stresses and tensile strengths from the environment

**Customizing with CAD/CAM**

In addition to the development of synthetic materials, the advent of computer-assisted designed/computer-assisted modeled (CAD/CAM) technology and software has revolutionized cranioplasty, enabling Dr. Tessler and other specialists, such as Rachel Ruotolo, MD, a pediatric plastic and craniofacial surgeon, to utilize customized cranial prostheses fully engineered and meticulously manufactured to meet each patient’s specific anatomical requirements.

“We provide the manufacturer with data from the patient’s CT scans,” explained Dr. Ruotolo. “Then a computer-generated 3D model is created and sent electronically to the surgeon for modifications. Once approved by the surgeon, the prosthesis is milled out of a synthetic material on a computer-controlled machine, producing a product that is structurally, functionally and biologically compatible with the patient.”

In addition to the anatomical dimensions, design of the customized implant considers a wide range of distinctive patient features, such as weight, height, age, ethnicity, activity level, gender, body build and comorbidities (e.g. osteoporosis). The implant design includes geometric shape, thickness and the number and layout of the fixation points.

“A synthetic implant fits the contour of the skull exactly,” said Dr. Tessler. “And because we don’t need to harvest bone for the implant — as in autologous implantation — there’s no donor site, reducing the length of surgery and the possibility for complications.”

For this patient, a CAD/CAM 3D model of his skull was constructed from data provided by thin-slice CT scans, and the implant was manufactured of PMMA. In the OR, Dr. Tessler opened the craniectomy incision, finding no evidence of cerebrospinal fluid leak or dural breach. After copious bacitracin irrigation, he placed a perfectly fitting, customized cranial implant.

One week later, the patient was transferred to rehabilitation. Although he still had right-sided weakness, he was awake, alert, answering questions and following commands.

“The development of customized cranio-plasty has provided us with a very reproducible option for skull reconstruction,” said Dr. Ruotolo. “It is an easier, faster and safer procedure, with less morbidity. However, while it has streamlined the process and is predictable, not every patient is a candidate, and we must consider each situation on its own merits before deciding which route to take.”

For more information call the Institute for Neurosciences at 1-866NEURO-RX or visit www.winthrop.org.

**REFERENCES**

The relationship between stress and performance among healthcare workers is well documented in the literature.1-2 Studies involving professionals, such as nurses, interns and social workers, support the occurrence of negative effects of stress on job performance and job satisfaction.2-4 Many factors influence stress in the workplace, and stress reactions can encompass many psychological and physical manifestations, ranging from depression to exhaustion.3

Incivility, Stress & Patient Safety

Regulatory agencies, such as The Joint Commission (TJC) and the Institute of Medicine (IOM), as well as many clinical societies like the American Association of Critical Care Nurses (AACN) and the American College of Healthcare Executives (ACHE), have written policy statements denouncing disruptive behavior.5-8

The issue of disruptive behavior among healthcare workers has come to the forefront in creating a culture of safety.1,8 Studies have shown that disruptive behavior is behind a breakdown in communication that threatens the well-being of patients and results in medical errors.10

Although collegial relationships among healthcare providers are critical to promoting a healthy work environment and to supporting quality patient care and safety,11 many healthcare workers demonstrate abusive or disruptive behavior by yelling, making threatening gestures, using foul/abusive language and criticizing co-workers publicly.12 Several passive-aggressive behaviors, which may further detract from patient care, include intentional miscommunication, not answering pages or delays in doing so, and exhibiting impatience with questions.

Most Recent Study

In an effort to understand what affects disruptive behavior in the workplace a study was recently conducted to explore the relationship between incivility (disruptive behavior) and stress, and the effects of these phenomena on the work environment.13 This investigation also sought to determine if there were gender differences in behavior, and what, if any, effects this had on the work environment.

Methods

A survey was emailed to nursing and physician groups across the U.S., as well as through a pre-determined e-mail list. The actual survey was placed online (https://www.surveymonkey.com/s/sconflitsurvey). In addition, the American Association of Neurosciences Nurses (AANN) and the New York State Nurse Practitioner Association (NYSNPA) posted the survey on their websites. A total of 617 individuals responded.

This survey consisted of the Provider Conflict Questionnaire (PCQ) and the Perceived Stress Scale (PSS).14 The investigator-developed tool — the Provider Conflict Questionnaire (PCQ), which was in large part adapted with permission from the ACPE’s validated instrument 2009 Doctor-Nurse Behavior Survey — was used as one of the survey tools. Additional questions were included by the investigators and adapted from the previously validated PSS.

The survey asked demographic questions, such as gender, educational level and job title, as well as specific questions about behaviors among doctors and nurses at the respondents’ institutions. Some of the questions included how often an institution experienced behavior problems among doctors and nurses and what types. The survey also sought information regarding circumstances surrounding the disruptive behavior, (stress, provocation, etc.) and whether to the respondent’s knowledge, that behavior affected patient care.

Results

The results of the relevant questions and their effect on total stress levels are shown in Tables 1 and 2; Table 3 shows the results of the stress component of the survey for all respondents. Over 78% of respondents felt that work was

Table 1: Summary of results of the provider conflict survey and their effects on stress level. The first number in the stress level column is the mean stress level. The number in parenthesis is the standard deviation. The p value following the two letters in parentheses is that computed using a non-parametric statistic either Kruskal-Wallis (KW), or the Mann-Whitney U Test (MW).

<table>
<thead>
<tr>
<th>Question</th>
<th>% Responses</th>
<th>Stress Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is Your Gender?</td>
<td>(KW)=1.02, p=.38, (MW)=.60</td>
<td></td>
</tr>
<tr>
<td>a. Female</td>
<td>87.8%</td>
<td>29.5 (6.4)</td>
</tr>
<tr>
<td>b. Male</td>
<td>12.2%</td>
<td>22.8 (5.3)</td>
</tr>
<tr>
<td>2. What is Your Job Title?</td>
<td>(MW)=.60</td>
<td></td>
</tr>
<tr>
<td>a. Student</td>
<td>1.1%</td>
<td>30.5 (4.9)</td>
</tr>
<tr>
<td>b. Teaching Faculty</td>
<td>3.6%</td>
<td>24.2 (6.0)</td>
</tr>
<tr>
<td>c. Clinical Nurse Specialist</td>
<td>9.6%</td>
<td>26.1 (6.1)</td>
</tr>
<tr>
<td>d. Patient Care Assistant</td>
<td>6.3%</td>
<td>28.0</td>
</tr>
<tr>
<td>e. Nurse</td>
<td>45.0%</td>
<td>25.3 (6.4)</td>
</tr>
<tr>
<td>f. Midlevel Practitioner (NP/PA)</td>
<td>30.0%</td>
<td>25.4 (6.4)</td>
</tr>
<tr>
<td>g. Physician</td>
<td>4.9%</td>
<td>25.6 (6.2)</td>
</tr>
<tr>
<td>h. Administrator</td>
<td>5.5%</td>
<td>26.9 (6.4)</td>
</tr>
<tr>
<td>3. What is the highest level of education you have completed?</td>
<td>(MW)=.60</td>
<td></td>
</tr>
<tr>
<td>a. High School Education</td>
<td>2.3%</td>
<td>25.7 (6.4)</td>
</tr>
<tr>
<td>b. Bachelor’s Degree</td>
<td>37.1%</td>
<td>26.1 (6.2)</td>
</tr>
<tr>
<td>c. Master’s Degree</td>
<td>49.0%</td>
<td>25.5 (6.0)</td>
</tr>
<tr>
<td>d. Doctoral Degree</td>
<td>11.8%</td>
<td>24.4 (5.8)</td>
</tr>
<tr>
<td>4. What is your practice setting?</td>
<td>(MW)=.53</td>
<td></td>
</tr>
<tr>
<td>a. Operating Room</td>
<td>9.5%</td>
<td>24.6 (6.1)</td>
</tr>
<tr>
<td>b. Intensive Care Unit</td>
<td>30.2%</td>
<td>26.3 (6.3)</td>
</tr>
<tr>
<td>c. Emergency Room</td>
<td>2.8%</td>
<td>23.5 (7.0)</td>
</tr>
<tr>
<td>d. Floor</td>
<td>25.3%</td>
<td>25.4 (6.2)</td>
</tr>
<tr>
<td>d. Other</td>
<td>31.1%</td>
<td>25.5 (6.2)</td>
</tr>
<tr>
<td>5. If you answered Hospital to the above question what is your practice setting within the hospital?</td>
<td>(MW)=.53</td>
<td></td>
</tr>
<tr>
<td>a. School</td>
<td>2.3%</td>
<td>26.4 (6.8)</td>
</tr>
<tr>
<td>b. Hospital</td>
<td>84.2%</td>
<td>25.5 (6.5)</td>
</tr>
<tr>
<td>c. Private Practice</td>
<td>13.5%</td>
<td>25.9 (5.8)</td>
</tr>
<tr>
<td>6. Does your Organization ever experience disruptive behavior between providers?</td>
<td>(MW)=.53</td>
<td></td>
</tr>
<tr>
<td>a. Yes</td>
<td>82.0%</td>
<td>25.9 (6.3)</td>
</tr>
<tr>
<td>b. No</td>
<td>18.0%</td>
<td>22.9 (6.2)</td>
</tr>
<tr>
<td>7. Have you personally ever witnessed disruptive behavior between providers?</td>
<td>(KW)=.000, (MW)=.003</td>
<td></td>
</tr>
<tr>
<td>a. Yes</td>
<td>74.2%</td>
<td>26.0 (6.4)</td>
</tr>
<tr>
<td>b. No</td>
<td>25.8%</td>
<td>23.9 (6.2)</td>
</tr>
<tr>
<td>8. Have you personally been the object of Disruptive Behavior?</td>
<td>(MW)=.000</td>
<td></td>
</tr>
<tr>
<td>a. Yes</td>
<td>53.8%</td>
<td>26.7 (6.4)</td>
</tr>
<tr>
<td>b. No</td>
<td>46.2%</td>
<td>24.1 (6.1)</td>
</tr>
</tbody>
</table>

1. Over the last 2 years, how would you characterize how the disruptive behavior between providers at your organization has changed over time? | (MW)=.000 | | |
| a. More Problems between Doctors and Nurses | 11.2% | 28.2 (7.5) |
| b. Less Problems between Doctors and Nurses | 41.3% | 24.5 (6.0) |
| c. About the same number of problems between Doctors and Nurses | 47.5% | 26.0 (6.3) |

Table 2: Additional information from the provider conflict questionnaire and the overall stress levels as a function of the answer to each question. The p value following the two letters in parentheses is that computed using a non-parametric statistic, either the Kruskal-Wallis test (KW), or the Mann-Whitney U Test (MW).
the survey for all respondents. Over 78% of respondents felt that work was the main source of stress in their lives, and >21% felt that the most stress in their home environment. The overall stress index ranged between 10 and 48, with a mean value of 25.5 (+/-6.4).

Females had a significantly higher stress index than males. The job title (student, nurse, midlevel, physician, administrator, etc.) of the respondent had no statistically significant effect on the stress level. Similarly, education, practice location or area of practice in the hospital did not have a statistically significant effect on stress.

As in the 2013 study, this survey contained three measures of disruptive behavior. The first was whether the respondent was aware of disruptive behavior at an organizational level. The second was whether the respondent had witnessed disruptive behavior, and the third was whether the respondent had been the object of disruptive behavior. All three measures were strongly correlated with increased stress in this study. Stress levels were also significantly higher in institutions where there was an increasing incidence of disruptive behavior and where there was more frequent disruptive behavior. When disruptive behavior affected patient care, stress levels also increased (Table 2). The respondent’s awareness of policies and procedures for dealing with disruptive behavior had no effect on the level of stress in this univariate analysis.

**Conclusions**

A study determined that work is a significant source of stress for healthcare providers, and that stress directly affects many aspects of care provided by healthcare workers, including the possibility of being linked to the commission of medical errors.

Stress also affects job satisfaction, burnout and civility in the workplace. In our study, women exhibited a greater level of stress than men. However, results in the literature are mixed with respect to this finding. Finally, institutions that exhibited fewer incidents of disruptive behavior among providers also demonstrated reduced levels of stress. This particular association is important on a global level for healthcare institutions as they strive to reduce burnout and possibly the incidence of medical errors.

For more information call the Institute for Neurosciences at 1-866NEURO-RX or visit www.winthrop.org.
Neurostimulation Can Relieve Chronic Pelvic Pain

The management of patients with chronic pelvic pain can be challenging.

Pelvic pain can be attributed to damaged or dysfunctional pelvic nerves (pudendal, ilio-hypogastric, ilio-inguinal or genital-femoral). Chronic pain in the pelvic cavity, groin and perineal area is defined as enduring beyond three-to-six months without existing infection or other pathology.1

A wide range of conditions — including trauma, abdominal surgeries, hernia, endometriosis, uterine fibroids and diabetic neuropathy — are associated with this debilitating, ongoing condition, which occurs in men as well as women. However, the exact cause can be misunderstood and difficult to pinpoint.

Laboratory and imaging studies often do not expose the cause of chronic pelvic pain. However, according to Winthrop-University Hospital neurosurgeon Brian Snyder, MD, who has extensive experience in the use of neuromodulation for pain management, “these syndromes do seem to have nerve injury and neuropathic pain in common.”

**Symptoms, which can be steady or intermittent, include:**
- Steady burning/stabbing pain
- Pain while sitting that fades at standing
- Pain radiating to the external sexual organs, abdomen or lower back
- Pain during sexual intercourse
- Pain during urination and bowel movements

**First-line treatment covers a broad spectrum and includes:**
- Medications, such as NSAIDs, to control mild pain associated with pelvic joint instability, as well as endometriosis and uterine fibroids
- Antidepressants and anticonvulsants to handle pain associated with vulvodynia
- Opioids for severe, uncontrolled pain
- Physical therapy
- Surgery to correct anatomic abnormalities

**Neurostimulation**

In select cases, when relief of chronic pelvic pain relief remains elusive despite use of conventional therapies, neurostimulation may achieve positive results.

“While the exact mechanism of neurostimulation remains unclear, the process involves delivery of a regular, benign, perceptible electric stimulus to a sensory pathway, with the patient experiencing a feeling of buzzing or tingling,” explained Dr. Snyder.

“The goal of neurostimulation is to relieve pain by interrupting or blocking the activity of certain nerve pathways. In successful patients, the stimulus masks the pain, interfering with delivery of the pain message to the brain.”

There are several types of neurostimulation, including deep brain, spinal cord, peripheral nerve and sacral nerve.

“Neurostimulation provides an exciting and novel approach to the management of chronic pelvic pain in patients unable to obtain meaningful pain relief with conventional medical therapies. It is a safe, titratable and adjustable modality that offers relief and improves quality of life for many patients who have run out of options.” concluded Dr. Snyder.

**REFERENCES**

Intracranial vasconstriction following subarachnoid hemorrhage (SAH) is a major cause of morbidity and mortality. Known as cerebral vasospasm, the condition can impede or shut down blood flow and lead to ischemia — the most common cause of serious disability and death after aneurysmal SAH. Typically, the syndrome can appear as early as 3-4 days following an aneurysmal rupture, reaching peak incidence and severity at 7-12 days. While the exact mechanism is not well understood, cerebral vasospasm is triggered by the release of oxyhemoglobin (blood breakdown product) in the subarachnoid space; the process appears to be multifactorial, and even with maximal therapy, it can cause stroke and death.

Symptoms, Detection & Monitoring

Symptoms include intensifying headache, confusion, diminishing consciousness, increased urine output and focal neurological deficits. The term “cerebral vasospasm” includes “symptomatic” vasospasm, which is detected on physical examination and associated with obvious neurological deficits, as well as “angiographic” vasospasm, which is identified during a cerebral angiogram. Transcranial Doppler (TCD) ultrasonography is also a useful noninvasive method of detecting vasospasm. Early detection is vital, and in Winthrop-University Hospital’s NeuroICU, patients with SAH are continuously and meticulously monitored with frequent neurological evaluations, careful fluid-status analysis and management, and ongoing blood pressure (BP) screening.

Increase in blood-flow velocity, as well as a spontaneous rise in BP, can precede clinical cerebral vasospasm by 24 hours. A drop in brain-tissue oxygenation, as well as EEG changes, can also signal impending vasospasm by a few hours. Additionally, hourly urine output of 200cc-300cc can precede clinical vasospasm by 24 hours; this is called Cerebral Salt Wasting Syndrome.

Traditionally, central venous pressure (CVP) has been considered a reliable indicator of fluid responsiveness. However, recent studies have shown there is a very poor relationship between CVP and the prediction of hemodynamic response to a fluid challenge. In fact, “CVP should not be used to make clinical decisions regarding fluid management.” Based on such findings, one of the most advanced monitoring devices — CHEE-TAH NICOM® — is utilized at Winthrop. It is a noninvasive hemodynamic management system that does not measure CVP but helps assess fluid status and provides continuous hemodynamic monitoring.

Treatment

Treatment focuses on limiting the extent and severity of vasospasm, reducing ischemic complications and improving neurological outcome.

Vasospasm before and after angioplasty

Medical therapy shown to improve the outcome after SAH consists of orally administered nimodipine (60mg every four hours for 21 days). Additionally, the benefits of low-dose verapamil, administered intra-arterially as an adjunct therapy for cerebral vasospasm have also been noted.

In patients with a clear increase in TCD velocities — or in whom new neurological deficits develop — triple-H (hypertension, hypervolemia and hemodilution) therapy is initiated. The goals of this treatment approach include hematocrit of 30%, moderate increase in volume status, and enough artificially induced hypertension to prevent or reverse new neurologic deficits.

Such deficits are usually associated with the vascular territory of the vessel in spasm. They may be as subtle as a drop in level of arousal or as obvious as a new hemiparesis. In light of the risk of cardiac dysfunction stemming from triple-H therapy, catheter angiography is occasionally used to confirm the findings on TCD examination.

Patients refractory to medical treatment and with persistent new neurologic deficits, should undergo urgent catheter angiography to confirm the presence of vasospasm, followed by angioplasty of the narrowed vessels or intra-arterial administration of smooth-muscle relaxants such as papaverine. However, radiographic success does not always mean clinical improvement. Some studies report a 61%-70% rate of neurologic improvement, but others claim no benefit, when compared with triple-H therapy.

Recently, the impact of triple-H therapy has been questioned, and we have learned that only permissive hypertension and prevention of dehydration is effective. What’s more, hypervolemia is not effective, may cause pulmonary complications and has not been shown to improve cerebral blood flow.

Despite the fact that we still have a great deal to learn about what generates cerebral vasospasm, improved, aggressive management of patients with SAH by experts has markedly reduced disability and death attributed to the syndrome.

For more information call the Institute for Neurosciences at 1-866NEURO-RX or visit www.winthrop.org.

REFERENCES

Transcranial Doppler Ultrasound Important to Assessment of Cerebrovascular Disease

Transcranial Doppler (TCD) ultrasound, first used in the 1982, is now a widely available technique employed in various cerebrovascular conditions. Fundamental to the approach is the use of the Doppler principle.

Noninvasive, portable and inexpensive, this sensitive and specific technology has been well established as a valuable tool for detecting, assessing and monitoring several disease processes, including intracranial vascular occlusions/stenosis, vasospasm in subarachnoid hemorrhage, microembolic signals and patent foramen ovale; it is also frequently employed to identify children with sickle cell disease at increased risk for stroke.

Ultrasound examination of a vessel by means of TCD is referred to as insonation. Underlying the technique is the Doppler effect, which occurs when “a pulsed wave transducer emits (insonant) waves, and then receives their reflections off the surfaces of the red blood cells within the intracranial vasculature. This information is analyzed by a computer to give us both numerical and visual output, which is useful for inferring the flow characteristics within a blood vessel.”

“Cranial bone thickness, which is affected by patient age, gender and race, has a significant impact on the use of TCD.”

Feliks Koyfman, MD
Director, Neurovascular Laboratory

Images courtesy of:
through thick skull bones, the TCD probe must be placed over a region of the cranium with thinner bones that allow for ultrasound penetration. These areas are known as acoustic windows.

- The temporal window, found along the zygomatic arch (between the angle of the eye and the pinna), affords access to the middle (MCA), anterior (ACA) and posterior (PCA) cerebral arteries, as well as the terminal portion of the internal carotid artery (ICA). However, satisfactory recordings may not be possible via this route in 10%-15% of patients.

- The orbital window (through the eye) allows for insonation of the ophthalmic artery and the siphon of the internal carotid artery. “This approach requires that wave intensity be kept to a minimum in order to avoid damaging the intraocular lens,” said Dr. Koyfman.

- The suboccipital/foraminal window (via the foramen magnum), enables assessment of blood-flow through the vertebral and basilar arteries.

TCD measurements of blood-flow velocity are also influenced by physiologic and pathologic factors, as well as vasoactive medications. Age, cerebrospinal fluid pressure, central venous pressure, carbon monoxide, blood viscosity and vasoconstrictive drugs can decrease flow velocity, whereas anemia and drugs with vasodilative properties increase the velocity.

Applications

TCD is considered one of the first-line approaches for detecting vasospasm in spontaneous subarachnoid hemorrhage (s-SAH). In approximately 30% of cases, SAH is complicated by vasospasm (VSP), and VSP-related ischemic neurological deficits are the major cause of mortality (7.2%) and morbidity (6.3%) in survivors of initial s-SAH.

“This is made possible because particulate (solid, fat) and gaseous materials in flowing blood have acoustic impedance properties that differ from the surrounding red blood cells,” Dr. Koyfman clarified. “The Doppler beam is both reflected and scattered at the interface between the embolus and the blood, resulting in increased intensity of the received Doppler signal.”

Detection of MES may be useful in predicting risk of stroke/TIA, as well as in monitoring the effects of antithrombotic medications. According to a meta-analysis review of 30 prospective studies, MES predicted future stroke, combined stroke/TIA risk for acute stroke, the perioperative period during carotid endarterectomy, large vessel disease and symptomatic, as well as asymptomatic, carotid disease.

As TCD technology continues to improve, the value of the technique will broaden knowledge of a wide range of intracranial and extracranial conditions associated with cerebral hemodynamics. The future will undoubtedly expand its applications.

Clinical application: sickle cell disease

To detect the presence of patent foramen ovale (PFO) with TCD, airbubbles are injected into the peripheral vein while the MCA is simultaneously isolated. If there is a shunt, microbubbles enter the systemic circulation, moving on to the cerebral vessels, where TCD picks them up as high-intensity-transient signals (HITS), also known as microembolic signals (MES); the microbubbles have a very distinct sound.

REFERENCES

Contributing Clinicians

Mark M. Stecker, MD, PhD  
Chairman, Department of Neuroscience  
516.663.4852

Dr. Mark Stecker is Board Certified by the American Board of Psychiatry and Neurology in Neurology and Clinical Neurophysiology, as well as by the American Board of Clinical Neurophysiology in EEG and by the American Board of Neurophysiologic Monitoring in Intra-Operative Neurophysiology. His special clinical interests are EEG/epilepsy and intra-operative neurophysiologic monitoring. His research interests center on the response of peripheral nerve to ischemia, the properties of electrodes and information theory. Prior to his appointment as Chairman of Neuroscience at Winthrop, he was Associate Chair for Neurology in the Department of Neuroscience at Marshall University in Huntington, West Virginia, where he was also a Professor of Neuroscience. His postgraduate training includes a Dana Fellowship in Neuroscience/Epilepsy/EEG at the University of Pennsylvania and Graduate Hospital in Philadelphia. He completed a residency in neurology at the Hospital of the University of Pennsylvania and an internship in medicine at Lankenau Hospital in Philadelphia. Dr. Stecker earned his medical degree from the Harvard Medical School/MIT HST Program and a PhD in physics from the University of Pennsylvania. He is a past president and a Fellow of the American Society of Neurophysiologic Monitoring and a Fellow of the American Clinical Neurophysiology Society. Dr. Stecker is a senior member of the IEE (Institute of Electrical and Electronics Engineers) and has authored over 100 papers and articles.

Michael H. Brisman, MD  
Chief, Division of Neurosurgery  
Co-Director, Institute for Neurosciences  
516.255.9031

Dr. Michael Brisman specializes in stereotactic surgery and radiosurgery for brain tumors and trigeminal neuralgia. He is Board Certified by the American Board of Neurological Surgeons and is a Fellow of the American College of Surgeons. His postgraduate training includes a neurosurgical residency and surgical internship at The Mount Sinai Medical Center in New York, where he was Chief Resident. He received his medical degree from Columbia University’s College of Physicians and Surgeons. Dr. Brisman has published numerous articles in professional journals. He is past President of the Nassau County Medical Society and serves on the Board of Directors of the New York State Neurosurgical Society.

Jonathan L. Brisman, MD  
Director, Cerebrovascular & Endovascular Neurosurgery  
516.255.9031

Dr. Jonathan Brisman specializes in cerebrovascular and endovascular surgery for diseases of the central nervous system. As one of fewer than 100 neurosurgeons nationwide with dual training in micro-neurosurgery and endovascular techniques (and the first on Long Island), he is skilled in aneurysm clipping and endovascular coiling for brain aneurysms, as well as in advanced procedures to treat brain arteriovenous malformations (AVM), carotid stenosis and acute stroke. His postgraduate training includes an Interventional Neuroradiology Fellowship at Roosevelt Hospital in New York and a Microvascular Neurosurgical Fellowship at Swedish Hospital in Seattle. He completed a neurosurgical residency and surgical internship at Massachusetts General Hospital, where he was Chief Neurosurgery Resident. Dr. Brisman received his medical degree from Columbia University’s College of Physicians and Surgeons. He has published over 40 articles in peer-reviewed neurosurgery journals, including “Medical Progress: Cerebral Aneurysms” in the New England Journal of Medicine and one on stroke management in Lancet Neurology.

Feliks Koyfman, MD  
Vascular Neurologist  
Director, Neurovascular Laboratory  
516.663.4525

Dr. Feliks Koyfman, a vascular neurologist and Director of Winthrop’s Neurovascular Laboratory has a special interest in stroke prevention and the use of imaging modalities in acute stroke treatment and workup. His postgraduate training includes Fellowships in Advanced Vascular Neurology and Imaging, as well as Vascular Neurology at Boston University Medical Center, where he also completed a residency in neurology. He earned his medical degree from the Stony Brook University School of Medicine. Dr. Koyfman has co-authored many abstracts and articles, including “Pelvic Magnetic Resonance Venography for Detection of Deep Vein Thrombosis in Young Patients with Cryptogenetic Stroke and Patent Foramen Ovale” published in Stroke. He also presents frequently at professional meetings.

John Pile-Spellman, MD  
Endovascular Neuroradiologist  
516.255.9031

Dr. John Pile-Spellman is an internationally known endovascular neuroradiologist, specializing in the diagnosis, management and treatment of cerebral aneurysms, strokes, tumors and vascular malformations. Dr. Pile-Spellman has many years of experience in developing high impact, clinically relevant imaging and treatment paradigms. His postgraduate training includes Fellowships in Neuroradiology at Massachusetts General Hospital and in Interventional Neuroradiology at New York University Medical Center; he was also a visiting Fellow in Endovascular Neurosurgery at the Kiev Neurosurgical Institute, Kiev, Ukraine. Dr. Pile-Spellman completed a residency in diagnostic radiology at Massachusetts General Hospital in Boston, and earned his medical degree from Tufts University School of Medicine in Boston. Prior to joining Winthrop, he was an attending radiologist and Director of Academic Interventional Neuroradiology at New York Presbyterian Hospital. He was also Vice Chair of Research and Director of...
Dr. Rachel Ruotolo performs a broad spectrum of reconstructive procedures and has a special interest in pediatric plastic surgery with an emphasis on craniofacial surgery. She is Board Certified by the American Board of Plastic Surgery. She has significant experience in correcting birth deformities, including cleft lip and palate, syndactyly, craniosynostosis, Pierre Robin Sequence, Apert Syndrome, Crouzon Syndrome, Pfeiffer Syndrome and Saethre-Chotzen Syndrome, as well as vascular malformations such as hemangiomas and port wine stains. Dr. Ruotolo also specializes in facial trauma in children and adults. Her postgraduate training includes a Fellowship in Pediatric Congenital and Craniofacial Surgery at Medical City Children’s Hospital in Dallas, Texas under the tutelage of Dr. Jeffrey Fearn. She received her general surgery and plastic surgery training at the Hospital of the University of Pennsylvania and earned her medical degree from George Washington School of Medicine, graduating with distinction.

Dr. Brian Snyder specializes in the surgical treatment of movement disorders such as Parkinson’s disease, tremor and dystonia, seizure disorders and epilepsy, as well as the surgical management of pain. He is an expert in deep brain stimulation (DBS), utilizing microelectrode recording; procedures for mapping, recording and identifying seizure foci in the brain; the surgical resection of these foci; vagal nerve stimulation (VNS); motor cortex stimulation (MCS); and spinal cord stimulation (SCS). His postgraduate training includes a Fellowship in Stereotactic and Functional Neurosurgery under Dr. Andres Lozano at the Toronto Western Hospital, University of Toronto. He completed a neurological surgery residency and general surgery internship at the Mount Sinai School of Medicine, where he was Chief Neurosurgical Resident. Dr. Snyder received his medical degree from the Temple University School of Medicine. He has published and presented extensively on functional neurosurgery, including works on deep brain stimulation for Parkinson’s disease, primary dystonia and depression, as well as stereotactic radiosurgery for tremor and seizure outcomes associated with cavernous malformations.

Dr. Mona Stecker, a nurse practitioner and Special Projects Manager at Winthrop, is responsible for initiating and coordinating activities that focus on patient-centered care, including administrative, clinical and research endeavors. Dr. Stecker is also involved in voluntary mentoring of new neuroscience nurses. Prior to joining Winthrop, she was the Epilepsy Nurse Practitioner at Cabell Huntington Hospital in Huntington, West Virginia, and the Stroke Program Coordinator at Geisinger Medical Center in Danville, Pennsylvania. Dr. Stecker was very active in starting two stroke programs, which obtained Primary Stroke Center Certification, and in spearheading the development of a neuroscience nursing fellowship, which provides clinical and didactic education for critical care nurses interested in neuroscience. Her training includes a Doctorate of Nursing Practice from West Virginia University in Morgantown, West Virginia, and a Master of Nursing from Misericordia University in Dallas, Pennsylvania. Dr. Stecker is on the Board of the American Association of Neuroscience Nurses, and has lectured nationally and internationally on epilepsy and stroke. She has published in a variety of professional publications, including Epileptic Disorders, the Journal of Neurology and Neurophysiology, the Canadian Journal of Neuroscience Nursing and Surgical Neurology International.

Dr. Lee Tessler specializes in the multimodality treatment of malignant and benign brain tumors, which includes stereotactic surgery and radiosurgery. He is proficient in CyberKnife® Radiosurgery. His postgraduate training includes a residency in neurosurgery and internship in general surgery at New York University Medical Center and Bellevue Hospital Center, where he was Chief Resident. He earned his medical degree at The Ohio State University College of Medicine and Public Health in Columbus, Ohio, with clinical honors in neurosurgery and general surgery.

Dr. Elzbieta Wirkowski specializes in cerebrovascular neurology and neurocritical care. She is Board Certified in Neurology, Vascular Neurology and Neurocritical Care. Her postgraduate training includes a Cerebrovascular Fellowship at Long Island Jewish Medical Center (LIJ), where she participated in multiple research trials dealing with neurocritical and cerebrovascular problems. She also completed a residency and internship in neurology at LIJ. Dr. Wirkowski earned her medical degree with honors from Warsaw University in Poland, where she also studied molecular biology. She is the author of many publications dealing with neurocritical care and stroke, and presents regularly at national and international meetings.
Winthrop-University Hospital’s Institute for Neurosciences

Winthrop-University Hospital is a 591-bed teaching hospital located on Long Island in Mineola, NY. A major regional healthcare resource, the Hospital has been a leading healthcare provider for more than a century, dedicated to the integrity, dignity and well-being of every individual. Winthrop offers a full complement of advanced inpatient and outpatient services with a deep commitment to medical education and research.

Physicians and surgeons in Winthrop’s Institute for Neurosciences are pioneering the use of technologically advanced approaches for the diagnosis and treatment of diseases of the brain and spine, including computed imaging systems, state-of-the-art surgical interventions and the latest generation of medication therapies.

The Institute’s interdisciplinary team includes neurologists; neurosurgeons; neurointensivists; pediatric neurologists and neurosurgeons; neuroradiologists; vascular surgeons; orthopaedic spine surgeons; neuro-oncologists; neuro-pathologists; neurophysiologists; and specially trained nurse practitioners, physician assistants and nurses. Specialized physical and occupational therapy, social work and other supportive services are also key components of the Institute. The Institute’s experts are up to date on the latest developments in neuroscience and help pave the way for new discoveries through participation in clinical research trials, which enable them to provide patients with access to tomorrow’s most promising therapies.

Programs & Services Offered by the Institute for Neurosciences

Neuroscience Intensive Care Unit
The 14-bed acute care NeurolCU is reserved for patients with serious, complex neurological issues. The focus is on providing continuous monitoring and instantaneous results of critical values, allowing the expert staff, experienced in using advanced technology and providing neurocritical care, to employ aggressive interventions that treat neurological deterioration.

Neurology
Comprehensive Level 4 Epilepsy Center
Movement Disorders Program
Multiple Sclerosis Care Center
Neurodiagnostic Laboratory
Neuromuscular/Peripheral Neuropathy Program
Neuroscience Intensive Care Unit
NYS Designated Stroke Center
with AHA and ASA “Gold” Level Status

Neurosurgery
Aneurysm Coiling & Clipping
Disc Replacement
Brain Aneurysm Program
Brain Tumor Program
Brain & Skull Base Surgery
Carotid Stenting & Endarterectomy
Cerebrovascular & Endovascular Surgery
Chiari Decompression Surgery
Complex & Minimally Invasive Spinal Surgeries
Complex Cranial Surgery
Computer-Assisted Resection of Brain Tumors
CyberKnife® Radiosurgery
Endoscopic Pituitary Surgery
Epilepsy Surgery Program
Facial Pain/Trigeminal Neuralgia Program
Image-Guided Spine Surgery
Kyphoplasty
Merci®/Penumbra® Clot Retrieval
Microdiscectomy
Microneurosurgical Techniques
Micravascular Decompression for
Trigeminal Neuralgia & Hemifacial Spasm
Neuro-oncology
Parkinson’s Disease Surgery Program
Posterior Lumbar Interbody Fusion
Prestige® Cervical Disc
Programmable Shunt Placement
Spinal Stimulation
Spine Revision Surgery
Stereotactic Radiosurgery
Traumatic Brain & Spine Injury Diagnosis & Treatment
X-Stop® for Spinal Stenosis

Neuroradiology
Aneurysm Treatment
CT Perfusion Scanning
Interventional Neuroradiology
Neuroangiography
Positron Emission Tomography (PET) Scanning
Ultrafast Computed Tomography (CT) & Magnetic Resonance Imaging (MRI)

Pediatric Neurology & Neurosurgery
Attention Disorders & Learning Disabilities Treatment
Craniosynostosis Surgery
Brain Tumor Treatment
Evaluation & Treatment of Children with Headaches
Evaluation & Treatment of Neurological Disorders Myelomingingocele Surgery
Neuro Developmental Screening & Early Intervention
Pediatric Intensive Care Unit
Seizure Disorders Management
Surgery for Pediatric Neurovascular Disorders
Treatment for Hydrocephalus & Other CNS Anomalies

For more information, call the Institute for Neurosciences at 1-866-NEURO-RX.