



# front line

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## Dear Colleagues,



I am pleased to announce that Abbott Northwestern Hospital has purchased a high field intraoperative MRI (iMRI) scanner for use with both pediatric and adult neurosurgical patients. This high field iMRI is the fourth unit of this type to be installed in the U.S. and the fifth in the world. The technology gives our neurosurgeons an unprecedented level of information as they treat brain tumors, epilepsy and movement disorders such as Parkinson's disease.

MRI at the end of an operation can confirm that surgical objectives have been accomplished and that no complications have developed, before the exposure is closed. I am delighted to have this new technology available so we can better serve your patients.

On a final note, the Minneapolis Neuroscience Institute will mark its twentieth annual Front Line Neurology Symposium this year. The symposium will be held October 11-12 at the Hotel Sofitel in Bloomington, Minn. Our Thursday evening featured guest speaker will be William Coplin, MD, from Wayne State University, Detroit. He will be discussing critical care for neurological emergencies. Other conference topics include various other neurologic emergency topics, management of migraine, patent foramen ovale, hydrocephalus, sleep apnea and cardiac disease, the relevance of EMGs, rehabilitation strategies in the treatment of Parkinson's and the latest in Alzheimer research. Look for your brochure and registration information in late August. For further information, please call Joan Brandl at 612-863-3339.

As always, if you wish to comment or have any recommendations for future topics, please contact me at the Minneapolis Neuroscience Institute at 612-863-3200.

Best regards,

**Mahmoud Nagib, MD**

## Introducing Abbott Northwestern's Neurologic Emergency Treatment NETWORK

The Neurologic Emergency Treatment Network, or "NETwork," is a new name but not a new concept. For many years, Abbott Northwestern Hospital and its physicians have been available as a resource to Emergency Departments throughout Minnesota and neighboring states in the management of complex patients. The ED to ED phone number was established to facilitate patient transfer when required and provides quick access to the expertise of Abbott Northwestern Emergency Department physicians and other medical specialists.

In recent months, out-state hospitals have expressed interest in developing or enhancing their ability to provide IV t-PA and other acute treatments to stroke patients. This has led to the development of NETwork which is designed to partner Abbott Northwestern with out-state emergency departments to care for patients neurologic emergencies.

### How does NETwork partner Abbott Northwestern Hospital with other emergency departments?

There are three primary goals of NETwork. The first is to support out-state hospitals in the provision of life (or brain) saving and time-sensitive treatments to patients who present with neurologic emergencies. The second goal is to aid in the identification of patients who would benefit from technology, treatment or specialty consultation available at Abbott Northwestern Hospital. Both of these goals are being accomplished with written protocols, educational offerings and specialist consultation to emergency department providers. The final goal is to facilitate the sometimes cumbersome transfer process for appropriate patients. An example of the value of this partnership is easily demonstrated in the ischemic stroke population. The treatment window for IV t-PA is too short to transfer all stroke victims to a hospital with a stroke team to receive therapy. NETwork provides patient care guidelines and stroke neurology consultation which allows hospitals to administer tPA on-site despite fewer resources.

### What types of neurologic emergencies are part of the NETwork program?

NETwork provides resources for common neurologic emergencies including acute

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## NETwork, *continued from page 1*

ischemic stroke, intracranial hemorrhage (ICH), subarachnoid hemorrhage (SAH) and prolonged or recurrent seizure activity.

Access to telephone consultation or facilitation of patient transfer for other neurologic disorders requiring urgent neurologic or neurosurgical consultation is also available. Such disorders include, but are not limited to, brain and spinal cord tumors, hydrocephalus, unexplained alteration in consciousness, Guillain-Barre Syndrome, myasthenic crisis, CNS infection and venous sinus thrombosis.

### What services are offered through NETwork?

- one-number access for ED to ED transfers, ED-facilitated direct admissions and ED physician triage and consultation 24 hours a day, seven days a week
- 24/7 stroke neurologist telephone consultation via ED to ED
- 24/7 neurosurgery coverage
- 24/7 interventional neuroradiology coverage
- 24/7 epilepsy neurologist telephone consultation via ED to ED will be



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added to the program in the near future.

Additionally, if patient transfer is required, a bed will be made available regardless of divert status.

### What specialized care is available at Abbott Northwestern that would require patient transfer?

- Post-IV tPA monitoring
- Intra-arterial thrombolytics
- Emergent intracranial and extracranial angioplasty
- Mechanical clot retrieval
- Neurosurgical intervention
- Aneurysm coiling
- Intracranial pressure monitoring

- Continuous EEG monitoring
- Epilepsy monitoring and surgery program
- Thrombolytic/mechanical device therapy for venous sinus thrombosis
- Embolization of vascular malformations

### How can NETwork be accessed?

For acute patient care situations, call the ED to ED number at 612-863-4233. The Emergency Physician will provide triage and consultation and facilitate specialist consultation or transfer as needed. If you are interested in learning more about the program, contact Donna Lindsay, RN, MN, at 612-775-4629 or [donna.lindsay@allina.com](mailto:donna.lindsay@allina.com). ■

## Status Epilepticus: Treatment and Outcomes

Traditionally status epilepticus (SE) has been defined as a seizure lasting 30 minutes or repeated seizures with incomplete recovery of consciousness. An updated definition was recently proposed to shorten the duration of seizure activity to meet the criteria for SE. The treatment for SE should be initiated for any seizure in an adult lasting five minutes or longer. Convulsive SE is a medical emergency. Morbidity and mortality from SE are related to damage to the central nervous system (CNS) caused by the acute insult precipitating the seizures, systemic stress from continued or repeated convulsions, and injury within the CNS from repetitive epileptic discharges. Mortality associated with SE is 20-25 percent, and greater than 38 percent in the elderly. Important predictors of outcome are etiology, age and duration of SE.

Prevention of SE with "rescue medications" is key in patients with known epilepsy.

These protocols typically consist of rectal diazepam (Diastat 10-20 mg) or sublingual liquid diazepam intensol (5-10 mg) or lorazepam intensol (1-2 mg) for a predefined cluster of seizures. Such amounts do not cause significant respiratory depression and may prevent a cluster of seizures from progressing to SE. Medications given rectally or buccally have rapid rates of response, as they are absorbed directly into the venous system, avoiding first-pass effect.

Treatment of seizures and diagnosing the cause in SE must be done in parallel. Blood for standard hematological and metabolic profiles as well as drug screens should be sent. A CT or MRI should be obtained, especially in patients with no known history of epilepsy. In patients with epilepsy, stat drug levels are required. A lumbar puncture to assess for meningitis or encephalitis may be necessary.

In adults, the first line of treatment for SE

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She is adjunct instructor of Neurology at the University of Minnesota and has been on staff at MINCEP Epilepsy Care since 2002. As an epileptologist, Dr. Beattie evaluates and treats school-age children and adults with epilepsy. ■



is the short-acting agents lorazepam IV (2-8 mg), diazepam IV (10-20 mg) or midazolam IM (5-10 mg) or IV (0.1-0.3 mg/kg). Drug treatment of SE should not be limited to these short acting abortive agents.

# Treatment of Dural Sinus Thrombosis

Dural sinus thrombosis is a relatively rare condition with a heterogeneity of clinical presentations, an unpredictable natural course and therefore, a difficult disease to treat.

Clinical symptoms and severity vary depending upon the extent and location of the thrombus, venous collateral vessels and rate of thrombus progression. Occlusions in the superficial venous system are better tolerated than are those in the deep venous system, due to a more robust collateral system in the superficial system. Involvement of the deep venous system has often been associated with a grave prognosis. In acute occlusions, collateral flow cannot be established and significant venous congestion with mass effect may result. Other poor prognostic indicators include extension into cerebral veins, presence of focal findings, rapid rate of progression of deficits and coma.

Conditions that are known to be predisposing factors for dural sinus thrombosis include puerperium, trauma, malignancy, disseminated intravascular coagulation, hypercoagulable states (especially Factor V Lieden and prothrombin mutation), infections particularly mastoiditis,

medications (synthetic steroids and contraceptive pills), connective tissue disorders and dehydration.

Diagnosis is made with computerized tomography of the brain which demonstrates no opacification of the major dural venous sinuses following intravenous infusion of contrast medium and on occasion, associated hemorrhages or venous infarcts. MRI and MR venography have a higher efficacy of clinical diagnosis with MR venograms clearly demonstrating the extent of dural sinus involvement. These studies also allow us to perform venous thrombolysis without the need for arterial angiography and therefore punctures of the arterial system picture. MR venography is also very useful for following this lesion as it is non-invasive.

Because of the variable natural history of dural sinus thrombosis, it can be difficult

the latter allowing for more rapid neurological assessment of the patient after the infusion has been discontinued. The infusion rate of the anesthetic drug is adjusted to seizure control or burst suppression; therefore continuous video EEG monitoring is necessary. Once seizure control or burst suppression has been achieved for 12-24 hours, the anesthetic drug is tapered off. During the infusion, standard AEDs are simultaneously optimized.

Even if convulsive SE is resolved early on with treatment, studies show 14-20 percent of patients remain in non-convulsive SE requiring EEG monitoring to be identified. All patients presenting with SE should be placed on continuous video EEG. SE is a true medical emergency associated with significant morbidity and mortality. The longer the delay in treatment, the more refractory the SE becomes. Prompt diagnosis and aggressive intervention for SE is critical for the prevention of brain damage and possible death. ■

Fosphenytoin (15-20 mg PE/kg) administered intramuscularly or intravenously can be used to initiate long-term drug treatment in SE. For patients already on phenytoin or with contraindications to phenytoin, intravenous valproic acid 15-25 mg/kg may be given. Due to its very sedative properties and interactions with benzodiazepines causing respiratory suppression, phenobarbital should be avoided if possible. Intravenous levetiracetam has recently become available and safety and tolerability data has been established for single dose infusions up to 4,000 mg over 15 minutes and 2,500 mg over five minutes. There are no studies to date, however, on the efficacy of levetiracetam in the treatment of SE.

For refractory SE, IV anesthesia is required with a loading bolus followed by continuous IV infusion of propofol, midazolam or pentobarbital. ICU care with intubation for mechanical ventilation is required and blood pressure support is often needed. Midazolam and propofol are less likely to cause significant hypotension and have faster clearance,



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Dr. Tubman has been board-certified by the American Board of Radiology since 1981. He is a senior member of the American Society of Neuroradiology and the American Society of Interventional and Therapeutic Neuroradiology. He is also a fellow of the American College of Radiology.

Dr. Tubman is an associate of Minneapolis-based Consulting Radiologists, Ltd. (CRL), a leading provider of subspecialty medical imaging services and minimally invasive therapeutics. CRL's 60 board-certified diagnostic and interventional radiologists practice at Abbott Northwestern Hospital and provide services at 30 locations. ■

to determine the extent to which aggressive therapy should be pursued. One randomized control study showed improvement in outcome of patients treated with heparin compared with patients with no treatment. The goal of the use of heparin anticoagulation is to prevent thrombus propagation from the dural sinuses into the cerebral cortical veins. Unfortunately, heparin usage does not lyse the thrombus that occludes the sinus. When sinus occlusion is poorly tolerated due to insufficient collateral blood flow, active re-establishment of venous drainage through thrombolysis to prevent cerebral edema and mass effect is felt to be a more plausible alternative.

Peripheral intravenous thrombolysis has resulted in variable outcomes. High dose peripheral infusion of streptokinase and urokinase can take days to recanalize vessels because the concentration of thrombolytic agent that actually arises at the site of occlusion is low. Thrombolysis is accelerated through direct intrasinus infusion of the thrombolytic agent. There is a lower incidence of hemorrhage associated with locally catheter-administered thrombolytic agent because lower doses are needed and because its direct delivery into the occluded sinus bypasses the infarcted brain tissue.

Our treatment regimen consists of

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intravenous heparin in those patients who have mild headache without papilledema and without any other clinical symptomatology and normal brain parenchymal images on MRI. If headache increases, papilledema develops or focal neurologic deficits occur, we proceed to selective intrasinus thrombolysis. This procedure is performed utilizing a transfemoral vein approach with a guide catheter placed through the femoral vein into the internal jugular vein. Three microcatheters are then advanced into the mid-superior sagittal sinus, the distal superior sagittal sinus, and into the transverse sinus which is commonly occluded as well. Typically a total dose of 24 mg of tPA is infused over 24 hours. Sixty percent of the dose is placed into the most distal microcatheter with 40 percent of the dose into the other two microcatheters. With this regime, we have been able to produce satisfactory thrombolysis within 24 hours with normalization of flow. Previously, utilizing 1 microcatheter and a single site

of infusion, it was often necessary to infuse these patients over three days. The goal of treatment is to produce flow in the major dural venous sinuses. It is not necessary to completely thrombolysed the sinuses. The patients are then placed on Coumadin for 3-6 months with MR venograms performed to follow up on the degree of intrinsic thrombolysis assuming a normal coagulation profile.

In those patients who have severe neurologic symptoms in spite of heparin therapy or have evidence of an intracranial hemorrhage on brain imaging, we prefer to use a mechanical device for more rapid thrombolysis. The device which has been the most successful is a rheolytic thrombectomy device called the AngioJet (Possis Medical, Minneapolis, Minnesota). This mechanical thrombectomy catheter works by creating a vacuum to fragment and aspirate the thrombus through the catheter. A one to two hour procedure often results in satisfactory reconstitution of flow in the major dural venous sinuses. We have had one non-significant intracranial hemorrhage with this treatment regiment

in over 30 cases, spanning 10 years.

Dural sinus thrombosis carries with it a mortality rate ranging from five to 30 percent. Once this diagnosis is made, patients need to be carefully monitored for neurologic change and treated initially with intravenous heparinization and adequate hydration. Any alternation in clinical status during this therapy necessitates rapid thrombolysis of the dural venous system. This can be performed safely with either sinus thrombolysis utilizing tPA or with a mechanical device. ■

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