Children's® Healthcare of Atlanta

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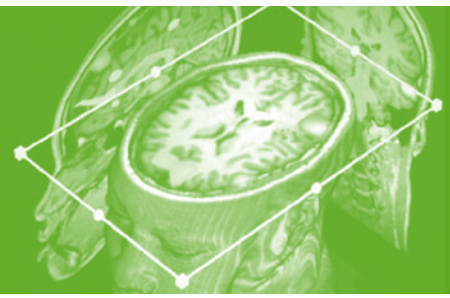

Neuro Update℠

SUBTRACTION ICTAL SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT) CO-REGISTERED MRI (SISCOM) CORRELATION IN INTRACTABLE EPILEPSY

J. Robert Flamini, M.D.

Epilepsy affects one out of every 100 children, with approximately 300,000 U.S. children younger than age 14 currently being treated for this disorder. Approximately 70 percent of patients respond to anti-epileptic drugs, with many pediatric patients outgrowing the condition. For these patients, the need for medication tapers off after a minimum treatment period of two years.

When pediatric patients with epilepsy do not respond to anti-epileptic drugs, they are diagnosed with intractable or medically refractory epilepsy. Studies have shown this occurs among approximately 25 percent to 30 percent of children with epilepsy. There is no universal agreement about how to define intractability. However, there is ample evidence supporting the critical importance of a patient evaluation to determine management options for intractable seizures.

The key element of the evaluation determines the seizures' likely site of origin. With adults, the temporal lobe is the most common site for seizures. Among children, the extratemporal cortex is the most common site. The challenge with trying to delineate the epileptogenic zone directly relates to the sensitivity and specificity of the presurgical diagnostic testing available, and the congruency obtained between all modalities used for testing.

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This inpatient, presurgical evaluation includes a digital-video electroencephalogram (EEG), which is typically the gold-standard for localizing seizures. During the video EEG, patients' seizures are recorded and studied with information obtained via scalp electrodes. Patients also are studied with magnetic resonance imaging (MRI). Currently, Children's Healthcare of Atlanta offers both a 1.5 Tesla and 3 Tesla MRI with specific sequences built for the evaluation of patients for epilepsy surgery.

Neuropsychological testing also is completed. Additional studies, including functional MRI (fMRI), intracarotid amobarbital test (Wada test) and dense array EEG, are obtained thereafter according to the patient-specific clinical picture. There is a direct correlation between outcome of epilepsy surgery and presurgical identification of the epileptogenic zone.

During the past several years, the Children's Epilepsy Center has spearheaded efforts to utilize additional presurgical localizing techniques, including a test combining nuclear medicine and MRI. This test is the subtraction ictal single photon emission computed tomography co-registered into MRI (SISCOM). The SISCOM technique began at the Mayo Clinic in Rochester, Minn., and it has been validated at several other institutions. SISCOM is of significant value, as one of the most useful localizing techniques.

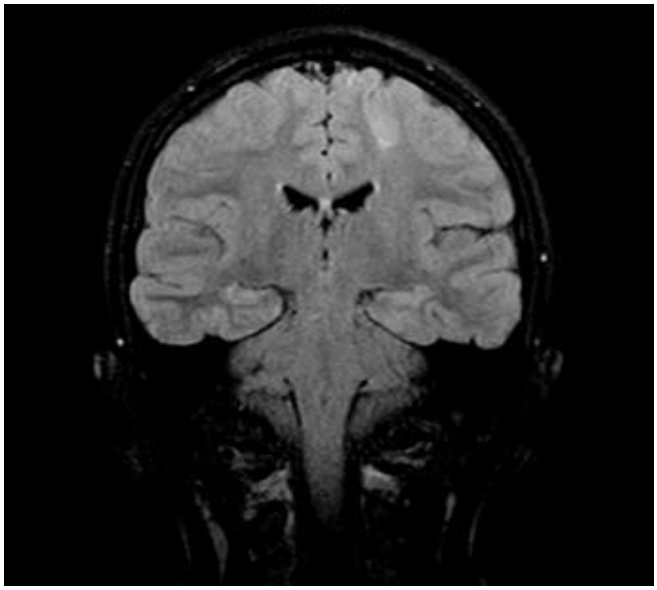
Beginning with an injection of a radiotracer (Tc-99m, Neurolite®) after the seizure starts—ideally within 30 seconds, the images are compared to a single photon emission computed tomography (SPECT) scan, obtained when the patient is not having a seizure. The subtracted images are co-registered on MRI (SISCOM) allowing the area of seizure onset to be visualized.

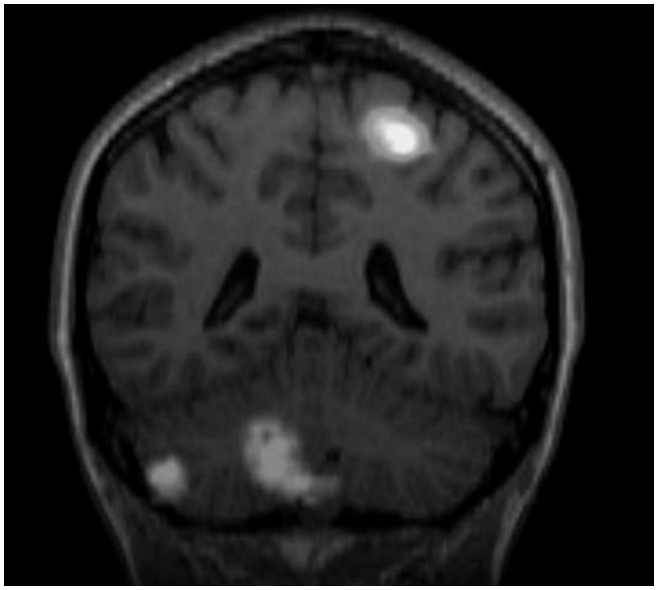
The test results are then correlated with all the other information, according to results and data congruency. Surgical options are explored, and an appropriate plan is delineated within a multidisciplinary epilepsy surgery conference at Children's.

Epilepsy surgery is currently the accepted standard of care for the appropriate candidate. In years past, an increasing consensus has grown toward the efficacy of surgery to treat children with drug-resistant focal epilepsy. In addition to controlling disabling seizures, surgery may improve a patient's developmental, psychosocial and behavioral impairments.

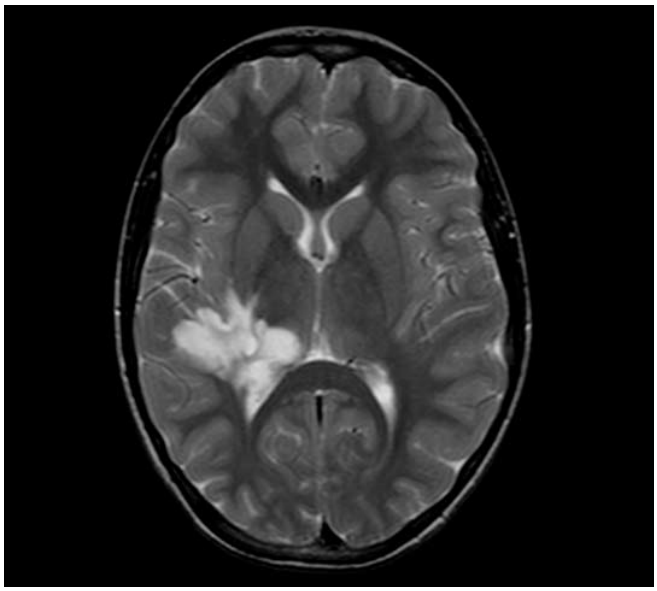
Moreover, surgery during early childhood may take advantage of the patient's brain plasticity, enhancing recovery from possible postsurgical neurological deficits. There are various options available including: resective surgery, disconnection surgery, multiple subpial transactions and extracranial interventions, such as vagus nerve stimulation. Further interventions currently being investigated include other types of implanted stimulators.

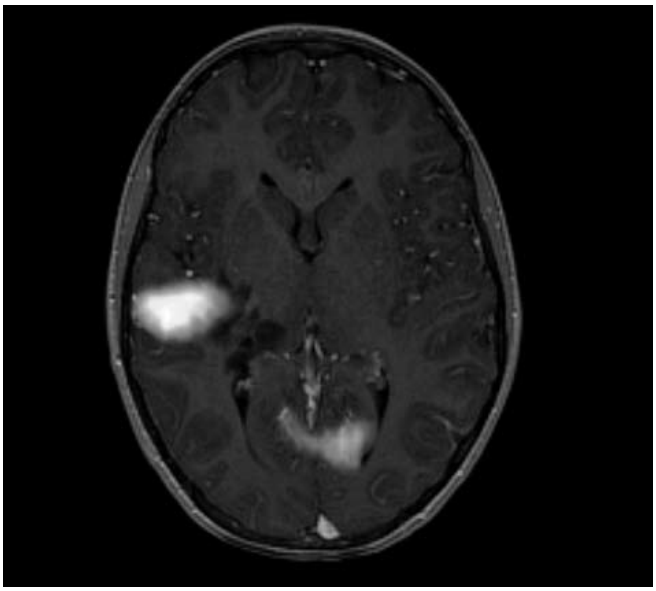
The pictures below are examples of the correlation between the anatomical abnormality, shown by the MRI and the SISCOM image.





Figures 1 and 2.
MRI and SISCOM support the correlation of seizure onset in the area of cortical dysplasia.





Figures 3 and 4.
MRI shows the presence of a subcortical lesion, and SISCOM images support the area of seizure onset as the cortex adjacent to the lesion.

The future will likely bring further integration of some, or all, of these modalities into a joined set of images for analysis and direct incorporation into intra-operative, neuronavigation systems. In an effort to continue to offer state-of-the-art diagnostic and treatment options, Children's continues to evaluate the newest technologies to bring into the clinical arena.

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