UCSF Epilepsy Center

a comprehensive center of excellence for adult & pediatric epilepsy
To provide outstanding, compassionate care for all persons with epilepsy, to advance the discovery of new knowledge leading to the prevention and cure of epilepsy, and to train young people of the highest caliber for careers in clinical epileptology and epilepsy research.
Treatment with antiepileptic drugs suppresses seizures in up to two-thirds of patients. Even when several medications have been tried without success, therapy with new medications brings seizures under control in some patients. At the UCSF Epilepsy Center, epileptologists and clinical pharmacists collaborate to develop effective treatment regimens and dosing schedules for each patient. Treatments are selected based on a comprehensive knowledge of medication effectiveness in various subtypes of epilepsy, and an understanding of drug-disease and drug-drug interactions. Patient preferences and patient values are a prominent consideration in guiding drug therapy.

Precise, ongoing adjustments in dosage are critical to successfully managing seizures and minimizing side effects. Our specialists form teams with referring neurologists and primary care physicians to monitor patients and carry out complex treatment plans.

Medical therapy at the UCSF Epilepsy Center involves:
- Expertise in the pharmacokinetics of epilepsy medications, including the management of complex drug interactions
- Suggestions for new combinations or dosages of medications
- Recommendations for lifestyle changes or dietary manipulation
- Education and support for patients, caregivers, and referring physicians

Our faculty also has expertise in the treatment of status epilepticus — a disorder marked by continuous seizures, which can often be life-threatening.

For patients who do not respond to medications, thorough evaluations incorporating 24-hour video electroencephalography (EEG) are performed to confirm the diagnosis of epilepsy or to determine whether the patient could be a candidate for neurological surgery.

Epilepsy case conferences that include neurological surgeons, neurologists, neuropsychologists, and neuroradiologists are held monthly to form treatment plans and discuss difficult or unusual cases.

The goal of medical management for epilepsy is full seizure control with minimal or no treatment side effects.
Subdural grids placed directly on the brain map electrical activity to precisely identify the epileptic focus.

Intraoperative mapping defines functional areas of the brain and the exact location of the epileptic focus.

Postoperative view of surgical cavity where epileptic focus has been removed and functional brain preserved.

Diagnostic Studies
Neurosurgeons perform diagnostic studies with intracranial EEG electrodes to localize epileptic foci. The electrodes may be in the form of grids, depth electrodes, or subdural strip electrodes and are used to map electrical activity as precisely as possible.

Focal Brain Resection
Focal brain resections are the most common surgical approach for treating epilepsy and provide the best chance for patients to gain complete seizure control. Types of focal brain resections include:

- Temporal lobectomy
- Lobar resection (frontal, parietal, occipital)
- Corticectomy
- Hemispherectomy

Disconnection Operations
Disconnection operations aim to disrupt the abnormal electrical activity that occurs in the brain and triggers epileptic seizures.

- Corpus callosumotomy — a palliative surgical procedure that is useful for stopping atonic and tonic seizures.

Vagus Nerve Stimulation
A vagus nerve stimulator is an implanted device that sends regular electrical pulses through the vagus nerve to the brain in order to potentially reduce the onset or frequency of seizures. It can be used to treat a wide variety of adult and pediatric seizure disorders that are not amenable to treatment by other surgical techniques.

Gamma Knife® Radiosurgery
Radiosurgery is most often used to treat seizures caused by hypothalamic hamartomas in adults and children (gelastic seizures). UCSF uses the most current model of the Gamma Knife units, the Perfoxion®. In addition, our clinicians are involved in an experimental protocol using Gamma Knife radiosurgery to treat temporal lobe epilepsy.
A dipole modeled for a spike on a magnetoencephalography reading is superimposed on MRI images to create a magnetic source image.

UCSF uses multi-modal diagnostic tools to precisely locate seizure foci and functional cortex that may be at risk during surgery.

**Video**
**Electroencephalography (EEG)**
Video EEG is used to record seizures when the diagnosis of epilepsy is in question and for pre-surgical evaluation of patients. Patients are monitored by technicians 24 hours/day over 4 to 5 days to locate the seizure focus and determine if it is in an area that can be safely resected.

**Magnetoencephalography (MEG)**
UCSF is one of few institutions on the West Coast with MEG. Using 256 sensors, MEG measures the magnetic field produced by brain waves. Data from MEG readings are used to determine a dipole, which is superimposed onto an anatomic scan to produce a magnetic source image (MSI). The high density of the sensors makes MEG more spatially sensitive than routine EEG. It can also be used for functional mapping of the somatosensory and motor cortices.

**Magnetic Resonance Imaging (MRI)**
3T MRI scanners are the primary mode of imaging at UCSF and give excellent detail of anatomic structures. Advanced equipment is used by the neuroradiology service and includes:
- Three 3T scanners and nine 1.5T scanners, all equipped with the most up-to-date software and protocols
- One 7T research scanner that creates highly detailed images to preserve functional areas of the brain during surgery

**Functional MRI (fMRI)**
Preoperative localization of language and motor centers in the brain can be visualized using noninvasive fMRI techniques. fMRI was approved for clinical use in 2007.

**Diffusion Tensor Imaging (DTI)**
DTI is used for visualization of connections between eloquent cortex and subcortical regions.

**Single Photon Emission Tomography (SPECT)**
A SPECT scan can be used to visualize the brain’s cerebral blood flow, which indicates flow activity patterns of the brain and can help to determine seizure origin.

**Positron Emission Tomography (PET)**
Three PET scanners are used to detect metabolic activity in the brain and can detect hypometabolic regions.
Participation of a clinical neuropsychologist plays a vital role in the care of epilepsy patients. Neuropsychological tests are used to identify cognitive strengths and weaknesses, to aid in diagnosis, to establish a baseline prior to an intervention (e.g., surgery), to plan future treatment, and to make inferences about functioning in the real world. Typical neuropsychological evaluations assess:

- Intellectual functioning
- Executive function skills (e.g., problem solving, abstraction, mental flexibility)
- Attention and concentration
- Learning and memory
- Language
- Visuospatial skills (e.g., perception)
- Motor skills
- Mood and personality

By analyzing a patient’s test scores, the neuropsychologist can make predictions and recommendations regarding potential need for rehabilitation after surgery, including appropriate referrals for speech therapy, occupational therapy, and cognitive remediation.

A neuropsychologist also works with specialists in radiology and nursing to administer the Wada test, which is used to identify the side of the brain that controls language and to assess how memory is shared between the two sides of the brain. This information greatly enhances the safety of surgery when the source of epileptic seizures is close to structures in the brain that control functional abilities.

Facts on Pediatric Epilepsy Surgery

- Fifty percent of pediatric patients who undergo surgery for epilepsy have their seizures controlled
- If seizure foci are located in eloquent cortex, subdural grids can be used to map the foci during surgery to provide more detailed information about the location and increase the safety of surgery
- Because younger children usually have a greater chance of functional recovery, an early referral for surgery is best
- fMRI techniques are being incorporated into clinical use to provide a noninvasive method of localizing language and motor centers in the brain

At the UCSF Epilepsy Center, a pediatric epileptologist, two pediatric neurosurgeons, and a pediatric epilepsy nurse practitioner provide specialized care for children with epilepsy. To accurately diagnose and locate epileptic foci, the pediatrics team uses a combination of video EEG, MEG, and 3T MRI scans for both structural and functional neuroimaging.

Approximately 15% of children with epilepsy have symptoms that cannot be controlled with medication. Patients who do not respond after being treated with two different medications are assessed to determine whether or not they would be good surgical candidates.
Clinical Trials

- Radiosurgery or Open Surgery for Epilepsy (ROSE) Trial: a phase III study of Gamma Knife® radiosurgery for mesial temporal sclerosis
- SANTE (Stimulation of the Anterior Nucleus of the Thalamus for Epilepsy) Trial: this study uses deep brain stimulation to treat medically refractory epilepsy
- A phase II placebo-controlled add-on study of brivaracetam for partial seizures
- A multi-center trial of progesterone therapy for women with medically refractory, localization-related epilepsy

Epilepsy Phenome/Genome Project

UCSF is the coordinating center for this national project, sponsored by the National Institutes of Health, which is aimed at collecting detailed phenotypic and genomic information on patients with idiopathic generalized epilepsy, localization-related epilepsy, infantile spasms, Lennox-Gastaut Syndrome, and certain types of malformations of cortical development. This information will help to identify multigenic determinants of the underlying epilepsy syndrome and pharmacoresponsiveness or pharmacoresistance.

Neuroimaging of Epilepsy

Highly sensitive 4T and 7T MRI scanners are being used to study epileptogenic brain regions in patients with mesial temporal sclerosis and non-lesional epilepsy.

Functional Brain Mapping

Several ongoing studies at the UCSF Epilepsy Center are focused on functional brain mapping, including:
- Non-invasive mapping of language cortex using MEG
- Validation of pediatric fMRI paradigms for clinical use
- Mapping functional cortical activity using electrocorticography (ECoG) recordings that reveal evoked spectral changes in brainwaves

Social and Emotional Functioning

Neuropsychology is an important aspect of treatment for epilepsy and current studies are aimed at:
- Examining social cognition in people with intractable epilepsy before and after resective surgery
- Exploring potential emotional deficits in patients with mesial temporal sclerosis using psychophysiological responses to emotionally loaded visual stimuli

Basic Science Research

Epileptogenesis in a Malformed Brain

This research is focused on the development and analysis of animal models for specific childhood seizure disorders. Scientists are currently using patch-clamp recording techniques to study the excitatory and inhibitory circuits of mice with malformations resembling those primarily seen in children.

Seizure Resistance in Zebrafish

A model of acute seizure in zebrafish has shown that these fish exhibit behavioral, electrophysiological, and pharmacological characteristics that are remarkably similar to those observed in mammals. Using a forward-genetic screening strategy, seven “seizure-resistant” mutants have been isolated. Identification of genes that confer resistance in these mutants is currently underway.

MGE Progenitor Cell Grafts and Epilepsy

By transplanting progenitors from the embryonic medial ganglionic eminence (MGE) into epileptic mice, researchers are exploring the possibility that these cells will influence synaptic function in the host brain and reduce hyperexcitability associated with seizures.

Wnt Signaling in Hippocampal and Neocortical Development

This project is designed to understand the role of morphogenetic signals from the Wnt family in regulating the development of the cortex.

SDF1/CXCR4 Signaling and Tangential Neuronal Migration in the Developing Cortex

This work aims to discover how tangential migration regulates the developing circuit function of the cortex. Investigators for this project are also studying the newly described role for tangential migration of neural stem cells to take up positions in the dentate gyrus.

Defective Forebrain Development in Mutant Mice

This study examines a previously unknown role for the embryonic meninges in regulating the morphogenesis of the cortex.
how to refer a patient to the ucsf epilepsy center

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