Epilepsy (Dr. Merchut)

Types of Clinical Seizures

1. Partial seizures

Consciousness is not lost during a partial seizure. The epileptic discharge consists of the repetitive firing of a few cortical neurons, arising either spontaneously or after various provoking factors, but it remains confined to a specific cortical area or focus. Lesions of subcortical areas, brainstem, or spinal cord do not produce seizures. In a **simple partial seizure**, the clinical manifestations are functionally related to the cortical area involved by this neuronal discharge. For example, a simple partial seizure within the left frontal motor cortex may cause rhythmical contractions or jerking of the right face, arm, and leg for 1-2 minutes. Since this neuronal discharge does not spread or generalize diffusely to other cortical regions, the patient is fully aware of this event, remains conscious, and may even speak or follow commands during the spell. After the spell, the patient recalls the event and does not appear confused. Symptoms of simple partial seizures may also consist of localized sensory, visual, or autonomic (sweating, flushing, nausea) disturbances **without loss of consciousness.**

Complex partial seizures usually occur from neuronal discharges in the medial temporal or hippocampal areas, causing **impaired consciousness.** Consciousness is probably impaired from a unilateral temporal cortical discharge spreading bilaterally into the subcortical networks (thalamic, hypothalamic centers) important for arousal and attention. These were previously named "psychomotor seizures." Although awake, the patient would be inattentive and unresponsive, "staring into space," as if in a trance (the "psycho" part of the seizure). Other psychic symptoms include emotional changes, hallucinations, and distortions of time and reality (déjà vu) which may also occur in simple partial seizures. If the seizure occurred while performing a task, the patient may continue the same motor activity, often repeatedly (the "motor" part of the seizure). Semipurposeful, stereotyped gestures or "automatic movements" (**automatisms**) may also occur, such as chewing, finger tapping, wandering about, or uttering short phrases. The patient is unable to follow commands during the 1 to 3 minute spell and after the event has **no recollection** of what happened, appearing confused for a brief period (**postictal phase**).

Either simple partial or complex partial seizures may secondarily spread or generalize diffusely to other bilateral cortical areas, causing loss of consciousness. Since the motor cortex is usually involved, rhythmical, vigorous jerking of the trunk and limbs occurs. Afterwards, the patient goes through a postictal phase and is amnestic for the generalized convulsion itself. Yet he or she may recall the symptoms of the initiating partial seizure (the **aura**), or an observer may notice the focal onset of a seizure, either of which provides a localizing clue for the seizure focus. In many secondarily generalized seizures, however, the focal discharge spreads so rapidly that the patient cannot recall a specific aura, and the seizure appears to be a generalized convulsion.

2. Generalized seizures

Primarily generalized seizures occur when an electrical discharge simultaneously arises from widespread, bilateral areas of cerebral cortex. An example of a non-convulsive primarily generalized seizure is the **absence seizures** of childhood, formerly called "petit mal seizures." They last only several seconds, but may occur many times daily. There is a brief impairment of consciousness, where the child often suddenly stops what he or she was doing, "freezes" motionless, and may stare off with a flurry of eye blinking. Abruptly the child then resumes his or her previous activity without any postictal confusion or recall of the event. Usually these seizures cease when the child has grown to the teen years. An electroencephalogram (EEG) during an absence seizure typically shows a generalized, 3 Hertz (3 per second), spike-and-slow-wave electrical discharge.

Generalized, tonic-clonic (convulsive) seizures were previously known as "grand mal seizures." The convulsion involves violent jerking of the limbs and body with **loss of consciousness,** falling to the ground, and frequent injury. This could result from a primarily or secondarily generalized cortical discharge. Before a generalized tonic-clonic seizure begins, the patient may recognize vague, nonspecific symptoms of dizziness or nausea. A more specific **aura** may later be recalled, such as tingling or twitching of one arm, which is actually a simple partial seizure that subsequently generalizes. The **tonic phase** of the convulsion is a sudden stiffness from contraction of limb and trunk muscles which may cause the patient to fall and forcibly expel air ("cry"). Apnea leads to a cyanotic, dusky face and consciousness is lost. Seconds later the **clonic phase** begins, with rhythmic, forceful, synchronous jerking of the limbs and face, **tongue biting or other oral trauma**, and excessive salivation or drooling. During the **postictal phase** after the actual seizure ends, breathing resumes at a rapid rate and bladder incontinence may be noted. The patient is sleepy, confused and unable to recall what happened. This phase lasts about 5 to 15 minutes. **If the seizure itself was not observed, the postictal phase is an important clue that consciousness was lost from a preceding seizure and not from syncope or fainting.**

Etiology and Evaluation of Seizures

Depending on the circumstances, a single seizure may be a one-time event, never to occur again, or it may represent **epilepsy**, where there is a tendency or predisposition for seizures to recur. Although epileptic patients may be seizure-free on anticonvulsant medication, seizures may recur when provoked by sleep deprivation, systemic illness, stress, or drinking alcohol. **Primarily generalized seizures** are the result of a global, synchronous cortical discharge from diffuse cortical disinhibition. This disinhibition may be due to **diffuse, permanent brain injury** as occurs with anoxia, hereditary metabolic disorders, or congenital brain malformations. **Transient metabolic disorders** may also cause such cortical disinhibition, from drugs like cocaine, alcohol withdrawal, toxins such as tetanus, and electrolyte disturbances, particularly the rapid lowering of serum sodium or glucose. Recognition and correction of these treatable conditions is critical.

In **secondarily generalized seizures,** the cortical discharge begins at a focus, the site of an acquired lesion. This lesion may be due to recent or remote head trauma, viral encephalitis, stroke (hemorrhage or infarction), or tumor. The cortical spread of a secondarily generalized tonic-clonic seizure often occurs so rapidly that even an

experienced observer would miss seeing any focal onset. Thus, even if an initial seizure clinically seems to be primarily generalized, that may not actually be the case and an evaluation for a focal lesion should be done. Even with thorough diagnostic testing, however, the etiology of some seizures remains unknown. Non-epileptic **pseudoseizures** may appear as episodic jerking or thrashing movements without any spontaneous cortical discharge, and are a behavior noted in patients often with a history of depression and physical abuse in addition to real epilepsy. Needless to say, these are difficult diagnostic and therapeutic challenges.

Diagnostic testing often includes imaging of the brain. **Magnetic resonance imaging (MRI)** provides a far better scan than computed tomography (CT). An MRI brain scan may show congenital abnormalities causing primarily generalized seizures or a tumor or infarction causing partial or secondarily generalized seizures. In seizure patients suspected of having viral encephalitis, testing the cerebrospinal fluid by lumbar puncture is necessary. Another key diagnostic test is the **electroencephalogram (EEG)**, a scalp electrode recording of "brain waves," which are periodically firing electrical potentials from the summated synaptic activity of pyramidal neurons. The EEG may record brain wave slowing or irritable electrical activity over a focal area, such as the right temporal lobe. However, such focal findings may be found in patients who will never have seizures. A more helpful finding would be the actual EEG recording of a seizure, often a rhythmical spike or spike-wave discharge, but this rarely happens. Sleep deprivation, hyperventilation, photic stimulation (flashing lights), or prolonged EEG recording may increase the chance of recording an actual seizure, but some epileptics never have an abnormal scalp EEG. Clinical observations and eyewitness accounts thus remain very important for the diagnosis of seizures.

Treatment of Seizures

In general, a convulsing patient should be rolled onto his or her side to help maintain an adequate airway. Since the jaw muscles are vigorously contracting during the seizure, insertion of any object into the mouth would be more injurious than helpful. If possible, nearby furniture or other objects should be pushed aside from the patient. After stabilization and transport to the nearest emergency room, the patient should be checked for fractures or other acute injuries in addition to evaluation and management of the seizure. It is critical to recognize and urgently treat any life-threatening metabolic problems causing the seizure, especially hypoglycemia, central nervous system infections, or uncontrolled hypertension. Prompt correction of these conditions alone may prevent further seizures, but in patients having multiple seizures or at great risk for recurrence, anticonvulsant medication is indicated.

It is usually best to use one anticonvulsant drug at a time, increasing the dosage to either achieve seizure control or limiting side effects. These drugs essentially enhance cortical inhibition by affecting sodium or calcium channels, acting as GABA analogues, or a combination of actions. Valproate, lamotrigine, and benzodiazepines treat many seizure types, including primarily generalized convulsive or nonconvulsive (absence) seizures as well as partial or secondarily generalized seizures. An older drug, ethosuximide, is effective for absence seizures. The other anticonvulsants are used

primarily to treat secondarily generalized or partial seizures, and include phenytoin, carbamazepine, oxcarbazepine, gabapentin, pregabalin, levetiracetam, and topiramate. It is often helpful to monitor the serum levels of anticonvulsants when adjusting the doses for patients. Several anticonvulsants may cause confusion, somnolence and ataxia at high serum levels and teratogenicity at minimal serum levels. The presence of nystagmus, dysarthria, dysmetria or ataxia may indicate high levels of these drugs.

Epileptic patients with persistent seizures despite multiple anticonvulsant trials may benefit from epilepsy surgery. Intraoperative EEG monitoring is often needed to clearly identify the seizure focus, which ideally should be surgically resected with little to no residual neurological deficit. Functional brain imaging is also helpful here. Intractable epileptics with severe neurological deficits or mental retardation may be candidates for more extensive surgery, such as extensive removal of cortex or resection of the corpus callosum to prevent seizure generalization.

Generalized tonic-clonic (convulsive) status epilepticus is defined as a continuous, **unabated seizure or series of repeated seizures** from which the patient does not recover, for a period of **30 minutes or longer.** Some experts feel that continued seizures for even 10 minutes represent status epilepticus. In either case, status is a neurological emergency. In addition to any injuries or metabolic disorders caused by prolonged muscle contractions and apnea, brain damage may result from the persistent cortical electrical discharges. When status epilepticus persists or takes a long time to control, survivors are apt to have permanent deficits of memory or cognition. Patients in status epilepticus require emergent life support measures, including mechanical ventilation and oxygenation with immediate correction of any hypoglycemia. Control of seizures here takes precedence over investigating seizure etiology. The anticonvulsants of choice for status are the benzodiazepines, such as diazepam or lorazepam, because of their rapid onset of action. Longer-acting anticonvulsants are added thereafter. More complicated treatment protocols are tried in patients with status refractory to these initial measures.

At Loyola University Medical Center, this is the preferred protocol for treating <u>generalized status epilepticus</u>: first, give lorazepam 0.1 mg/kg (4-8 mg) as an IV bolus, repeatable in 5-10 minutes if needed, followed by loading with either fosphenytoin 20 phenytoin equivalents (PE)/kg IV, no faster than 150 mg/min, or phenytoin 20 mg/kg IV, given in saline no faster than 50 mg/min.