Epilepsy: Comprehensive Overview

1 Definition

Epilepsy is a chronic neurological disorder characterized by recurrent, unprovoked seizures due to abnormal electrical activity in the brain. Seizures vary in type (e.g., focal, generalized) and severity, resulting from an imbalance between excitatory and inhibitory neuronal activity.

2 Etiopathogenesis

Epilepsy arises from a combination of genetic, structural, and environmental factors:

- **Genetic Factors**: Mutations in ion channel genes (e.g., SCN1A in Dravet syndrome), GABA receptor genes, or other neuronal signaling pathways.
- **Structural Causes**:
  - Brain injury: Traumatic brain injury, stroke, or hypoxic-ischemic injury.
  - Developmental abnormalities: Cortical dysplasia, hippocampal sclerosis.
  - Infections: Meningitis, encephalitis, or neurocysticercosis.
  - Tumors: Gliomas or metastases.
- **Metabolic/Other Causes**: Electrolyte imbalances, hypoglycemia, or drug withdrawal.
- **Risk Factors**: Family history, febrile seizures in childhood, head trauma, and central nervous system infections.

3 Clinical Manifestations

Epilepsy manifests as seizures with varying presentations:

- **Focal Seizures**: Originate in one brain region.
  - With preserved awareness: Auras, sensory changes, or unilateral motor symptoms.
  - With impaired awareness: Confusion, automatisms (e.g., lip-smacking).
- **Generalized Seizures**:
  - Tonic-clonic: Muscle stiffening and jerking.
  - Absence: Brief staring spells, often in children.

  - Myoclonic: Sudden muscle jerks.
  - Atonic: Sudden loss of muscle tone ("drop attacks").
- **Complications**: Status epilepticus, sudden unexpected death in epilepsy (SUDEP), injuries, or psychosocial impact.

4 Pathophysiology

Epilepsy results from neuronal hyperexcitability and hypersynchrony, leading to seizures. The flowchart below illustrates the key mechanisms.

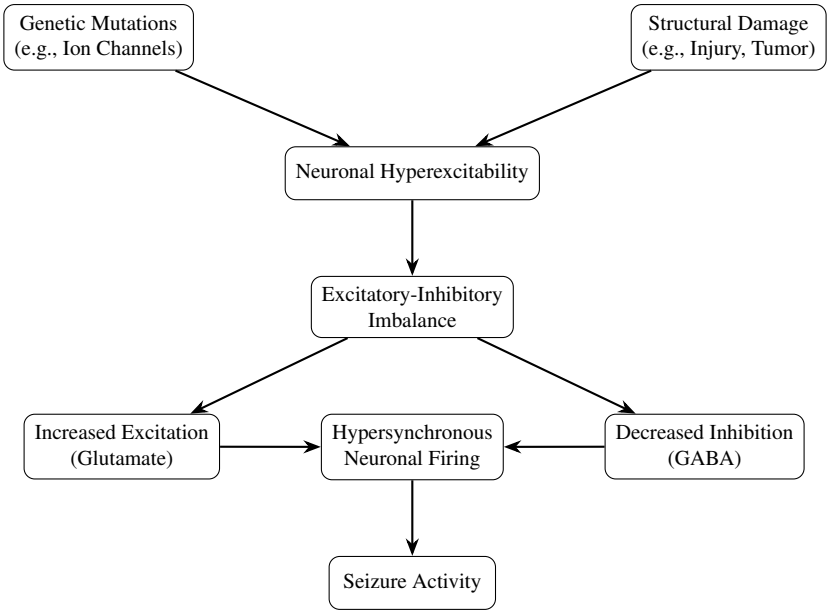

Figure 1: Pathophysiology of Epilepsy

5 Symptoms

- **Focal Seizures**:
  - Sensory: Tingling, visual/auditory disturbances.
  - Motor: Jerking or twitching of limbs.
  - Autonomic: Sweating, nausea.
  - Cognitive: Confusion, déjà vu.
- **Generalized Seizures**:
  - Tonic-clonic: Convulsions, loss of consciousness.
  - Absence: Brief unresponsiveness, staring.
  - Myoclonic: Sudden muscle jerks.
  - Atonic: Sudden falls or head drops.

- **Postictal Symptoms**: Confusion, fatigue, headache after seizures.
- **Associated**: Anxiety, depression, or memory difficulties.

6 Diagnosis

Diagnosis involves clinical evaluation and diagnostic tests:

- **Clinical History**: Seizure description, frequency, triggers, and family history.
- **Electroencephalogram (EEG)**: Detects abnormal electrical activity (e.g., epileptiform discharges).
- **Imaging**: MRI or CT to identify structural causes (e.g., tumors, cortical dysplasia).
- **Laboratory Tests**: Rule out metabolic causes (e.g., glucose, electrolytes).
- **Classification**: Focal vs. generalized, per ILAE (International League Against Epilepsy) criteria.
- **Differential Diagnosis**: Exclude syncope, psychogenic non-epileptic seizures, or migraines.

7 Nonpharmacological Management

Nonpharmacological strategies focus on seizure control and quality of life:

- **Trigger Avoidance**: Identify and avoid triggers (e.g., sleep deprivation, stress, flashing lights).
- **Lifestyle Modifications**:
  - Ensure adequate sleep (7–8 hours/night).
  - Limit alcohol and avoid recreational drugs.
  - Manage stress through relaxation techniques (e.g., meditation, yoga).
- **Patient Education**: Teach seizure first aid, medication adherence, and safety precautions (e.g., avoid driving during uncontrolled seizures).
- **Dietary Therapy**: Ketogenic diet or modified Atkins diet for drug-resistant epilepsy, especially in children.
- **Surgical Options**: For drug-resistant epilepsy:
  - Resective surgery (e.g., temporal lobectomy).
  - Vagus nerve stimulation (VNS).
  - Responsive neurostimulation (RNS).
- **Psychosocial Support**: Counseling or support groups for mental health and stigma.

8 Pharmacological Management

Antiseizure medications (ASMs) are the cornerstone of treatment, tailored to seizure type:

- **Focal Seizures**:
  - **Carbamazepine**: 200–1200 mg/day, effective for focal seizures.
  - **Lamotrigine**: 25–500 mg/day, broad-spectrum.
  - **Levetiracetam**: 500–3000 mg/day, well-tolerated.
- **Generalized Seizures**:
  - **Valproate**: 500–2000 mg/day, effective for tonic-clonic and absence seizures.
  - **Lamotrigine**: Also used for generalized seizures.
  - **Ethosuximide**: 500–1500 mg/day, first-line for absence seizures.
- **Broad-Spectrum ASMs**: Levetiracetam, topiramate (50–400 mg/day), or zonisamide for mixed seizure types.
- **Emergency Treatment**:
  - **Benzodiazepines**: Lorazepam (0.1 mg/kg IV) or midazolam (10 mg intranasal) for status epilepticus.
- **Monitoring**: Adjust doses based on seizure control, side effects, and serum levels (e.g., for phenytoin, valproate).
- **Considerations**: Start with monotherapy; combine ASMs for refractory cases. Taper slowly to avoid withdrawal seizures.