Epilepsy

Epileptic seizures: an abnormal and excessive discharge of brain neurons involving hypersynchrony accompanied by some behavioral change.
Definition of epilepsy

- Epilepsy: – two or more seizures
  - occur in attacks
  - the behavioural changes are usually stereotyped
  - epileptiform abnormalities on EEG

- Acute and recurrent seizures, status epilepticus, occasional convulsion
Epidemiology of epilepsy

1. *The prevalence* within a particular population: 0.3-0.6-1.0%. In children: >1%
2. Man/woman: 1.1-1.7
3. *The incidence*: 0.4-0.7-1.0‰ /year
4. *The chances* of having at least one seizure during a lifetime: 8-10%
New classification of epilepsy (ILAE, 2017)
Classification of epileptic seizures

1. Partial (focal, local) seizures
   1.1. Simple partial seizures
       • with motor signs
       • with somatosensory or special sensory symptoms
       • with autonomic symptoms
       • with psychic symptoms
Classification of epileptic seizures

1.2. Complex partial seizures

- Simple partial onset followed by impairment of consciousness
  - only with impairment of consciousness
  - with automatism
- With impairment of consciousness at onset
1.3. Partial seizures evolving to secondary generalized seizures

- Simple partial seizures →
- Complex partial seizures →
- Simple partial seizures → Complex partial seizures →
Classification of epileptic seizures

2. Generalized seizures
   Absence seizures (typical and atypical)
   Myoclonic seizures
   Clonic seizures
   Tonic seizures
   Tonic-clonic seizures
   Atonic (astatic) seizures

3. Unclassified epileptic seizures
Situation-related seizures

- Febrile convulsions
- Seizures occurring only with an acute or toxic event, due to factors such as alcohol, drugs, eclampsia, nonketotic hyperglycaemia
Pathophysiology and neurobiochemistry of epilepsy

- The role of ION channels: Na\(^+\), Ca\(^{2+}\), Cl\(^-\) and GABA receptor system and the glutamate (NMDA) receptors:

  some antiepileptics have effect on the closing and the opening mechanism of the Na-channel, prolonging the refractor time.
Pathophysiology and neurobiochemistry of epilepsy

- **GABA**: The most important inhibitor neurotransmitter of the brain on the GABA A-Benzodiazepine-Phenobarbital-receptor complex, controlling the opening and closing mechanism of the Chloride-channel.

- **GABA B-receptor** connects to the K+-ion channels and influences the NMDA mediated excitability.
Pathophysiology and neurobiochemistry of epilepsy

- GABA hypofunction causes seizure. The GABA agonists can protect (valproate, vigabatrin, tiagabine).
Developmental cortical malformations with epilepsy

- Pachygyria, heterotopia (nodular), lissencephaly
- Polymicrogyria, shizencephaly, cortical dysplasia (gliosis), microdysgenesis
Developmental cortical malformations with epilepsy

2. *Malformations due to abnormal neuronal and glial proliferation:* microencephaly, non-neoplastic (tuberous sclerosis), neoplastic (ganglioglioma)

3. *Neurocutaneous disorders:* Sturge-Weber syndrome, neurofibromatosis

4. *Others:* subarachnoid cyst, porencephaly
Etiologies of epilepsy

**genetic factors**

- The concordance rate in monozygotic twins: >70%, in dizygotic twins: 15%

- *Occurrence of epilepsy in relatives*
  - In idiopathic epilepsy: 1.3 - 8%
  - In symptomatic epilepsy: 0.5 - 5%
  - In normal population: 0.5%
Etiologies of epilepsy

Genetic factors

Known genes associated with epilepsy:
6p, 16p, 1q, 8q, 10q, 20q, 21q, mitochondrial DNA disorder: MERRF

Epilepsy may occur in 141 genetically determined neurological diseases
Diagnosis of epilepsy

- Seizures are diagnosed primarily by the history (anamnesis, heteroanamnesis)
- Laboratory tests, ECG (Holter), Doppler examination of supraaortic arteries, examination of CSF, toxicology
Diagnosis of epilepsy

**EEG:** routine, sleep deprivation, photic stimulation, HV, digital analysis of power spectrum, sphenoidal recording, Holter EEG, split screen EEG (video+EEG)
LORETA (A low resolution electromagnetic tomography)

Spike
Postspike1
Postspike2
Postspike3

9 years
T3 spike
FOI: 2 Hz
ROI: BA 13, Insula (left), Talairach Z-koord = 1 mm
Diagnosis of epilepsy

- **Neuroimaging**
  - MRI, (CT scan), SPECT, PET
- Genetic examination
- Psychological, psychiatric examination
Nonepileptic paroxysmal disorders

- Cardiovascular
  - Syncope
  - Breath-holding spells (cyanotic, noncyanotic)
  - Mitral valve prolapse

- Cerebrovascular (transient ischemic attack)

- Migraine
Nonepileptic paroxysmal disorders

- Movement disorder
  - Tics, Tourette’s syndrome
  - Myoclonus
  - Chorea and paroxysmal choreoathetosis
Nonepileptic paroxysmal disorders

- Sleep disorders
  - Narcolepsy
  - Sleep terrors and somnambulism
  - Rapid eye movement (REM) sleep disorder
  - Benign sleep jerks
  - Periodic leg movements (nocturnal myoclonus)
Nonepileptic paroxysmal disorders

- Metabolic-toxic (e.g., pheochromocytoma, drug ingestion)
- Gastrointestinal (vomitus, diarrhoea: disturbance of ion levels)
- Psychiatric
  - Psychogenic seizures
  - Somatization and dissociative disorders
  - Panic disorder
  - Intermittent explosive disorder
  - Malingering
Sixty-seventy percent of patients are seizure free on AE therapy and another 25 percent’s are decreased.
Status epilepticus

- After 5 min, after 10 min, should be stopped in an hour
- Life threatening event
- Medication:
  - first choice BDZ: lorazepam, diazepam, clonazepam
  - IV. valproate, levetiracetam, lacosamide
  - IV. phenytoin
  - IV. propofol, midazolam
Surgical treatment of epilepsy

Ten percent to 15% of patients with refractory seizures may be surgical candidates.

The aim of surgery is

- to remove the focus of origin of the seizures
- or to prevent spread of the seizure discharge
- DBS (deep brain stimulation)
VNS

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- Vagus nerve
- Electrodes
- Pulse generator

Anatomical diagram showing the vagus nerve and associated structures, including:
- Lt. glossopharyngeal n.
- Lt. hypoglossal n.
- Lt. ext.CA
- Lt. int.CA
- Lt. CCA
- Lt. vagus n.
- Ext. meatus
- Superior ganglion
- Jugular foramen
- Inferior ganglion
- Lt. accessory n.
- Lt. jugular v.
- Lt. phrenic n.
Presurgical evaluation

- Patient selection
- Clinical evaluation
- EEG (interictal recordings, ictal recordings to document seizure onset, EEG/video telemetry monitoring is required, intracranial EEG recording: epidural electrodes subdural strip electrodes, IC electrodes)
- Neuroimaging (MRI, SPECT, PET, functional MRI)
- Neuropsychological Psychiatric Assessment
Subdural records
Lesionectomy (dysplasia, ganglioma, low grade gliomas, vascular anomalies, neuronal migration, in presence of mesial-temporal sclerosis)

Selective amygdalohippocampectomy (focal mesio-temporal sclerosis)
Surgical procedures

- Anterior temporal lobectomy (amygdala, anterior hippocampus, anterior temporal neocortex)
- Hemispherectomy (Sturge-Weber syndrome, Lennox-Gastaut Syndrome)
- Corpus callosotomy (anterior two-thirds or complete; atonic seizures, Lennox-Gastaut Syndrome)
- Multiple subpial transection
Temporal lobectomy