Benign childhood focal seizures

- Benign childhood focal seizures & related idiopathic epileptic syndromes affect approximately 22% of children with non-febrile seizures.
- The most useful diagnostic test is the EEG.
- The combination of a normal child with infrequent seizures and an EEG showing normal background with disproportionately severe spike activity is highly suggestive of these benign childhood syndromes (Panayiotopoulos 1999).

Three identifiable epileptic syndromes (by ILAE)
- Benign childhood epilepsy with centrotemporal spikes (Benign Rolandic Epilepsy)
- Panayiotopoulos Syndrome
- Benign Childhood Epilepsy with Occipital Paroxysm- Gastaut (CEOP-G) including the idiopathic photosensitive occipital lobe epilepsy

Benign focal epilepsy with centrotemporal spikes (Benign Rolandic Epilepsy)

- ~15-20% of childhood epilepsy
- onset 1-7 years; peak 3-5 years
- All seizures stop around 15-16 years
- nocturnal onset of seizures
- autosomal dominant with low penetrance
- 66% have only 1-2 szs (Lerman & Kivity)
- No relationship between interictal- clinical course
- 7-11% had status

Clinical manifestations:
- parasthesia in the lips gums, and inner cheeks
- focal motor seizures: face, face + hand, rarely lower extremity, salivation, speech arrest
- generalized tonic clonic seizures
- good response to treatment (which is often not required)
- <4 y/o higher incidence of Sz, may need Rx (Loiseau)

EEG Findings-Benign Rolandic Epilepsy

- Timing: 75% in sleep
- Inter-ictal EEG: Normal background with abundant clusters of CTS, markedly accentuated during sleep.
- In 10% to 20%, CTS evoked by somatosensory stimuli.
- Rarely, CTS only during sleep, very small CTS or normal awake.
- CTS occur in 2% to 3% of normal school-age children and in a variety of organic brain diseases. They are age-dependent and disappear before age 16.
- Frequency, location, and persistence of CTS do not determine clinical manifestations, severity, and frequency of seizures or prognosis.
- Ictal EEG: Slow waves and spikes, with onset from the Rolandic regions.
**PANAYIOTPoulos Syndrome (PS)**

- **Prevalence**
  13% of children with non-febrile seizures aged 3 to 6 years, 6% in the age group 1 to 15 years.

- **Age at onset**
  3 to 6 years in 74% of cases; range 1 to 14 years.

- **Sex**
  Males = females.

- **Neurological and mental state**
  Normal.

- **Genetic and other factors**
  Febrile seizures in ~17%. Occurrence in other siblings is exceptional.

**Clinical manifestations - PS**

- The seizures mainly autonomic symptoms
- Ictal vomiting - most common (70% to 80%).
- Other ANS pallor, incontinent urine/feces, mydriasis/miosis, cardio-respiratory irregularities, ictal syncope (unresponsive and flaccid) hypersalivation, thermoregulatory changes.
- Behavioral ictal features - irritability or quietness, feels unwell.
- Consciousness usually intact at onset but severely disturbed in the seizure progression.
- Other ictal features include eye deviation (60% to 80%); half progress to hemiclonizations or generalized convulsions.
  Visual hallucinations are rare (10%) and do not appear at the onset.
- Duration is long, typically 5 to 10 min; nearly half have autonomic status epilepticus (>30 min).
EEG findings- PS

- **Timing**
  2/3 of the seizures occur in sleep.

- **Inter-ictal EEG**
  Multifocal spikes are the more common; occipital spikes +/- extra-occipital spikes predominate, extra-occipital spikes (1/3) or brief generalized discharges may occur, 1/10 have normal EEG.

- **Ictal EEG**
  Focal slow waves intermixed with spikes. May start posteriorly or anteriorly.

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**Fixation off sensitivity**

- Opening the eyes immediately eliminated the occipital paroxysms for as long as the eyes were opened.
- The occipital paroxysms were similarly activated by elimination of fixation and central vision (darkness, vision through goggles covered with semitransparent tape) and not related to eye opening in darkness.

Panayiotopoulos, 1980
Benign Childhood Epilepsy with Occipital Paroxysm- Gastaut (CEOP-G)

- **Prevalence**
  ~2% to 7% of benign childhood focal seizures.

- **Age at onset**
  3 to 15 years; mean ~8 years.

- **Sex**
  Males = females.

- **Neurological and mental state**
  Normal.

- **Genetics**
  Probably genetically determined.

**Frequent visual seizures; elementary visual hallucinations, blindness, or both.**

**Ictal elementary visual hallucinations:** small multicolored circular patterns that often appear in the periphery of a visual field, last for several sec to 1 to 3 min.

**Other occipital symptoms:** (sensory illusions of ocular movements and ocular pain, tonic deviation of the eyes, repetitive eye closures).

**Complex visual hallucinations/illusions, and other symptoms from anterior spreading may terminate with hemiconvulsions or generalized convulsions.**

**Ictal blindness usually sudden and lasts for 3 to 5 min.**

**Ictal headache, mainly orbital, occurs in 1/10 of patients.**

**Interictal EEG**

- Occipital spikes, often with fixation off sensitivity. The EEG shows occipital spike-wave paroxysms that are attenuated or disappear when the eyes are opened (Panayiotopoulos 1999a).
- Others may have only random occipital spikes, some may have occipital spikes in sleep EEG alone, and a few may consistently have normal EEG. Whether occipital photosensitivity is part of this syndrome or not is debated.

**Ictal EEG**

- Occipital discharge of fast rhythms, fast spikes, or both.

**Prognosis**

Relatively good. Half of patients will remit within 2 to 4 years from onset. The others will continue having visual seizures and infrequent secondarily generalized tonic-clonic seizures, particularly if not appropriately treated with carbamazepine.

**Differential diagnosis**

Migraine, symptomatic occipital epilepsy

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Interictal EEG in five patients with PS separated by vertical lines. Despite similar clinical features, spikes are localized in the occipital, centro-temporal and frontal regions or they are frequently multifocal and may appear as clone-like, repetitive, spike-wave complexes. Brief generalized discharges of slow wave with small spikes (extreme right) are sometimes an interictal EEG feature.

Interictal EEG in two patients with ICOE-G separated by a vertical line. Left: Classical occipital paroxysms demonstrating FOS. Right: spontaneous scattered occipital spikes and occipital photosensitivity.

TEMPORAL LOBE EPILEPSY (TLE)

- **Prevalence**
  ~30% to 50% of all epilepsies; 2/3 mesial and 1/3 lateral TLE.

- **Age at onset**
  Mainly late childhood to adolescence.

- **Sex**
  Males = females.

- **Neurological and mental state**
  Depends on etiology.

- **Etiology**
  Symptomatic, cryptogenic, idiopathic. Hippocampal sclerosis is the most common. Other structural causes: tumors, vascular, malformations of cortical development, traumatic, viral and other infectious and parasitic disorders, and CVA.

**Clinical manifestations - TLE**

- Depend on whether seizures are of mesial TLE or lateral TLE (neocortex).
- MTLLE: ascending epigastric aura and fear in simple focal seizures. Oro-alimentary automatisms typically occur in complex focal seizures (~70%).
- LTLE: auditory hallucinations/illusions, vestibular phenomena, experiential symptoms, visual hallucinations/misperceptions. Language disturbances in dominant hemispheric focus.
- Post-ictal symptoms are very frequent and often severe.
- Secondarily generalized tonic-clonic seizures (GTCS) are infrequent in properly treated patients.

**EEG Findings - TLE**

- **Inter-ictal EEG**
  In half of patients, single routine EEG is normal or with non-specific abnormalities. Only 1/3 show the classic spike or sharp and slow-wave focus in the anterior temporal electrode. Prolonged EEG monitoring, along with sleep EEG, increases the yield to 70% to 80%. Half have regional temporal inter-ictal runs of slow waves, which are of lateralizing value.

- **Ictal EEG**
  Rhythmic 4 to 7 Hz slow activity over the affected temporal lobe, before or simultaneously with clinical events. Fast spiking is exceptional.
Bilateral independent temporal spikes
FRONTAL LOBE EPILEPSIES

- **Prevalence**
  - ~1% to 2% of all epilepsies; 22.5% among focal epilepsies in community studies; second, after temporal lobe epilepsy (TLE) in neurosurgical series.

- **Age at onset**
  - Any age.

- **Sex**
  - Males = females.

- **Neurological and mental state**
  - Depends on etiology.

- **Etiology**
  - Symptomatic, cryptogenic, and idiopathic (Autosomal dominant nocturnal frontal lobe epilepsy).
  - In neurosurgical series, 2/3 are symptomatic from MCDs (57.4%), tumors (16.4%), traumatic and other lesions (26.2%).

COMMON FRONTAL LOBE SEIZURES SEMIOLOGY

- **Frontal seizures from the motor cortex**
  - Simple focal motor clonic or tonic-clonic seizures with or without Jacksonian march to neighboring motor regions. Hand and main thumb, face, and lips are preferentially affected (per the motor homunculus).
  - Myoclonic seizures are unilateral or bilateral such as in epilepsy partialis continua of Kozhevnikov.
  - Tonic postural motor with clonic movements.

- **Frontal seizures from the supplementary sensorimotor area (SMA)**
  - Stereotyped hypermotor seizures of bilateral and asymmetric tonic posturing of limb-girdles, often with contraversive of the eyes and head, vocalizations, or speech arrest.
  - Brief for sec.
  - Abrupt onset and termination.
  - Nocturnal circadian distribution; rarely occur in awake states.
  - High frequency, sometimes many per night.
  - Lack of post-ictal confusion.
  - Somatosensory and ill-defined auras (not epigastric) are common.

- **Cingulate**
  - Cingulate seizure patterns are complex partial with complex motor/gestural automatisms at onset. Autonomic signs are common, as are changes in mood and affect. Gelastic seizures of frontal lobe origin emanate from this region.

- **Anterior frontopolar**
  - Anterior frontopolar seizure patterns include forced thinking or initial loss of contact and adversive movements of head and eyes, with possible progression including contraversive movements and autonomic signs.

- **Orbitofrontal**
  - Orbitofrontal seizures are complex partial seizures with initial motor and gestural automatisms, oflactory hallucinations and illusions, and autonomic signs.

- **Dorsolateral**
  - Dorsolateral seizure patterns may be tonic or, less commonly, clonic with versive eye and head movements and speech arrest. Seizures characterized by unusual symptoms of “forced thinking” and “forced acts” usually emanate from the dorsolateral intermediate frontal lobe.

- **Opercular**
  - Opercular seizure characteristics include mastication, salivation, swallowing, laryngeal symptoms, speech arrest, epigastric aura, fear, and autonomic phenomena. Simple partial seizures, particularly partial clonic facial seizures, are common and may be ipsilateral. If secondary sensory changes occur, numbness may be a symptom, particularly in the hands. Gustatory hallucinations are particularly common in this area.
Left Frontal lobe: Dialectic->Fearful-> R fencing
Occipital Epilepsies

- **Prevalence**
  ~5% to 10% of epilepsies, both in neurosurgical series and demographic studies.

- **Age at onset**
  Any age. Idiopathic occipital epilepsy appears in late childhood.

- **Sex**
  Males = females.

- **Neurological and mental state**
  Normal or abnormal depending on etiology.

- **Etiology**
  Symptomatic, cryptogenic, idiopathic, or metabolic. Symptomatic causes are congenital, residual, or progressive (malformations of cortical development, vascular, neoplastic, metabolic, hereditary, congenital, inflammatory, parasitic infections). Metabolic or other derangement such as eclampsia may have a particular predilection for the occipital lobes. There is an association between coeliac disease and occipital lobe epilepsy. Occipital seizures may be the first manifestation of Lafora disease or mitochondrial disorders.
Landau-Kleffner Syndrome (LKS)

- In 1957 Landau & Kleffner described 6 children with relatively mild and self-limited seizure disorder, lost their language skills and developed an aphasia.
- Acquired epileptic aphasia (ILAE, 1989)
- LKS was the first syndrome linking epilepsy, electroencephalographic (EEG) activity, and isolated language loss [Beaumanoir1992; Deonna1991; Landau and Kleffner1957]

LKS: Clinical Manifestations

- Acquired aphasia and paroxysmal, sleep-activated EEG paroxysms predominating over the temporal or parieto-occipital regions.
- Secondary symptoms: psychomotor or behavioral disturbances and epilepsy with a favorable outcome for seizure control.
- Male: female approximately 2:1 ratio
- Affects children after having achieved early developmental milestones
- Usual age of presentation: 3-9 years old
- “Word deafness” or auditory verbal agnosia extends to familiar noises including bells, whistles, or a ringing phone

LKS: EEG findings

- Bilateral independent temporal or temporoparietal spikes,
- Bilateral 1-3 Hz slow-wave maximally temporal activity,
- Generalized sharp- or slow-wave discharges, and multifocal or unilateral spikes as described.
- Significant activation of SWC during non-REM sleep
- Eventually in LKS, essentially all patients have bilateral spike-and-wave over 85% of non-REM sleep (ESES).
- LKS represents selective loss of language in association with an abnormally paroxysmal EEG, eventually characterized by ESES
LKS: EEG findings
- EEG abnormalities as epiphenomena of underlying pathology of cortex concerned with speech rather than cause if the aphasia (Holmes 1981)
- Transient suppression of EEG discharges with IV BZD does not result in improvement of aphasia
- EEG changes may not be accompanied by a charge in aphasia
- Aphasia not respond to AED despite sz control
- Aphasia persists into adulthood despite normalization of EEG

Alternatively, improvement and worsening may coincide in the same direction, particularly in the sleep EEG.
Disappearance of continuous spike-wave may herald improvement of aphasia.
Patients with otherwise classical seizures of rolandic epilepsy may develop atypical seizures, includes generalized tonic-clonic, atonic, and atypical absences, as well as ESES and cognitive or behavioral disturbances

Treatment
- High dose corticosteroids – best results, prolonged Rx or intermittent may be necessary
- VPA, ETX, BZD and new AEDs
- Sulthiame
- IVIG
- MST
MST (Multiple Subpial Transections)
Morrell & Hanbery introduced the technique over 30 yrs ago for the elimination of epileptogenic foci in eloquent cortex, based on the premise that regional seizure spread depends on horizontal connections in the cortex and that the primary functions of the cortex (language, sensory, and motor) are more dependent on the vertical input of thalamocortical and subcortical association pathways. Interruption of the horizontal connections by multiple, closely spaced linear subpial incisions—
with sparing of the long entering and exiting vertical axons—should therefore (in theory) eliminate the epileptic processes while sparing the primary "eloquent" cortical function. [Morrell and Hanbery, 1969; Morrell et al., 1995]

Electrical Status Epilepticus in slow wave Sleep (ESES) or CSWS
- Patry et al (1971) described a syndrome, electrical status epilepticus in slow wave sleep (ESES), where continuous epileptiform activity in slow wave sleep was associated with regression of specific skills, including language [Patry et al.1971; ILAE1989; Tassinari et al., 2000; 2002]
- ESES (or CSWS) is an age-specific epilepsy characterized by continuous spike activity in slow wave sleep and associated with cognitive and behavioral decline
- Spectrum of cognitive decline includes language, memory, global intelligence, and in some cases motor function

Continuous Spike activities during slow Wave Sleep (CSWS) or ESES
- A heterogeneous epileptic disorder
- A deterioration of neuropsychological functions assoc. with or independent from the epileptic disorder
- A deterioration of motor functions
- Peak age of onset: 5 to 7 years (similar to LKS)
- Incidence: <1% of childhood onset epilepsies
- ~ 1/3 have preexisting neurological abnormalities
- 1/3 to 2/3 of cases have abnormal imaging
- Most common abnormalities being atrophy (either unilateral or diffuse) and errors in brain development include polymicrogyria
- No reports of actual pathological specimens in ESES

ESES (Encephalopathy with Status Epilepticus during slow wave sleep)
Dx Criteria [Tassinari et al., 2000,2002]
1. Neuropsychological impairment; global or selective regression
2. Motor impairment; ataxia, dyspraxia, dystonia
3. Epilepsy, with focal and/or generalized (tonic seizure never occur)
4. ESES > 85% during slow wave sleep and persisting 3> records over at least 1 mo
ILAE criteria: Far less stringent and simply describe continuous EEG activity during slow-wave sleep, as well as substantial activation from the awake state [Commission on Classification, 1989].

ESES: Treatment
- Based on the seizure type(s) and EEG pattern.
- Sz typically more difficult to control than in LKS.
- Treatment of the cognitive, language, and behavioral deficits is aimed at abolishing the EEG abnormality, although normalization of the EEG does not always correlate with clinical improvement.
- Steroids (primarily high-dose prednisone) appear to be the treatment of choice [Tassinari et al., 2002].
- No randomized clinical trials; treatment is based on limited amount of data, much of which comes from LKS
- ESES has not been considered surgically treatable.

High dose Diazepam Rx in ESES
- De Negri et al proposed a treatment of ESES with high doses DZP in short cycles (3 weeks): 7/8 patients responsive to the DZP test (87%). [Brain & Dev 1993;15: 311-312 ]
- DZP test 1 mg/kg iv. with EEG monitoring -> 0.5mg/kg q hs x 3-4 wks
- De Negri et al (1995): 43 ESE from TS, LKS, ESES, Infantile spasm, Gen symptomatic epilepsy, etc treated with High-DZP
- A remission of ESE was obtained in 58% of cases, a negative response in 42%, particularly in hypsarhythm patterns.
- The response to treatment was positive in 64%, particularly in ESES [Brain & Dev 1995; 17: 330-333 ]
ESES: Prognosis

- Prognosis - variable.
- The seizures, even if initially severe, typically remit in adolescence, although there is considerable variability as to when.
- Language, cognitive, and behavioral deficits typically also improve, but frequently left with persistent, often severe, deficits.
- Only 1/2 were leading a normal life as adults [Tassinari et al., 2002].
- Mortality is low.

Clinical and EEG Features of LKS and ESES

<table>
<thead>
<tr>
<th></th>
<th>Age at regression</th>
<th>Gender ratio</th>
<th>Regression</th>
<th>Cognitive impairment</th>
<th>Seizure disorder</th>
<th>EEG findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>LKS</td>
<td>3–8 years</td>
<td>2:1 male</td>
<td>Isolated language</td>
<td>Acquired receptive deficits with well established verbal skills</td>
<td>Easily controlled with AEDs</td>
<td>Predominantly temporal spikes, usually bilateral, frequent, activated in sleep</td>
</tr>
<tr>
<td>ESES or CSWS</td>
<td>5–7 years</td>
<td>3:2 male</td>
<td>Language; May also involve memory and behavior</td>
<td>Language, memory, behavior, and cognitive impairment of varying severity</td>
<td>Difficult to control with AEDs</td>
<td>Generalized or focal CSWS</td>
</tr>
</tbody>
</table>

ESES: Electrical Status Epilepticus in Slow Wave Sleep
CSWS: Continuous slow spike and wave during non-REM