Neonatal seizures

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Significance of Neonatal seizures

Neonatal seizures may be the first and only clinical sign of central nervous system disorder in a newborn. May indicate presence of treatable condition prompting evaluation and treatment. Seizures may contribute to further brain injury.
Definition: Paroxysmal behavior caused by hypersynchronous discharge of a group of neurons.

May be classified as:

**Clinical only seizure:** Sudden paroxysm of abnormal clinical changes that do not correlate with simultaneous EEG seizure

**EEG only seizure** (sub-clinical seizure): Definite EEG seizure not accompanied by any visible clinical signs

**Electro-clinical seizure:** Definite clinical seizure signs simultaneously coupled with EEG seizure
Epidemiology of Neonatal Seizures

- Seizures occur most frequently in newborn period than any other time of life, most often in the first week of life.
- Reported incidence varies 1.5 to 5 per 1,000 newborns and up to...and varies with specific risk factors.
- Incidence may be significantly underestimated due low accuracy of diagnosis based on clinical signs and lack of population-based studies using cEEG.
- Increased incidence with decreasing gestational age and birth weight and with increasing acuity of illness.
Pathophysiology of neonatal seizures

Neonatal brain is hyperexcitable compared to adult brain:
- Critical period of synaptogenesis
- Glutamatergic (excitatory) receptors are over-abundant
- GABA (inhibitory) receptors are reduced
- GABA exerts a paradoxical excitatory action due to ↑NKCC1 and ↓KCC2 expression

![Graph showing the developmental profile of glutamate and GABA receptor expression and function.](Image)
Types of seizures

Clinical classification usually according to motor manifestations

**Clonic**: Most common overt clinical seizure in newborn, slow migratory rhythmic jerking of one or more body parts in a non-ordered fashion, not stopped with restraint. Not the same as generalized tonic-clonic seen in older children.

**Tonic**: Less common, sustained but transient asymmetrical posturing of extremities or trunk resembling decerebrate posturing. Associated focal EEG events.

**Myoclonic**: Rare, seen in conjunction very abnormal EEG and exam, diverse range movements, contractions of muscle groups usually non-repetitive and erratic.
Types of seizures (continued)

**Subtle or subclinical:** Most common type in newborn, either no signs or subtle ocular movements, lip smacking, swimming or bicycling, apnea.

**Autonomic changes:** Changes in heart rate, blood pressure, respirations, flushing, pupil dilation. Rarely associated EEG events unless other features present.
Diagnosis of neonatal seizures

Historically, the diagnosis of seizures was most often made based on clinical signs. However, EEG studies have demonstrated that not all clinically suspicious events are epileptic seizures and most neonatal seizures are sub-clinical.

Inaccurate seizure diagnosis has important consequences:

• Neonates with subclinical seizures are undertreated without cEEG screening

• Infants with suspicious activity that is not associated with EEG events may be exposed to unnecessary medications
Differentiating seizures from non-seizure events

- **Purpose:** To determine the gap between EEG seizure burden, video recorded clinical findings, and clinical documentation of seizures by neonatal clinicians

- **Method:** 51 infants at risk for seizures were monitored with video EEG

- **Results:**
  
  9 had EEG seizures and 3 had clinical seizures
  
  Of 526 EEG seizures, only 34% had clinical manifestations
  
  Of 177 clinical seizures, 27% had EEG seizures

Percentage time electrographic seizures had clinical signs recognized by clinicians

Inter-observer agreement in seizure identification

**Purpose:** Determine the accuracy in distinguishing seizures from other neonatal movements

**Methods:** 137 clinicians (90 MD, 46 other) given clinical history and shown 20 video clips (11 EEG seizures and 9 non-seizures)

**Results:** Average number of events correctly identified - 50%
Clonic seizures were most frequently correctly identified (36-96%)
Subtle seizures were poorly identified (20-49%)

**Conclusions:** Impossible to accurately differentiate EEG seizures from other non-seizure events using clinical findings
Until cEEG is more widely available likely many babies with seizures will be undetected while others will be treated unnecessarily.

Uncoupling or electro-clinical dissociation

**Definition:** Persistence of electrographic seizures despite suppression of ≥50% clinical seizures

**Methods:** 50 newborns with EEG and clinical seizures treated with either PB or phenytoin

**Results:**
24 had no EEG or clinical seizures
26 had persistent seizures:
- 5 EEG only
- 10 ≥ 50% suppression clinical seizures
- 11 < 50% suppression clinical seizures

**Conclusion:** 58% newborns had “uncoupling” with only or predominantly EEG seizures following treatment with anticonvulsants