Detection of Neonatal Seizure

Samsung Seoul Hospital
Pediatric Neurology
Jeehun Lee, M.D.
Neonatal Seizure

- Seizures appeared in the first 4 weeks of life
- The first and important clinical sign of CNS disorder in the neonate
- May leave a permanent mark on the developing CNS
- Controversies related to the characterization and classification of neonatal seizures
Diversities

- Neonatal seizures: a diverse group of clinical events
- Varying clinical manifestations
- Diverse pathophysiological mechanisms of generation and propagation
- Various treatment strategies and long-term outcomes
Epidemiology

- Neonatal period is one of the great period of seizure occurrence in all life span.

- Reported incidence rates: 1.5-5.5 per 1,000 neonates

- Greater frequency of seizure in premature or LBWI
  - 57.5 per 1,000 in VLBWI (<1,500g)
  - 4.4 per 1,000 in LBWI (1,500-2,499g)
  - 2.8 per 1,000 in normal birth weight infants (2,500-3,999g)

- Most neonatal seizures occur within the first weeks of life, majority within the first few days

- Incidence varies with specific risk factors: birth weight, degree of illness, etiologies
Ictal Features

- Ictal features are unique compared with seizures in older infants and children

- Fragmentation, disorganization, unusual patterns of spread, asynchronous multiple regions of involvement

- Due to different mechanisms of epileptogenesis and the state of immature brain

- Relative importance of ‘nonepileptic mechanisms’ of seizure generation
Clinical Characteristics

- **Clinical classification**
  - Clonic or tonic, not tonic-clonic
  - Focal: unifocal or multifocal
  - Myoclonus

- **Subtle seizures**
  - Anarchic or minimal seizures
  - Oral-buccal-lingual movements: sucking, chewing
  - Movements of progression: bicycling of the legs, swimming movements of arms
  - Random eye movements
  - ‘Brain stem release phenomena’, ‘motor automatisms’: exaggerated reflex behaviors
Clinical Characteristics

- Non-motor phenomena
  - Vasomotor changes
  - Apnea, pallor
  - Changes in respiration, or heart rate
  - Excessive salivation
  - Elevation in blood pressure

- These occur, perhaps exclusively, in association with motor phenomena
Focal Clonic Seizures

- Repetitive, rhythmic contraction of muscle groups of the limbs, face, or trunk
- Maybe unifocal or multifocal
- May occur asynchronously or asynchronously in muscle groups on one side of the body or on both sides
- Cannot be suppressed by restraint
- Epileptic pathophysiology
Focal Tonic Seizures

- Sustained posturing of single limbs
- Sustained asymmetric posturing of the trunk
- Sustained eye ball deviation
- Cannot provoked by stimulation or suppressed by restraint
- Epileptic pathophysiology
Generalized Tonic Seizures

- Sustained symmetric posturing of limbs, trunk, and neck
- May be flexor, extensor, or mixed
- May be provoked or intensified by stimulation
- May be suppressed by restraint or repositioning
- Presumed pathophysiology: nonepileptic
Myoclonic Seizure

- Random, single, rapid contractions of muscle groups of the limbs, face, or trunk

- Typically not repetitive, or may recur at a slow rate

- May be generalized, focal, or fragmentary

- May be provoked by stimulation

- Presumed pathophysiology: may be epileptic or nonepileptic
Spasms

- May be flexor, extensor, or mixed
- May occur in clusters
- Cannot provoked by stimulation or suppressed by restraint
- Epileptic pathophysiology
Subtle Seizures

- **Motor automatisms, Ocular signs**
  - Random and roving eye movements or nystagmus

- **Oral-buccal-lingual movements**
  - Sucking, chewing, tongue protrusions

- **Progression movements**
  - Rowing or swimming movements
  - Pedaling or bicycling movements of the legs

- **Complex purposeless movements**
  - Sudden arousal with transient increased random activity of limbs
Classification: Pathophysiology

- Nonepileptic seizures: subtle seizures
- Features more consistent with reflex phenomena
- Provoked by tactile stimulation
- The intensity of response: proportional to stimulus
- Suppressed by restraint or repositioning
Classification: Pathophysiology

Seizure of epileptic origin

- Focal clonic – unifocal, multifocal, hemiconvulsive, axial

- Focal tonic – asymmetrical truncal posturing, limb posturing, sustained eye deviation

- Myoclonic – generalized, focal

- Spasms – flexor, extensor, mixed
Classification: *Etiology*

- **Idiopathic**
  - Benign familial neonatal seizures (BFNS)
  - Benign idiopathic neonatal seizures (BINS)

- **Symptomatic**
  - Most neonatal seizure
  - HIE, ICH, CNS infections, infarction, metabolic
  - Chromosomal anomaly, CNS anomaly, neurodegenerative diseases

- **Cryptogenic**
Detection of Neonatal Seizure

- Clinical diagnosis

- Knowledge of epileptic and non-epileptic seizure is prerequisite

- Recognize high risk patients with symptomatic etiologies

- Treatment for metabolic etiologies and diagnosis is parallel
Detection of Neonatal Seizure

- Electrophysiologic diagnosis

- VEM is gold standard, but is not always available.

- Conventional EEG with clinical observation by trained electro-neuro-diagnostic technologist is very useful.
Interictal EEG

- Interictal epileptiform discharges in neonatal EEG: not considered as direct evidence of seizure

- Meaningful focal sharp waves
  : Persistent, excessively numerous, high amplitude, present in waking and sleep status, complex morphology

- Multifocal sharp waves: suggest diffuse brain dysfunction such as meningitis or hypoglycemia

- Interictal BG abnormality: extent and type of CNS dysfunction, risk of seizure
Ictal EEG

- Electrical seizure activity in neonate is rare before 34-35 weeks of GA

- Frequency, voltage, and morphology of the seizure discharges varies
  - Within an individual seizure
  - Between seizures in an individual infant
  - Among infants

- The minimum duration: 10 seconds

- The electrical events
  - Focal and well circumscribed
  - Frequently arise from the unilateral C or CT region
  - Gradual widening of focal area, involvement of entire hemisphere, or migration to another area
Summary

- Neonatal seizures are a diverse group of clinical events with varying clinical manifestations, pathophysiologica mechanisms, treatment strategies and long-term outcomes.

- Neonatal seizures are classified as epileptic and nonepileptic seizures based on electroclinical findings.

- Neonatal seizures have unique interictal and ictal characteristics, and can be diagnosed by clinical observation with the assistant of EEG and initiation of treatment for metabolic derangements.