PAEDIATRICS NEUROLOGY
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NEONATAL SEIZURE

Neonates are at particular risk for the development of seizures because the immature brain is more excitable, 2^{ndly} metabolic, toxic, structural, and infectious diseases are more likely to be manifested during this age.

Generalized tonic-clonic convulsions tend not to occur in the 1st mo of life because the arborization of axons and dendritic processes as well as myelination is incomplete in the neonatal brain, so seizure discharge cannot readily be propagated throughout the neonatal brain to produce a generalized seizure.

TYPES OF NEONATAL SEIZURES

There are 5 main neonatal seizure types: subtle, clonic (focal, multifocal), tonic, spasms, and myoclonic.

According to clinical and electrical activity, they are divided into:

1- Clinical seizure with a consistent EEG event: these are clearly epileptic and are likely to respond to an anticonvulsant.
2- Clinical seizures with inconsistent EEG events: those represent release phenomena with abnormal movements secondary to brain injury rather than true epileptic seizures,
3- Electrical seizures with absent clinical seizures: electrical seizures in comatose infants or those persist after the introduction of an anticonvulsant.

Subtle Seizures

Subtle seizures include transient eye deviations, nystagmus, blinking, mouthing, abnormal extremity movements (rowing, swimming, bicycling, pedaling, and stepping), fluctuations in heart rate, hypertension episodes, and apnea. Subtle seizures occur more commonly in premature than in full-term infants.

Seizures vs Jitteriness

Jitteriness can be defined as rapid motor activities, such as a tremor or shake, that can be ended by flexion or holding the limb. Seizures, on the other hand, generally do not end with tactile or motor suppression. Jitteriness, unlike most seizures, is usually induced by a stimulus. Also unlike jitteriness, seizures often involve eye deviation and autonomic changes.

ETIOLOGICAL CLASSIFICATION

AGES 1-4 DAYS

- Hypoxic–ischemic encephalopathy

- Drug withdrawal (maternal drug use of narcotic or barbiturates)
- Drug toxicity: lidocaine, penicillin
- Intraventricular hemorrhage
- Acute metabolic disorders: Hypocalcemia, Sepsis, Maternal hyperthyroidism., Hypoglycemia, Hypomagnesemia, Hyponatremia or hypernatremia
- Inborn errors of metabolism.
- Pyridoxine dependency.

AGES 4-14 DAYS

- Infection: Meningitis (bacterial), Encephalitis (enteroviral, herpes simplex)
- Metabolic disorders: Hypocalcemia, Hypoglycemia
- Inborn error of metabolism
- Drug withdrawal, maternal drug use of narcotics or barbiturates
- Benign neonatal convulsions, familial and non familial
- Kernicterus, hyperbilirubinemia
- Epilepsy, neonatal diabetes syndrome

AGES 2-8 WK

- Infection: Herpes simplex or enteroviral encephalitis, Bacterial meningitis
- Head injury
- Subdural hematoma, Child abuse
- Inborn error of metabolism
- Malformations: lissencephaly, Focal cortical dysplasia
- Tuberous sclerosis, Sturge-Weber syndrome

APPROACH TO NEONATAL SEIZURE

- Determinations of **glucose, calcium, magnesium, electrolytes, and blood urea nitrogen.**
- A **lumbar puncture** is indicated in virtually all neonates with seizures, unless the cause is obvious.
- Unintentional **injection of a local anesthetic** into a fetus during labor can produce intense tonic seizures. Examination may show a needle puncture of the skin or a perforation or laceration of the scalp. An elevated serum anesthetic level confirms the diagnosis.
- Careful neurologic examination of the infant may uncover the cause of the seizure disorder, e.g. spastic limbs in CP.
- Examination of the **retina** for chorioretinitis, suggesting a TORCH infection.
- Inspection of the **skin** : hypopigmented lesions (tuberous sclerosis) or the typical crusted vesicular lesions (incontinentia pigmenti).
- An unusual body or urine odor suggests an inborn error of metabolism.

- I**nborn errors of metabolism** cause generalized convulsions. Autosomal recessive or X-linked recessive fashion, so careful family history be obtained if there is consanguinity or whether siblings or close relatives developed seizures or died at an early age.
- **EEG** can show epileptic paroxysmal activity.
- **Pyridoxine dependency,** a rare disorder, must be considered when seizures begin shortly after birth with signs of fetal distress in utero and are resistant to conventional anticonvulsants.
- For focal seizures: **MRI or CT scan.**

TREATMENT

- A mainstay in the therapy is the diagnosis and treatment of the underlying etiology.
- AED: for clinical seizure and electrographic seizure. Phenobarbital is the drug of choice followed by phenytoin. Whether to use a benzodiazepine first depends on the clinical situation.

PROGNOSIS.

The underlying etiology of the seizures is the main determinant of outcome.

STATUS EPILEPTICUS

It is defined as continuous seizure activity or recurrent seizure activity without regaining of consciousness lasting for more than 20- 30 min. At present, the duration has been reduced to 5 min because of the risks involved with the longer durations, at the same time, the same measure to control fit must be followed in both conditions. It may be convulsive or non-convulsive.

It is a medical emergency, it requires an organized and skillful approach to minimize the associated mortality and morbidity. **Refractory status epilepticus** is status epilepticus that has failed to respond to therapy, usually with at least 2 medications.

During status epilepticus there is increased cerebral metabolic rate and a compensatory increase in cerebral blood flow that, after a period, is not able to keep up with the increases in cerebral metabolic rate. This leads to a transition from adequate to inadequate cerebral oxygen tensions and, together with other factors, contributes to neuronal injury. Prolonged status epilepticus has been associated with severe damage to the hippocampus in children (**hippocampal sclerosis)**. It may also lead to dysfunction of the autonomic nervous system with hypotension and shock, lactic acidosis, myoglobinuria, and acute tubular necrosis.

Epidemiology

- ✖ The incidence of status epilepticus was **10 - 60 per** 100,000 population in various studies.

- ✖ Status epilepticus is most common in children younger than 5 yr of age, with an incidence in this age group of **>100 per** 100,000 children.
- ✖ The most common type is **convulsive status epilepticus** (generalized tonic, clonic, or tonic–clonic), but other types do occur.

ETIOLOGY

Three major causes: prolonged febrile seizures; idiopathic status epilepticus; and symptomatic status epilepticus.

A **febrile seizure** is the most common cause of status epilepticus. The **idiopathic**, in which a seizure develops in the absence of an underlying CNS lesion or insult, it may be the initial presentation of epilepsy or due to sudden withdrawal of anticonvulsants in epileptic one. Sleep deprivation and an intercurrent infection tend to render epileptic patients more susceptible to status epilepticus.

Symptomatic type: A prolonged convulsion may be the initial manifestation of **encephalitis or meningitis.** Other causes are: congenital malformations of the brain, inborn errors of metabolism, electrolyte abnormalities, hypocalcaemia, hypoglycemia, drug intoxication, Reye syndrome, lead intoxication, extreme hyperpyrexia, and brain tumors.

TREATMENT

Supportive measures: Status epilepticus is a medical emergency that requires initial and continuous attention to securing airway, breathing, and circulation. The oral airway is secured and inspected for patency, Excessive oral secretions are removed by gentle suction, and a properly fitting face mask attached to oxygen is applied. IV line is immediately inserted. The pulse, temperature, respirations, and blood pressure are observed. Children should be transferred to ICU.

Laboratory studies:

- Glucose (by dextrostix, a rapid infusion of 5 mL/kg of 10% dextrose is provided if hypoglycemia is detected), sodium, calcium, magnesium, CBC, CT scan and continuous EEG are needed for all patients.
- Blood and spinal fluid cultures, toxic screens, tests for inborn errors of metabolism are often needed.
- Anti- epileptic drug (AED) levels need to be determined in all patients known already to be taking these drugs.

Drugs: should always be administered IV in good enough doses; the IM route is unreliable because some drugs are sequestered by muscle. Care should be given with regard to how the anticonvulsant is administered, e.g. phenytoin forms a precipitate in glucose solutions and is rendered ineffective.

A **benzodiazepine** (diazepam, lorazepam, or midazolam) should be used initially. Diazepam should be given IV directly into the vein in a dose of 0.15 mg/kg up to a max total dose of 10 mg, may repeat in 5-10 min (it must be given slowly at a rate no greater than 2 mg/min). If IV line cannot be available or at home, diazepam can be given rectally (diluted in 3 mL 0.9% NaCl is placed into the rectum by a syringe and a flexible tube at a dose of 0.3–0.5

mg/kg). Respiratory depression and hypotension can occur, especially if administered with phenobarbital. In some infants, a trial of pyridoxine may be warranted.

After the emergent therapy of benzodiazepine, if the convulsive activity ceases or persist, the subsequent medication is usually fosphenytoin (not available, **phenytoin** is alternative, it is started by the loading dose of 15- 30 mg/kg IV at the rate of 1 mg/kg/min, it is safely added to normal saline. ECG is recommended during the loading phase to identify arrhythmias and bradycardia, a rare complication in children. Systemic hypotension may also complicate IV phenytoin. If the seizures do not recur, a maintenance dose of 3–9 mg/kg divided into two equal doses daily is begun 12–24 hr later.

The subsequent medication is often **phenobarbital**, the dose used in neonates is usually 20 mg/kg loading dose, but in infants and children the dose is often 5-10 mg/kg (to avoid respiratory depression), with the dose repeated if there is not an adequate response. It is given within 10–30 min. With control of the seizures, the maintenance dose is 3–5 mg/kg/24 hr divided into two equal doses.

Other choices for further drug management include **valproate, midazolam continuous, levetiracetam, barbiturate coma, and general anesthesia**.

After the second or third medication is given, and sometimes before that, the patient might need to be intubated to given **general anesthesia**.

A comprehensive examination: should be undertaken once the seizures are under control; evidence of trauma; papilledema, a bulging anterior fontanel, or lateralizing neurologic signs suggesting increased ICP; manifestations of sepsis or meningitis; retinal hemorrhages that may indicate a subdural hematoma; failure to thrive, a peculiar body odor, or abnormal hair pigmentation suggests an inborn error of metabolism; and constriction or dilatation of pupils suggesting a toxin or drugs as the cause of the status epilepticus.

PROGNOSIS.

The mortality rate of status epilepticus is ≈ 5%. The greatest numbers of deaths occur in the symptomatic group, most of whom have a serious and life-threatening CNS disorder known before the onset of status epilepticus.