Status Epilepticus

Condition: Status Epilepticus (SE) in Children

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Pathophysiology:

Status epilepticus occurs when the brain fails to terminate a seizure by its usual mechanisms, or when recurrent seizures occur without recovery of consciousness. There is an imbalance between:

- Excessive glutamate-mediated excitation (NMDA/AMPA receptors)
- Failure of GABA-mediated inhibition (GABA-A receptors internalize over time)

This results in sustained neuronal depolarization, progressive internalization of benzodiazepine-sensitive GABA receptors, and accumulating excitotoxic neuronal injury — explaining why earlier treatment is more effective.

Brief Report:

Status epilepticus (SE) is a neurological emergency defined as a seizure lasting ≥5 minutes or two or more seizures without return to baseline consciousness. It is classified into convulsive (most common), non-convulsive, and refractory forms. Immediate pharmacological intervention is essential to minimize brain injury, systemic complications, and mortality. Treatment follows a time-sensitive stepwise escalation beginning with benzodiazepines, followed by second-line antiepileptic drugs, and finally anesthetic agents for refractory cases.

Clinical Features:

Presentation depends on seizure type and age:

- Convulsive SE: rhythmic or tonic-clonic limb movements, eye deviation, cyanosis
- Non-convulsive SE: altered consciousness, staring, subtle automatisms (often missed)
- Infants: subtle signs — apnea, eye deviation, lip smacking, bicycling movements
- Older children: classic generalized tonic-clonic, with post-ictal confusion
- Fever, hypoxia, and hemodynamic instability may accompany SE

Risk Factors:

- Febrile illness (febrile SE — most common cause in children 6 months–5 years)
- Epilepsy with subtherapeutic antiepileptic drug (AED) levels
- CNS infection (meningitis, encephalitis)
- Structural brain lesions (trauma, stroke, tumors)
- Metabolic disturbances (hypoglycemia, hyponatremia, hypocalcemia)
- Hypoxic-ischemic injury
- Toxic ingestion or drug withdrawal

Investigations:

- Bedside glucose — first priority (exclude hypoglycemia)
- Electrolytes (Na^+, Ca^{2+}, Mg^{2+}), renal and liver function

- Blood gas — assess acidosis and oxygenation
- CBC, CRP — for infection workup
- AED serum levels — if patient is on antiepileptic drugs
- ECG — before phenytoin/fosphenytoin administration
- EEG — essential for non-convulsive SE diagnosis and monitoring in refractory SE
- Neuroimaging (MRI/CT) — after stabilization, if structural cause suspected
- LP (lumbar puncture) — if CNS infection suspected (after CT/neuroimaging)

Management: Acute Drug Sequence

Treatment must follow a strict, time-sensitive stepwise protocol. Each phase is initiated if the seizure continues:

Phase / Time	Drug	Dose & Route	Notes
Phase 1 0–5 min (Early)	**Benzodiazepines (1st line)**		Give ASAP; do not delay
	• Lorazepam (IV)	0.1 mg/kg IV (max 4 mg)	Preferred IV drug; may repeat ×1 after 5 min
	• Diazepam (IV or rectal)	0.2 mg/kg IV; 0.5 mg/kg PR	Rectal if no IV access
	• Midazolam (IM/buccal/intranasal)	0.1–0.2 mg/kg IM; 0.3 mg/kg buccal/IN	Use when IV access unavailable
Phase 2 5–20 min (Established SE)	**Second-line Agents**		Give if seizure continues after 2 benzodiazepine doses
	• Phenytoin / Fosphenytoin	20 mg/kg IV (fosphenytoin: 20 mg PE/kg)	Monitor ECG & BP; infuse slowly
	• Valproate (IV)	20–40 mg/kg IV over 15 min	Avoid in mitochondrial disease, liver disease
	• Levetiracetam (IV)	60 mg/kg IV over 15 min (max 4500 mg)	Favorable safety profile; fewer drug interactions
	• Phenobarbital (IV)	20 mg/kg IV	Preferred in neonates; monitor respiration
Phase 3 20–60 min (Refractory SE)	**Anesthetic / Third-line Agents**		ICU admission required; continuous EEG monitoring
	• Midazolam (infusion)	0.1–0.2 mg/kg bolus → 0.05–2 mg/kg/hr infusion	First choice in pediatric RSE
	• Propofol	1–2 mg/kg bolus → 2–10 mg/kg/hr infusion	Avoid in children <3 yrs (PRIS risk)
	• Thiopental / Pentobarbital	3–5 mg/kg loading dose → titrate infusion	EEG burst suppression target
	• Ketamine	1–2 mg/kg IV bolus	NMDA antagonist; useful adjunct in RSE

Supportive Measures (Simultaneous):

- Airway: positioning, suction, oxygen (target SpO_2 >94%); intubate if needed in RSE
- IV access: establish as quickly as possible
- Vital signs monitoring: BP, HR, RR, SpO_2, temperature
- Treat underlying cause: glucose (2–4 mL/kg of 10% dextrose), antibiotics for meningitis, correct electrolytes
- Avoid hyperthermia: antipyretics, cooling if needed
- ICU referral for all refractory SE cases

Key Home Messages:

- **Seizure lasting ≥5 minutes = Status Epilepticus — treat immediately; do not wait.**
- **Benzodiazepines are always first-line; give as fast as possible.**
- GABA receptor internalization over time explains why benzodiazepines become less effective — escalate early.
- Fosphenytoin, valproate, and levetiracetam are equally recommended second-line agents.
- **Refractory SE requires ICU, continuous EEG, and anesthetic infusions.**
- Always treat the underlying cause (glucose, electrolytes, infection).
- Prognosis depends on the etiology; the drug sequence itself does not damage the brain — delay does.