SEIZURES

Neonatal seizures are a manifestation of neurological dysfunction. Seizures occur in 1–3% of term newborn babies and in a greater proportion of preterm babies. They can be subtle, clonic, myoclonic or tonic

RECOGNITION AND ASSESSMENT

Physical signs

In addition to obvious convulsive movements, look for:

- Eyes: staring, blinking, horizontal deviation
- Oral: mouthing, chewing, sucking, tongue thrusting, lip smacking
- Limbs: boxing, cycling, pedalling
- Autonomic: apnoea, tachycardia, unstable blood pressure
- Focal (1 extremity) or multifocal (several body parts)
- Perform a detailed physical examination and neurological assessment

Differential diagnosis

- Jitteriness: tremulous, jerky, stimulus-provoked and ceasing with passive flexion
- Benign sleep myoclonus: focal or generalised, myoclonic limb jerks that do not involve face, occurring when baby is going to or waking up from sleep; EEG normal; resolves by aged 4–6 months
- Differentiation between jitteriness and seizures:

Table 1

Sign	Jitteriness	Seizure
Stimulus provoked	Yes	No
Predominant movement	Rapid, oscillatory, tremor	Clonic, tonic
Movements cease when limb is held	Yes	No
Conscious state	Awake or asleep	Altered
Eye deviation	No	Yes

Investigations (*consider which tests are relevant under clinical circumstances)*

First line

- Blood glucose
- Serum electrolytes including calcium, magnesium
- FBC and coagulation (if stroke suspected, thrombophilia screen)
- Blood gases
- Blood culture
- CRP
- LFT
- Serum ammonia, amino acids
- Urine toxicology, amino acids, organic acids
- Lumbar puncture – CSF microscopy and culture (bacterial and viral PCR for herpes simplex including enterovirus)
- discuss CSF sample for further metabolic testing [e.g. glycine, lactate etc. (as guided by metabolic testing)] with consultant
- Cranial ultrasound scan (to exclude intracranial haemorrhage)
- EEG (to identify electrographic seizures and to monitor response to therapy). Consider cerebral function monitor (CFM–aEEG)

Second line

- Congenital infection screen (TORCH screen)
- MRI scan
- Screen for maternal substance abuse
- Serum acylcarnitine, biotinidase, VLCFA, uric acid, sulphocysteine, total and free homocysteine

- Trial of pyridoxine treatment, preferably during EEG monitoring, may be diagnostic as well as therapeutic
- If further advice required, contact metabolic team

TREATMENT

- Ensure ABC
- Treat underlying cause (hypoglycaemia, electrolyte abnormalities, infection)
- hypoglycaemia: give glucose 10% 2.5–5 mL/kg IV bolus, followed by maintenance infusion. Wherever possible, obtain 'hypoglycaemia screen' (see **Hypoglycaemia** guideline) before administration of glucose bolus
- hypocalcaemia (total Ca <1.7 mmol/L or ionised Ca <0.64 mmol/L): give calcium gluconate 10% 0.5 mL/kg IV over 5–10 min with ECG monitoring (risk of tissue damage if extravasation) (see **Hypocalcaemia** guideline)
- hypomagnesaemia (<1 mmol/L): give magnesium sulphate 100 mg/kg IV or deep IM (also use for refractory hypocalcaemic seizure)
- Pyridoxine (50–100 mg IV) can be given to babies unresponsive to conventional anticonvulsants or seek neurologist opinion

Initiation of anticonvulsants (for immediate management follow flowchart)

- Start anticonvulsant drugs when:
- prolonged: >2–3 min
- frequent: >2–3/hr
- associated with cardiorespiratory compromise (frequent apnoeas and bradycardia requiring intervention)

Administration

- IV to achieve rapid onset of action and predictable blood levels
- To maximum dosage before introducing a second drug
- If no IV access and glucose and electrolyte abnormalities excluded, consideration can be given to buccal/intranasal midazolam

Maintenance and duration of treatment

- Keep duration of treatment as short as possible. This will depend on diagnosis and likelihood of recurrence
- May not require maintenance therapy after loading dose
- If maintenance therapy is required:
- monitor serum levels
- develop emergency seizure management plan, including, if required, a plan for buccal/intranasal midazolam

Stopping treatment

- Consider when:
- seizures have ceased and neurological examination is normal or
- abnormal neurological examination with normal EEG

Anticonvulsant drug therapy schedule
(also see **Flowchart: Immediate management** below)

Drug	Loading dose	Maintenance dose
Phenobarbital	• 20 mg/kg IV – administer over 20 min • Optional additional doses of 10 mg/kg each until seizures cease or total dose of 40 mg/kg given	• 2.5–5 mg/kg IV or oral once daily beginning 12–24 hr after loading dose
Phenytoin	• 20 mg/kg IV – maximum infusion rate of 1 mg/kg/min • Monitor cardiac rate and rhythm and blood pressure for hypotension	• 2.5–5 mg/kg IV or oral 12-hrly • Measure trough levels 48 hr after IV loading dose

Midazolam (if no response to above drugs)	• Give 200 microgram/kg IV over 5 min followed by continuous infusion 60–300 microgram/kg/hr if required • Reconstitution and dilution: dilute 15 mg/kg of midazolam up to a total of 50 mL with sodium chloride 0.9%, glucose 5% or glucose 10% 0.1 mL/hr = 30 microgram/kg/hr ◦ may cause significant respiratory depression and hypotension if injected rapidly, or used in conjunction with narcotics • If no IV access, glucose and electrolyte abnormalities excluded, give 300 microgram/kg intranasal/buccal. (**Note:** can be repeated once; wait 10 min before repeating. Ensure cardiorespiratory status stable)	
Clonazepam (if midazolam not available)	• 100 microgram/kg IV over 2 min ◦ repeat dose after 24 hr if necessary ◦ concurrent treatment with phenytoin reduces the half-life of clonazepam	
Lidocaine (if above medications ineffective)	• 2 mg/kg IV over 10 min, then commence infusion ◦ 6 mg/kg/hr for 6 hr, **then** ◦ 4 mg/kg/hr for 12 hr, **then** ◦ 2 mg/kg/hr for 12 hr	Exercise caution with phenytoin as concurrent IV infusion of both these drugs has a cardiac depressant action (refer to **Neonatal Formulary** for doses in preterm babies)
Levetiracetam (if not responding in any order)	• Loading dose: ◦ 20 mg/kg IV infusion over 15 min ◦ can be repeated if seizures persist (maximum 40 mg/kg)	• 10–15 mg/kg 12-hrly IV/oral **[Note:** ½ maintenance dose in babies with severe renal impairment (creatinine >150 micromol/L)]

- **Refer to unit physiotherapist/occupational therapist (where available)**

DISCHARGE AND FOLLOW-UP

Discharge

- Ensure parent(s) are provided with appropriate discharge documentation
  - seizure emergency management plan
  - copy of discharge summary, including: types of seizures, medications/anticonvulsants administered

Follow-up

- Follow-up will depend on cause of seizures and response to treatment
- Consider: specialist follow-up for babies discharged on anticonvulsant drugs
- Refer to community allied health professionals on discharge as appropriate

Further information for parents

www.**bcmj**.org/**sites**/**default**/**files**/**HN_Seizures-newborns**.pdf

Flowchart: Immediate management