Waiting for the Paediatric Retrieval Team

by

Dr Christopher Flannigan
Status Epilepticus

Initial Management

Airway

- Airway opening manoeuvres with high flow oxygen (10-15 litre/minute via face-mask with reservoir bag) and suction secretions as needed.
- Consider nasopharyngeal airway if difficulty maintaining airway (insertion of oropharyngeal airway normally not possible due to clenched teeth).
- Indications for intubation include inability to maintain/protect airway, apnoea or if seizure doesn’t terminate following phenytoin/phenobarbitone loading dose. Intubation may be considered, even if the seizure has terminated, to allow CO\textsubscript{2} control in suspected raised intracranial pressure or to facilitate safe transfer for neuroimaging.
- Call Anaesthetist/Intensivist when starting phenytoin/phenobarbitone or if airway concerns at any stage.
- If intubation is required a rapid sequence induction should be performed using thiopentone 4mg/kg (2 mg/kg in neonates). All induction agents must be used with caution and the dose stated should be adjusted according to response and the patient’s haemodynamic status i.e. cardiovascularly unstable patients may require considerably less that the above dose.
- Have volume e.g. 10 - 20 ml/kg of 0.9% saline and vasoactive drugs e.g. push dose adrenaline 1 in 100,000, prepared incase of haemodynamic instability on induction.
- Suxamethonium 1 mg/kg (2 mg/kg < 1 year) is the preferred muscle relaxant (provided its use is not contraindicated) as due to its short duration of action, it will allow rapid neurological assessment to occur following intubation. Contraindications to suxamethonium include hyperkalaemia, prolonged immobility, severe muscle trauma, personal or family history of malignant hyperthermia or burns > 10% body surface area. If contraindicated a RSI dose of Rocuronium (1 mg/kg) can be used. However due to its longer duration of action determining whether the seizure has stopped with the
induction of anaesthesia will be more difficult (persistent tachycardia, hypertension and mydriasis should raise suspicion of ongoing seizure activity).

- Consider prophylactic atropine if using suxamethonium 20 micrograms/kg (minimum dose 100 mcg; maximum dose 600 mcg).
- Don’t routinely change endotracheal tube to nasal (normally extubate quickly).

**Breathing**

- Routine settings on ventilator i.e I:E ratio 1:2, PEEP 5 cm H₂O, Ti < 1 year = 0.6 - 0.8 seconds, 1-5 years = 0.8 - 1 seconds, 5-12 years = 1-1.2 seconds, >12 years = 1.2-1.5 seconds and adjust depending on blood gases.
- A peak pressure of around 20 cmH₂O or tidal volume of 6-8 ml/kg is a reasonable starting point and adjust depending of chest movement and blood gases.
- Target a PaCO₂ of 4.5 - 5 kPa and PaO₂ > 10 kPa until raised intracranial pressure had been excluded (continuously monitor end tidal CO₂ and correlate this with PaCO₂).
- Chest radiograph following intubation for endotracheal tube position.

**Circulation**

- Ensure patient has two working peripheral access. Central and arterial line not normally necessary unless haemodynamically unstable or if there are concerns about raised intracranial pressure.
- Monitor ECG and non-invasive blood pressure.
Disability

• If planning to extubate locally once awake enough, don’t add any additional sedative agents (unless transfer to CT is required). Although the effects of the thiopentone will wear off very quickly due to its redistribution, the sedating effects of the other anticonvulsants/postictal period often last longer.
• If facilities don’t exist to safely extubate the child locally sedate with morphine (10 - 60 mcg/kg/hr) and midazolam (1 - 4 mcg/kg/min).
• Try to avoid any further muscle relaxants if possible to allow for clinical neurological assessment. If unavoidable (after trying sedation boluses) administer a non-depolarising muscle relaxant by bolus rather than infusion.
• Don’t tape the eyes closed as pupils will need to be assess regularly as part of ongoing regular CNS observations.
• Monitor blood glucose.
• Consider performing a CT scan of the brain if the seizures are atypical or the aetiology is uncertain.
• If there is any suspicion of raised intracranial pressure (ICP) i.e. relative bradycardia and hypertension, focal neurological signs, abnormal posture/posturing, unequal, dilated or poorly responsive pupils, papilloedema or abnormal ‘doll’s eye’ movements administer 3ml/kg of 3% hypertonic saline over 15 minutes and ensure neuroprotective measures (see raised ICP section) are adhered to.

Sepsis

• Pyrexia can be the cause of the seizure (febrile convulsion) or can be caused by the seizure itself even in a child without an infection. If there is any suspicion of meningitis/encephalitis or if the cause of the pyrexia is unknown it is advisable to
administer intravenous antibiotics and aciclovir (use encephalitis dose) until further information becomes available.

• If it doesn’t delay their administration, a blood culture should be taken prior to the giving antimicrobials, however a lumbar puncture is contraindicated in the postictal phase and **MUST NOT** be performed.

• Control temperature with antipyretics (paracetamol and ibuprofen) and by patient exposure and using a cool air fan. If the above measures are ineffective and there is concern that ongoing pyrexia with trigger a further seizure, consider active cooling by placing ice packs in the axilla and groin.

### Renal

• Restrict intravenous fluids to 80% maintenance.

• Use isotonic fluids (risk of SIADH) e.g. 0.9% saline and 5% dextrose +/- added potassium depending on serum potassium.

• Bladder catheterisation is normally not necessary as most children with status epilepticus extubate quickly, however an ‘in/out’ catheter specimen of urine is indicated if there are sepsis concerns or pyrexia with no obvious source.

### Gastrointestinal

• Keep nil by mouth.

• Insert and aspirate nasogastric tube and leave on free drainage.
Labs & Electrolytes

- Routinely check FBP, U&E, LFTs, Ca, Mg, Phosphate, CRP, blood gas and lactate in all patients.
- Send blood cultures if starting antibiotics and consider checking anticonvulsant levels if on regular anti-epileptic drugs. Consider metabolic screen/ammonia and toxicology screen if cause of seizure is unknown.
- Hyponatraemia should be treated by administering 4 ml/kg of 3% hypertonic saline over 15 minutes and hypoglycaemia should be treated with a 2 ml/kg bolus of 10% dextrose.

Drugs & Infusions

Lorazepam

- Intravenous lorazepam is the preferred first-line benzodiazepine (provided intravenous access can be rapidly established) as it is more effective, has a lower risk of respiratory depression and has a longer duration of action than both diazepam and midazolam.
- It should be administered at a dose of 0.1 mg/kg (maximum dose = 4 mg). This dose can be repeated after 10 minutes if the seizure is ongoing, provided no more than two doses of any benzodiazepines are given (remember to include prehospital medications). Administering more than two doses of benzodiazepines is unlikely to work, will delay the administration of medications that are likely to be effective and significantly increases the risks of respiratory depression.
- If intravenous access can not be rapidly established initially, buccal midazolam or rectal diazepam should be administered (see below for doses) while attempts at intravenous access are made. However the second dose of benzodiazepines, if required, should be intravenous or intraosseous lorazepam.
• Monitor respiration and be prepared to support breathing with bag and mask should respiratory depression occur.

Midazolam

• Buccal midazolam is more effective than rectal diazepam so should be used first line when intravenous access cannot be immediately established. The risk of respiratory depression is the same as with rectal diazepam.
• It should be administered in a dose of 0.5 mg/kg buccally (maximum dose = 10 mg).

Diazepam

• Rectal diazepam should be reserved for cases where intravenous access cannot be immediately established and buccal midazolam is unavailable/contraindicated.
• It should be administered in a dose of 0.5 mg/kg rectally (maximum dose = 10 mg).
• If intravenous access is available and lorazepam is unavailable, diazepam can be administered by either slow intravenous or intraosseously injection, in a dose of 0.25 mg/kg (maximum dose = 10mg). Diazepam emulsion e.g. Diazemuls® should be used where possible as this preparation is least irritant to the veins.

Phenytoin

• Administer if the seizure is not terminated after two doses of benzodiazepines.
• It should be administered in a dose of 20 mg/kg by intravenous infusion over 20 minutes via a 0.22-0.5 micron filter with ECG and blood pressure monitoring (maximum dose = 1.5g).
• If the patient is already on maintenance phenytoin use Phenobarbitone instead (see below for dosing), unless the plasma phenytoin level is known to be < 5 mg/L.
Phenytoin should be avoided in cardiovascularly unstable patients, where phenobarbitone should be used instead.

- Consider checking a plasma level 1-2 hours following completion of the loading dose. Normal therapeutic range: Age < 3 months = 6 - 15 mg/L; Age ≥ 3 months = 10 - 20 mg/L.

- As preparation of the infusion takes time, start preparing it when administering the second dose of benzodiazepines. Likewise when starting phenytoin inform the Anaesthetist/Intensivist so that preparations for RSI can be made.

Phenobarbitone

- Used in place of phenytoin where patient is either on oral phenytoin or when it is contraindicated.

- It should be administered in a dose of 20 mg/kg by intravenous infusion over 20 minutes (maximum dose = 1g).

- Consider checking a plasma level 2-3 hours following completion of the loading dose to confirm therapeutic levels (normal therapeutic plasma range = 15 - 40 mg/L).

Paraldehyde

- Consider giving at the same time as phenytoin (optional), but insure it doesn’t delay the administration of phenytoin.

- It should be administered rectally in a dose of 0.8 ml/kg using a 50% Paraldehyde/50% olive oil premixed enema (maximum dose = 20 ml).
Additional Information

- If there is ongoing concerns that the patient is having refractory/recurrent seizures following induction of anaesthesia discuss further treatment options with the retrieval team (will likely involve a conference call with neurology).
- Make sure electrolyte abnormalities, toxin ingestion or a metabolic problem have been excluded and organise a CT scan of the brain if it hasn’t already been performed.
- Pyridoxine-dependent seizures should be considered in all children under 2 years old with refractory status epilepticus with no obvious cause (although presentation is commonly in the neonatal period). After discussion with a paediatric neurologist administer 100 mg of pyridoxine by slow intravenous injection over 3 - 5 minutes.

Treatment options for refractory status epilepticus normally involves one of the following three approaches:

1) Midazolam Infusion

- Administer an intravenous bolus of 0.5 mg/kg (maximum dose = 10 mg) of midazolam and start a midazolam infusion at 4 mcg/kg/min.
- If seizure doesn’t terminate after 5 minutes repeat intravenous bolus and increase infusion rate by 4 mcg/kg/min.
- Continue to repeat bolus and increase infusion by 4 mcg/kg/min every 5 minutes till seizure controlled or maximum dose of 32 mcg/kg/min is reached. Expect and monitor for cardiovascular instability with the higher doses of midazolam.
- If seizure activity is not controlled on 32 mcg/kg/min of midazolam, stop midazolam and start a thiopentone infusion.
2) Thiopentone Infusion

- Administer a loading dose of 4 mg/kg (2mg/kg in neonates) and start infusion at 2 mg/kg/hr (reduce dose if haemodynamically unstable).
- Titrate infusion to burst suppression (maximum dose = 10 mg/kg/hr) using EEG/CFAM.
- Hypotension should be expected when starting a thiopentone infusion. A central line should be sited and noradrenaline used to treat any hypotension.

3) High Dose Phenobarbitone

- Repeat half loading dose of phenobarbitone (10mg/kg) every 30 minutes till seizure controlled up to a maximum dose of 120 mg/kg/day and adjust according to phenobarbitone levels.

Other Treatments

Other treatments options include loading with intravenous levetiracetam or sodium valproate, ketamine or isoflurane (volatile anaesthetic agent). While propofol infusions have been used in adults with some success, their use in children cannot be recommended due to the risk of propofol infusion syndrome.