Seizures and Status Epilepticus

Introduction

A seizure is a sudden change in behaviour that is the consequence of brain dysfunction:

- Epileptic seizures: electrical hypersynchronization of neuronal networks in cortex. Recurrent and either genetically determined or acquired. ~0.5-1% pop.
- Nonepileptic seizures (NES) lack typical epileptic neurophysiological changes. May be:
  - Physiological - metabolic derangement or hypoxemia
  - Psychogenic (pseudoseizures) - stressful psychological conflicts or major emotional trauma. Patients usually have psychiatric history.

The pharmacological treatment of epileptic seizures is directed at restoring neuronal function to normal, while the treatment of NES is specific to the disorder that triggered the seizure.

Status Epilepticus: 2+ seizures without full recovery in between or >5mins continuous seizure activity. May be convulsive or non-convulsive.

Seizure Classification:

Partial (focal, local) seizures

Simple partial seizures (usually conscious)

- Focal motor symptoms - ± Jacksonian march, postural, speech
- Special sensory
- Autonomic
- Psychic (e.g. déjà vu, hallucinations)

Complex partial (impaired consciousness)

- Often arise from temporal lobe and ± aura
- Automatisms, stereotyped for individual
- Post-ictal confusion

Secondary generalised

Generalized seizures (usually impaired consciousness)

Non-convulsive (absence)

- Awareness briefly lost
- EEG typically shows 3/sec spike and slow wave complexes

Convulsive

- Tonic-clonic seizures - ± initial ictal cry or Todd's paresis
- Tonic seizures
- Clonic seizures - rare
- Atonic ("drop attacks")
- Myclonic seizures – may be conscious

Unclassified seizures

Epidemiology

Children>elderly>adults

Causes

- Vascular: CVA, SAH, SDH, EDH
- Metabolic: ↓↑BSL, ↓↑Na^+, ↓Ca^{2+}, ↓Mg^{2+}
- Trauma
- CNS infection esp encephalitis
- Structural lesion: tumour, AVM, scar, cong.
- Anticonvulsant withdrawal
- EtOH withdrawal
- Toxin: TCA, many OD's
- Complex febrile convulsion
- Eclampsia
- Hypoxia
- Liver or HT encephalopathy

Physiological effects

- Increased cerebral blood flow, metabolism, lactic acidosis
- Autonomic stimulation – ↑BP, ↑HR, ↑T, sweating, salivation
- Other stress responses: ↑WCC, ↑BSL,

If prolonged >30mins, compensatory mechanisms start to fail

- ↓BP, ↓cerebral blood flow, ↓BSL
- Hypoxia – central resp. failure, increased demands, pulmonary oedema, aspiration
- Organ dysfunction (cerebral, cardiac, renal, hepatic)

Assessment

History: Precips or threshold (strobes, fever, menstruation, lack of sleep, EtOH, stress), detailed desc of seizure (nature, focality, progression, duration, assoc incontinence, post-ictal state). PMHx of sezures, trauma, other med conds, drug & EtOH use, medications, FamHx.
Exam: Vitals. Seek HI, neck injury, disloc shoulder, tongue lac, pulm aspiraton. Neuro exam.

Investigations

Urine: Toxicology, culture if febrile
Bloods: FBC, UEC, glucose, CMP, anticonvulsant levels, CK, ABGs, cultures if febrile, βhCG, rarely tests for porphyria. Post-ictal metabolic acidosis, ↑WCC, ↑PRL, ↓HCO_3^- all common.
Imaging: CXR (aspiration), C-Spine (trauma), CT (+contrast or MRI may be req later if CT needs clarifying or is normal). CT indications:

- Age>40
- First seizure
- Anticoagulation
- Focal deficits
- Fever
- Trauma
- Cancer
- ?HIV
- Partial seizure
- Long post-ictal state
- EtOH related

Other: EEG (may be a primary investigation in NCSE). LP (once seizures controlled)

Management

Triage to resus area with team approach % non-invasive monitoring – T, SaO_2, HR, BP, RR
Airway – recovery position, bedsides up, careful suctioning of pooled secretions
Breathing – high flow O2, ± assisted ventilation
Circulation – IV access
Disability:

- If BSL low 25-50ml of 50% (child: 5ml/kg 10%) **dextrose** or.
- If fit>5min, use a BDZ:
  - **Midazolam** 5-10mg (0.15mg/kg) IM/IV, in child also 0.5mg/kg IN/buccal
  - **Lorazepam** 2-4mg (0.05-0.1mg/kg) IV
  - **Diazepam** 5-10mg (0.25mg/kg) IV or double dose PR
- Repeat if still fitting in 5 mins.
- If still fitting in 5 mins, load on:
  - **Phenytoin** 20mg/kg 30min [ECG] or **phenobarbitone** 20mg/kg 10min IV/IO, or
  - **Pyridoxine** 100mg IV in infants
  - If no iv access: **paraldehyde** 0.4ml/kg PR diluted with equal vol of NS
- Consider **levetiracetam** or **valproate** 30mg/kg IV (max 800mg) if fitting continues
- If still fitting: RSI (+**rocuronium**) with infusion - **propofol** 2mg/kg then 1-15mg/kg/h IV
  - Alternative agents: **thiopentone** or **midazolam** and **suxamethonium** for relaxant
- Consider ABx (e.g. **ceftriaxone**) and **acyclovir**
- In adults consider **thiamine** and **$MgSO_4$**
- In eclampsia give **$MgSO_4$** 4g IV followed by infusion 1-2g/h
- In infants or isoniazid OD consider **pyridoxine**

Treat any underlying pathology
May need ongoing maintenance therapy
Driving – State-dependent. Variable 1-24 mo depending on classification/circumstances.
Hospitalization - if a prolonged post-ictal state/incomplete recovery, status epilepticus, presence of a systemic illness that may require treatment, head trauma.
Referral to neurologist if unsure of Dx, focal seizure or focal findings on examination or EEG.

Complications

Respiratory: hypoxia, hypercarbia, aspiration
Cardiovascular: hypotension, cardiac failure, arrhythmias
Metabolic: hypoglycaemia, electrolyte abnomalities, hyperthermia, rhabdomyolysis, DIC
Trauma: head injury, tongue lac, dental injury, #upper lumbar vertebra, post shoulder disloc
Environmental: drowning, electrical, thermal

Prognosis

If patient has status epilepticus with 1st fit, the chance of a structural brain lesion is >50%.
↑Morbidity/mortality: Increased duration (esp >1hr), Extremes of age, Underlying illness
Mortality rates are up to 5-10% in adults and 3% in children.
Recurrence ↑risk: Age<50, FHx. 2nd seizure <7 days, Cerebral tumour, Prior neurological insult

---

Regular Anticonvulsants

Generalised seizures

Absences: ethosuximide and sodium valproate (VPA)
Tonic-clonic (grand mal): carbamazepine, lamotrigine, VPA and topiramate.
Myoclonic seizures: VPA, clonazepam, ethosuximide or lamotrigine
Atonic and tonic seizures: VPA and lamotrigine. 2nd line - clonazepam, levetiracetam, topiramate.
Paediatric generalised seizures: 1st line VPA or carbamazepine. lamotrigine or topiramate.
West syndrome/infantile spasms: ACTH or prednisolone, vigabatrin or sodium valproate.

Partial seizures:

1st Line: Carbamazepine, lamotrigine, VPA, topiramate & phenytoin, if resistant may add any of gabapentin, levetiracetam, lamotrigine, tiagabine, topiramate, vigabatrin, clobazam, clonazepam

Side effects of some antiepileptic drugs

Drug	Systemic side effects	Neurotoxic side effects
Carbamazepine	N/V, diarrhea, hypoNa, rash, & rarely SJS, aplastic anemia, agranulocytosis, hepatic failure, serum sickness, pancreatitis	Drowsiness, dizziness, blurred or double vision, lethargy, headache
Ethosuximide	N/V & rarely: agranulocytosis, SJS, aplastic anemia, hepatic failure, dermatitis/rash, serum sickness	Sleep disturbance, drowsiness, hyperactivity
Gabapentin	None known	Somnolence, dizziness, ataxia
Lamotrigine	Rash, nausea & rarely SJS, hypersensitivity	Dizziness, somnolence
Levetiracetam	Infection	Fatigue, dizziness, agitation, anxiety
Phenytoin	Gingival hypertrophy, body hair increase, rash, lymphadenopathy & rarely agranulocytosis, SJS, aplastic anemia, hepatic failure, dermatitis/rash, serum sickness	Confusion, slurred speech, double vision, ataxia, neuropathy (with long-term use)
Phenobarbitone	N, rash & rarely agranulocytosis, SJS, hepatic failure, dermatitis/rash, serum sickness	Alteration of sleep cycles, sedation, lethargy, behavioral changes, hyperactivity, ataxia, tolerance, dependence
Topiramate	Weight loss, renal stones, paraesthesias & rarely acute myopia and glaucoma; oligohydrosis and hyperthermia which primarily occur in children	Fatigue, nervousness, difficulty concentrating, confusion, depression, anorexia, language problems, anxiety, mood problems, tremor
Valproate	Weight gain, N/V, hair loss, easy bruising & rarely agranulocytosis, SJS, aplastic anemia, hepatic failure, dermatitis/rash, serum sickness, pancreatitis	Tremor