Epilepsy in anaesthesia and intensive care

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Key points

Epilepsy affects 40–70 per 100 000 of the population; it is more common in males and the lower socioeconomic groups.

Epilepsy is caused by an abnormal or excessive discharge of neurones in the brain.

Seizures may be partial or generalized; a cause is identified in approximately one-third of cases.

Anaesthetic drugs may modulate seizure activity and interact with antiepileptic medication.

Epileptics often have concurrent medical problems.

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Epilepsy is defined as recurrent (two or more) epileptic seizures unprovoked by any immediately identifiable cause. A seizure can be defined as the clinical manifestation of an abnormal and excessive discharge of neurones, which is seen as alteration of consciousness, motor, sensory or autonomic events. Epilepsy is relevant to the anaesthetist for several reasons, for example medication and drug interactions, postoperative seizures, and intensive care management of status epilepticus.

Incidence rates are variable (40–70 per 100 000, >100 per 100 000 in developing countries); prevalence is 1.5–57 per 1000 (average 10.3 per 1000). There is a greater incidence in males and lower socioeconomic groups.

Classification

Epileptic seizures are classified as partial, generalized, pseudo- or non-epileptic. This is based upon the clinical presentation of the seizure and its electroencephalographic (EEG) picture (Table 1).

Causes

Only one-quarter to one-third of cases of epilepsy is attributable to a specific cause. They include:

Genetically determined: epilepsy syndromes, juvenile myoclonic epilepsy, benign rolandic epilepsy.

Trauma: risk factors that predict post-traumatic epilepsy include early seizures, depressed skull fractures or evidence of intracranial haemorrhage.

Tumour: epilepsy is more common with slow-growing tumours, anterior hemisphere tumours and may be generalized or focal in nature.

Infection: infection is the cause of 3–5% of seizures. Epilepsy is a recognized feature of bacterial, fungal or tuberculous meningitis and also of viral encephalitis.

Cerebral degeneration: Alzheimer's disease and multi-infarct dementia.

Cerebrovascular disease: epilepsy follows 6–15% of strokes. It is as likely after cerebral infarction as after cerebral haemorrhage.

Multiple sclerosis: 2% of cases.

Alcohol: lowers seizure threshold. Seizures may occur with binge drinking or withdrawal.

Metabolic disorders: hypocalcaemia, hypercalcaemia, hypomagnesaemia, hypoglycaemia, hyponatraemia and hypernatraemia. Hepatic and renal failure can also precipitate seizures.

Table 1 Classification of epileptic seizures

Partial seizures
Simple
Complex
Partial onset with generalization
Generalised seizures
Inhibitory
Absence
Atonic
Excitatory
Myoclonic
Clonic
Tonic
Pseudoseizures
Nonepileptic seizures

Differential diagnosis

There are several potential differential diagnoses. They include:

Syncope: multifocal myoclonus can be observed after loss of consciousness.

Micturition syncope: predominantly in males, usually nocturnal and usually after alcohol consumption.

Cough syncope: valsalva manoeuvre is performed during coughing.

Cardiac syncope: reduced cardiac output and cerebral perfusion are associated with syncopal attacks. Causes include complete heart block, ventricular tachycardia or fibrillation and supraventricular tachycardia or bradyarrhythmia. Autonomic failure and postural hypotension can also cause syncope.

Carotid sinus syncope: patients usually present with vertigo or syncopal attacks. These are usually triggered by pressure over the neck and are related to atrioventricular block or asystole.

Transient ischaemic attacks: these should not be confused with epilepsy. Some patients

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with carotid occlusion or severe stenosis suffer with limb shaking and involuntary movements. These attacks may coincide with limb weakness or speech difficulty.

Migraine: basilar migraine can cause loss of consciousness. Tonic–clonic seizures are rarely seen.

Hyperventilation: symptoms include dizziness, vertigo, weakness, paraesthesia, chest pain and altered consciousness.

Narcolepsy and cataplexy: narcolepsy is excessive daytime sleepiness. Cataplexy is triggered by sudden arousal. Loss of muscle tone occurs and the patient falls.

Non-epileptic seizures: the majority of sufferers are women. They are likely to have a previous psychiatric history. Attacks usually occur with a witness present and develop gradually rather than suddenly. Vocalisation is common. Incontinence is uncommon. Plasma prolactin concentrations 20 min after the event are normal (vide infra).

Investigation

Investigations are performed to provide support for the diagnosis, to indicate which part of the brain is involved or to provide information about the underlying structural process involved. They include:

EEG: interpretation of the EEG is difficult for a number of reasons. Epileptiform discharges are encountered in up to 4% of individuals who have never had a seizure. Patients with established epilepsy will show epileptiform abnormalities in up to 50% of cases.

CT scanning: this is used to establish whether a structural abnormality is the cause for a patient's epilepsy and if additional treatment may be required.

Magnetic resonance imaging (MRI): this is more sensitive and specific than CT in detecting small brain lesions and abnormalities that may be related to epilepsy.

Single photon-emission computed tomography (SPECT): this allows measurement of cerebral blood flow; it can be performed during or between seizures.

Positron-emission tomography (PET): this can be used to measure cerebral blood flow, regional cerebral glucose metabolism and the distribution of specific receptors. The resolution is superior to SPECT. Epileptic foci display a reduced blood flow and reduced glucose metabolism.

Treatment

A variety of anti-epileptic drugs are available to treat epilepsy. Optimal management requires choosing the appropriate anticonvulsant at the correct dose for the individual patient before progressing to multiple drug therapy. Individual drug properties such as pharmacokinetics, toxicity and efficacy should be considered. Types of epilepsy respond differently to anti-convulsant drugs. Further details of individual drug pharmacology are outside the scope of this article.[1 2]

Several anticonvulsants induce liver enzymes (phenytoin, carbamazepine) and will, therefore, alter the pharmacokinetics of other drugs that undergo hepatic metabolism. Plasma drug concentrations are often measured in order to check compliance, monitor dose adjustment with phenytoin and evaluate the unpredictable effect of combining anticonvulsants.

There is a 4–8% risk of congenital malformations in women who have taken anti-convulsants during pregnancy. Seizure frequency increases in pregnancy in some patients (approx one-third). Tonic–clonic seizures are associated with an increased risk of miscarriage. All the commonly used anti-convulsants are present in low concentrations in breast milk. Barbiturates and benzodiazepines can cause sedation of the baby. If breast feeding is withdrawn abruptly in these patients a withdrawal reaction can occur in the baby.

Anti-convulsant medication is usually continued until a seizure-free period of 2–3 yr has elapsed. Approximately two-thirds of patients remain seizure-free after drug withdrawal, which should be gradual (3–6 months). In the UK, patients are not allowed to drive for 1 yr after any type of seizure. Driving is allowed if night-time seizures only have been established for 3 yr; a 10 yr seizure-free period must be established in drivers of heavy goods vehicles.[3]

Anaesthetic considerations

Concerns for the anaesthetist in the management of the patient with epilepsy include: (i) the ability of anaesthetics to modulate or potentiate seizure activity; (ii) interactions of anaesthetic drugs with anti-epileptic drugs; (iii) perioperative care of the patient with epilepsy; and (iv) associated medical conditions.

Pro-convulsant and anti-convulsant properties of anaesthetics

Many anaesthetics have been reported to produce seizure patterns on the EEG associated with convulsions. Planning an anaesthetic in a patient with epilepsy requires knowledge of the specific conditions and doses under which some anaesthetics can produce seizures. Many anaesthetic agents can be pro-convulsant, anti-convulsant or both (Table 2).

Interaction of anti-epileptic drugs and anaesthetic drugs

Anti-epileptic drugs can produce numerous adverse effects including learning impairment, sedation, enzyme induction or inhibition. This may result in changes in pharmacokinetics of drugs that may be important in anaesthesia. Individual drug properties and interactions are outside the scope of this text.[1 2]

Perioperative care of the patient with epilepsy

Anti-epileptic medication should be stopped at the latest opportunity before surgery and restarted again at the earliest

Table 2 Pro-convulsant and anti-convulsant properties of anaesthetic agents

Anaesthetic	Pro-convulsant	Anti-convulsant
Nitrous oxide	+	–
Halothane	+	++
Enflurane	+++	+
Isoflurane	++	+++
Sevoflurane	++	
Desflurane	–	
Thiopental	++	+++
Methohexital	+++	+++
Etomidate	+++	+++
Benzodiazepines		+++
Ketamine	++	+
Propofol	++	++
Opioids	+++	

opportunity. Most anti-epileptic medication comes in the form of modified release tablets that cannot be crushed and given by nasogastric tube. Of the commonly used antiepileptic medications, only sodium valproate and phenytoin are available in injectable forms; patients can be transferred to one of these drugs perioperatively if it is thought that the risk of them having a seizure is high or that they are poorly controlled normally. Advice should be sought from a neurologist. Epileptogenic drugs should be avoided. Consideration of the need for high dependency care should be made on an individual basis, taking into account the degree of control of the epilepsy and the surgery undertaken.

Associated medical conditions

Numerous conditions have been associated with epilepsy. The most common disorders are psychiatric in nature including a variety of neuroses or psychoses. Less common syndromes can be associated with epilepsy (e.g. neurofibromatosis).

Anaesthetic management for epilepsy surgery

Patients with medically intractable seizures may be considered for surgical resection of the seizure focus. This may involve a number of procedures including electrode placement, cortical speech mapping and focus resection.

Electrode placement

Electrode placement may involve stereotactic insertion of electrodes through burr holes or craniotomy and insertion of electrodes. Both these procedures are usually performed under general anaesthesia.

Cortical speech mapping and/or resection

This technique was initially performed under an anaesthetic composed of a neuroleptic agent and an analgesic (e.g. droperidol and fentanyl). 'Neurolept' anaesthesia has now fallen out of favour after the introduction of propofol, which is associated with a more rapid return of consciousness thus facilitating functional testing. This technique requires propofol to be infused for sedation and local anaesthetic to be used for the craniotomy. After the cortex is exposed, propofol is stopped and functional testing performed. When the area mapping is complete the patient is re-anaesthetized for the remainder of the case.

Cervical vagus nerve stimulation

This involves intermittent electrical stimulation of the left cervical vagus nerve trunk to produce neuronal excitability; its aim is to decrease seizures but its mechanism has not been identified. Possible side-effects of stimulation include respiratory compromise and vocal cord dysfunction.[4]

Postoperative pseudo-epileptic seizures

Postoperative generalised shaking and shivering is common often associated with volatile anaesthetic agents. They may be mistaken for epileptic seizures but these are rare after surgery and are usually caused by metabolic or neurological events. Some anaesthetic drugs can cause dystonic movements or epileptiform activity, but drug-induced seizures are rare. Postoperative seizures are more common after neurosurgery.

Pseudo-epileptic seizures appear to be relatively common in the postoperative period. These are seizures that resemble tonic–lonic seizures but are not associated with abnormal electrical discharges in the brain. Pseudo-seizures tend to be associated with a history of convulsions and/or psychosomatic illness. They are characteristically flamboyant, last longer than 90 s and are associated with asynchronous limb movements, side-to-side head movements, closed eyes (including a resistance to eye opening) and maintenance of papillary reflexes. There is no cyanosis or post-ictal period but there may be incontinence or tongue-biting. Seizures may settle with reassurance. Plasma prolactin concentrations tend to be raised after epileptic seizures and normal after pseudo-seizures. However, the diagnosis of pseudo-seizures remains primarily clinical.[5,6] It is possible for both epileptic and pseudo-epileptic seizures to coexist.

Status epilepticus

Status epilepticus is defined as continuous seizure activity of at least 30 min duration or intermittent seizure activity of at least 30 min duration during which consciousness is not regained. Status epilepticus can be classified as generalized or partial seizures and either convulsive or non-convulsive in nature. The remainder of this article will refer to generalized convulsive status epilepticus which is the most common form.

Status epilepticus is diagnosed clinically and is characterized by tonic–clonic seizures, loss of consciousness, urinary incontinence and tongue-biting. Differential diagnosis includes myoclonic jerks, septic rigors, dystonia and pseudostatus epilepticus. Status

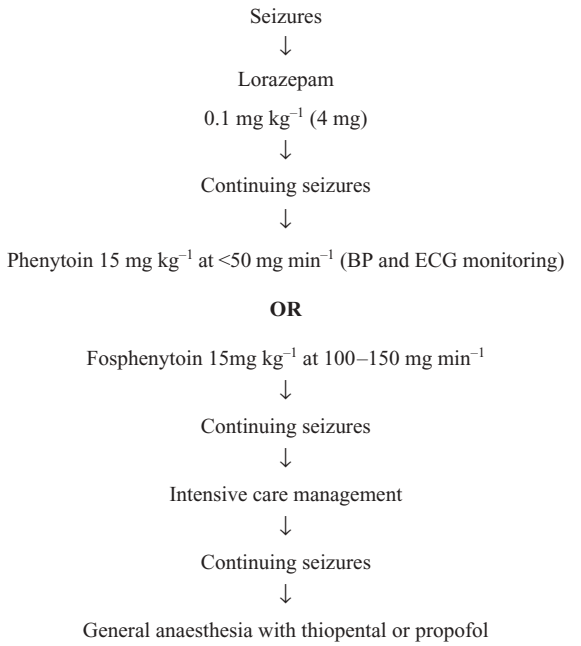

Fig. 1 Emergency treatment for status epilepticus.

epilepticus is a medical emergency that should be treated as quickly and aggressively as possible to prevent neuronal damage.

Management consists of attention to ABC and pharmacological intervention (Fig. 1). Airway management should prevent aspiration of gastric contents. Neuromuscular blocking drugs will be required to secure the airway but should not be needed after that. If they are required, continuous EEG monitoring must be used to allow monitoring of seizure activity.

Other management includes monitoring of electrocardiography, arterial pressure and pulse oximetry, and fluid resuscitation to maintain arterial pressure at normal levels ensuring adequate cerebral perfusion pressure. Blood should be taken for full blood count, urea and electrolytes, glucose, arterial gases, liver function, toxicology and drug concentrations if the patient is on anti-epileptic therapy. Hypoglycaemia should be treated with 50% glucose 50 ml.

Complications of status epilepticus or to the drugs used to treat it are listed in Table 3. Mortality is ~25%.[7 8]

Table 3 Complications of status epilepticus

Central nervous system
Cerebral hypoxia
Cerebral oedema
Cerebral haemorrhage
Cerebral venous thrombosis
Cardiovascular system
Myocardial infarction
Hyper/hypotension
Arrhythmias
Cardiac arrest
Cardiogenic shock
Respiratory system
Apnoea
Respiratory failure
Pneumonia
Pulmonary oedema
Metabolic
Hyponatraemia
Hypoglycaemia
Hyperkalaemia
Metabolic acidosis
Acute tubular necrosis
Acute hepatic necrosis
Acute pancreatitis
Miscellaneous
Disseminated intravascular coagulopathy
Rhabdomyolysis
Fractures

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See multiple choice questions 88–90.