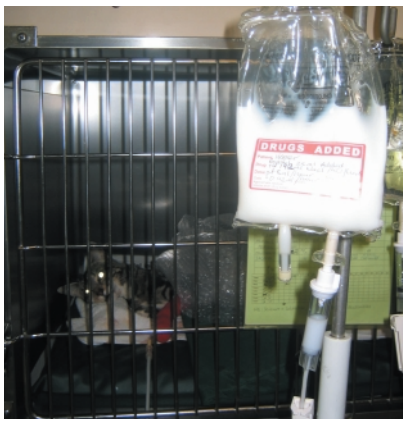

Two-year-old male domestic shorthaired cat with idiopathic epilepsy, which presented in status epilepticus. After a loading dose of phenobarbital (15 mg/kg intramuscularly divided over a 30-minute period), the patient was sedated with propofol which had been mixed with sodium chloride and administered via an infusion pump; 1·5 ml/hour propofol over 24 hours was required to control the seizures. The infusion was then gradually withdrawn over the following 48 hours

Diagnosis and control of epilepsy in the cat

CLARE RUSBRIDGE

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SEIZURES are the one of the most common presentations in the neurological feline patient and can be a daunting prospect for the veterinary clinician. The list of possible differential diagnoses is huge and demands a careful and systematic diagnostic approach. This article steers the practitioner through the work-up and provides guidance on the provision and monitoring of antiepileptic drug therapy in cats.

PREVALENCE AND MANIFESTATION

Idiopathic (primary) epilepsy is less common in cats than in dogs (see table on the right). Idiopathic epilepsies in dogs are generally genetic, but there is little evidence of this in the cat. It is probable that a considerable proportion of the idiopathic feline group actually have acquired epilepsy, but no obvious structural lesions are seen on magnetic resonance imaging (MRI).

Tonic-clonic generalised seizures are the most common type of seizure seen in dogs, but are less often observed in the cat. Complex partial seizures, during which animals may remain in sternal recumbency or can be very active (eg, running and climbing), are typical in cats. Urination and defecation may be seen. Some seizures last only a few seconds (eg, face twitching or 'blank' staring). Generally, such cats will have multiple episodes a day. In the author's experience, many epileptic cats have cluster seizures as their first seizure event. While this is a poor prognostic sign in dogs, this does not appear to be the case in cats and good seizure control may be achieved easily.

PREVALENCE OF EPILEPSY IN A REFERRAL POPULATION OF CATS AND DOGS*

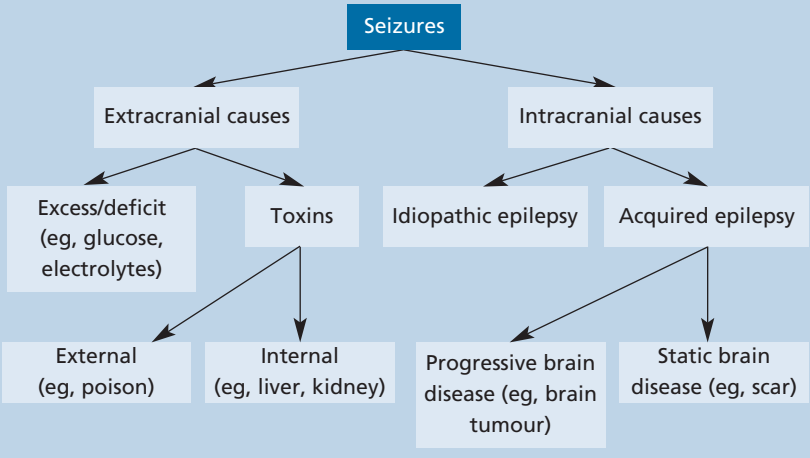
	Cats	*Dogs*
Idiopathic epilepsy	54%	68%
Extracranial pathology† (eg, metabolic derangement such as hepatic encephalopathy)	4%	5%
Intracranial pathology (eg, neoplasia)	42%	27%

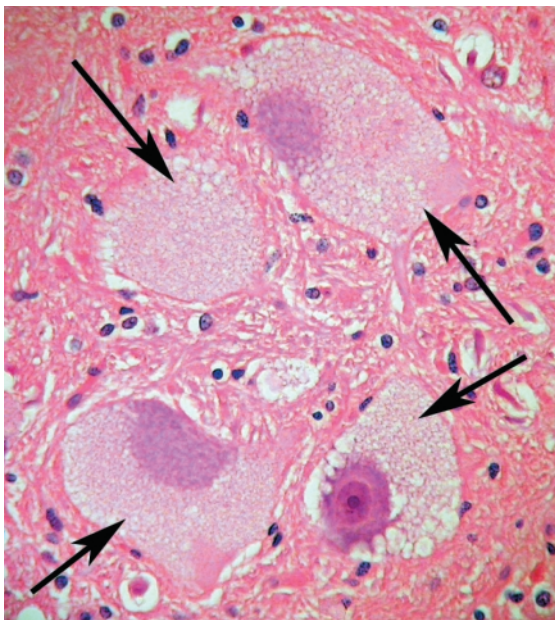
*From data collated at the author's referral practice
†Reactive seizures are more common in general practice

APPROACH TO DIAGNOSIS

The causes of seizures are traditionally divided into intracranial and extracranial (see box on the right). Intracranial causes may be further subdivided into idiopathic (ie, primary/genetic) and acquired (ie, secondary/symptomatic/cryptogenic). For prognostic purposes, it is useful to divide acquired epilepsy into static and progressive brain disease.

Classification of seizures





Histopathology section from the medulla of a three-year-old female cat which presented with seizures. The cat had a progressive gait abnormality characteristic of cerebellar disease and was deaf. The nerve cells (arrows) are full of a storage material which was autofluorescent under ultraviolet light. This is characteristic of ceroid lipofuscinosis.
Haematoxylin and eosin stain. Magnification x 400.
Picture, Dr Caroline Hahn, Neuromuscular Laboratory, University of Edinburgh

The list of differential diagnoses for seizures is huge and, as with most aspects of neurology, it is easiest to sub-categorise them using the DAMNIT-V system (see table, above right). This list can be daunting and, hence, the work-up of an epileptic patient requires a systematic approach to narrow down the likely cause of the seizures.

HISTORY

Good history taking is of paramount importance, as seizures can be easily confused with other causes of collapse or movement disorders (see box on the right). It is very helpful to have a video recording of the suspected seizure.

DIFFERENTIAL DIAGNOSIS OF SEIZURES IN CATS

	Type	*Conditions*
D	**Degenerative**	Lysosomal storage disease
A	**Anomalous**	Hydrocephalus, lissencephaly
M	**Metabolic**	Hepatic encephalopathy, hypoglycaemia, hypocalcaemia, uraemia, hypertriglyceridaemia, hypernatraemia, polycythaemia vera (primary erythrocytosis), post-metabolic acquired epilepsy, hypoxia, hyperosmolarity, mitochondrial encephalomyelopathy
N	**Neoplastic**	Primary and secondary brain tumours
	Nutritional	Thiamine (vitamin B_1) deficiency (raw or overcooked fish diet, anorexia)
I	**Inflammatory**	Granulomatous meningoencephalomyelitis, eosinophilic meningoencephalomyelitis, feline polioencephalomyelitis
	Infectious	Feline infectious peritonitis, toxoplasmosis, feline immunodeficiency virus infection, *Cryptococcus* infection, post-infection acquired epilepsy, abscess
	Idiopathic	Epilepsy where all diagnostic tests such as haematology, cerebrospinal fluid analysis, viral titres and magnetic resonance imaging are normal
	Iatrogenic	Post-surgical acquired epilepsy
T	**Traumatic**	Trauma to the cerebrum or diencephalon, post-traumatic epilepsy
	Toxic	Lead, organoarsenicals, organomercurials, organophosphates, chlorinated hydrocarbons, bromethalin, pyrethrins, metaldehyde, strychnine, metronidazole
V	**Vascular**	Cerebral ischaemic necrosis (feline ischaemic encephalopathy)

Easily confused non-epileptic conditions

Myoclonus

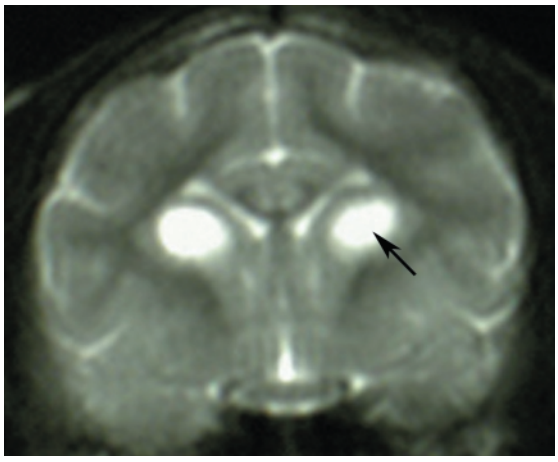
Myoclonus is an occasional diagnosis in cats and is characterised by a brief, repetitive contraction of a muscle/muscle group. Occasionally, myoclonus can be induced by a repeatable stimulus (eg, sudden movement in the visual field) or may be seen at certain times (most commonly as the animal falls asleep).

Mutilation

Syndromes leading to mutilation are rarely the result of seizures although some of these conditions may respond to anticonvulsant drugs. A common example is a (presumed) orofacial pain syndrome, which causes the cat to paw at, and mutilate, its mouth/tongue. This is especially seen in Burmese cats.

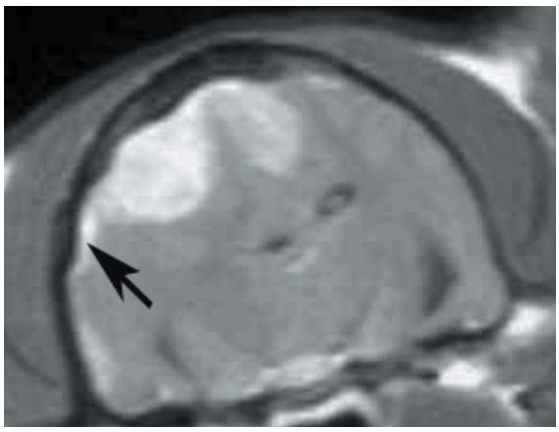
Syncope

Syncope is very rare in cats.

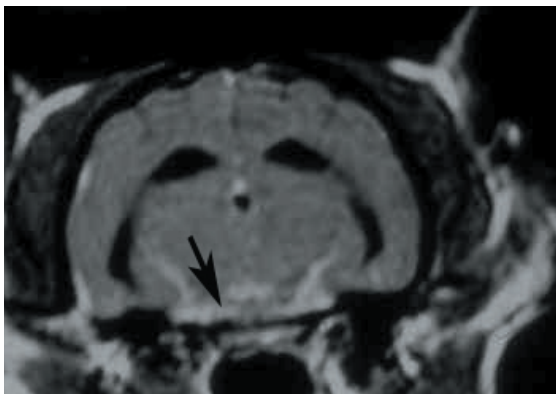


Transverse T2-weighted MRI scan from an 11-month-old cat which presented with a three-week history of seizures. The image shows high signal intensity, which is characteristic of oedema, within the caudate lobes (arrow). There is also a high signal area within the periaqueductal grey matter. This appearance on MRI is typical of a mitochondrial encephalopathy (ie, a mitochondrial enzyme defect). Urinalysis revealed a citric aciduria. The cat was given supplements containing the mitochondrial cofactors, L-carnitine and coenzyme Q, together with thiamine and riboflavin. The seizures ceased and the animal's demeanour improved markedly – it became more active, and started to play and go outside

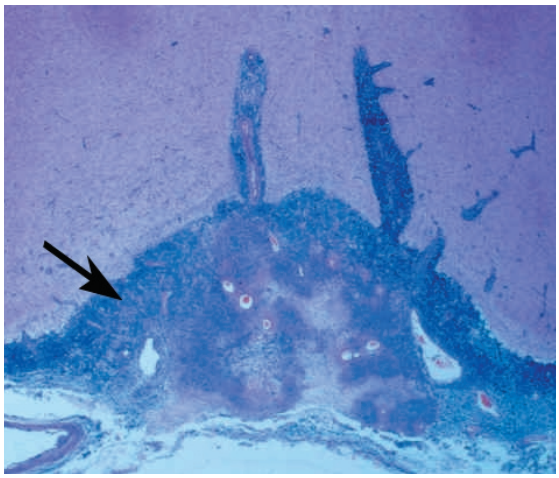
Nine-month-old cat with hepatic encephalopathy, showing stunting and copper-coloured irises, which are typical of cats with congenital portosystemic shunts. Serum biochemistry revealed low urea and low-normal albumin levels and raised resting bile acid values



Transverse T1-weighted gadolinium-enhanced MRI scan of the brain showing a meningioma in a 14-year-old male domestic shorthaired cat which presented with seizures. The tumour is seen as an enhanced (white) area with contrast. Note the thickened bone (black) adjacent to the tumour (hyperostosis) and the spread of the tumour along the meninges (arrow)



(above) Transverse T1-weighted gadolinium-enhanced MRI scan of the brain of a one-year-old domestic shorthaired cat with feline infectious peritonitis. There is mild ventricular dilation, which is occurring secondarily to obstruction of cerebrospinal fluid pathways. There is meningeal enhancement suggesting an inflammatory or neoplastic infiltrate (arrow). Cerebrospinal fluid analysis revealed a neutrophilic pleocytosis and a high anti-FCoV antibody titre. (below) Histopathological sample showing the cerebral cortex. There is massive inflammatory cell influx (basophilic cells, arrow) in the meninges, which explains why the area was enhanced on MRI. Haematoxylin and eosin. Magnification x 20



The timing and nature of a seizure may provide clues about its aetiology. For example, partial seizures suggest a focal lesion. It can be difficult to distinguish partial secondary generalised seizures from primary generalised ones – in such cases, ask the owner if the seizure starts in one body part or is asymmetrical (eg, only in one side of the face). Establish if the animal is normal between seizures. Abnormal behaviour in the interictal period, such as lethargy, aimless wandering, and inappropriate urination and defecation, implies an intracranial pathology. Finally, explore the possibility of a past medical history (eg, head trauma) or a previous diagnosis of systemic illness such as toxoplasmosis or diabetes.

NEUROLOGICAL EXAMINATION

A neurological examination is invaluable, yet its importance is often underestimated. The aim is to answer three main questions, discussed below.

Is the animal normal?

Cats with idiopathic epilepsy will have normal results on neurological examination (except in the postictal period), while cats with progressive brain disease generally provide abnormal findings. The clinician should be aware of rostral lesions (eg, in the frontal lobe), as postural reactions are often normal. Disease of the frontal lobe is characterised by behavioural changes (eg, lethargy, aimless wandering and loss of normal greeting behaviour). In the case of progressive disease (eg, a slow growing neoplasm), motor and sensory deficits will develop with time, so it is important to repeat the neurological examination after a few weeks, especially if other diagnostic tests such as MRI are not available.

If there are deficits, can these be related to disease of the forebrain?

In the absence of metabolic disease, seizures indicate disease of the cerebrum or diencephalon and any of the following deficits would be suggestive of an intracranial pathology:

- Behavioural changes;
- Depression/stupor/coma;
- Circling (towards the side of the lesion);
- Postural deficits (contralateral to the lesion);
- Visual deficits (contralateral to the lesion, normal pupillary light responses).

The side and location of a pathology can be established. Asymmetrical forebrain disease is most likely to have a neoplastic aetiology.

Is there multifocal disease?

The neurological examination should be used to determine whether there are any deficits relating to pathologies of more than one area of the nervous system. For example, vestibular signs suggesting brainstem disease imply either an inflammatory process (eg, feline infectious peritonitis [FIP]) or a multifocal tumour (eg, lymphoma).

CLINICAL EXAMINATION

A general clinical examination is important. For instance, central nervous system infections are rarely confined to this area and there will be systemic signs such as retinal changes in cases of FIP and toxoplasmosis. Toxoplasmosis is also associated with myositis, pneumonia and hepatic disease.

RULE OUT EXTRACRANIAL DISEASE

Full haematological and biochemical analysis should be carried out to rule out metabolic causes of seizures, the most common of which are listed in the table on page 209. In addition, dynamic bile acid testing (ie, before and two hours after feeding) is appropriate to rule out hepatic encephalopathy.

INFECTIOUS DISEASES CAUSING SEIZURES IN THE CAT

Disease	*Common neurological signs*	*Useful diagnostic tests*	*Frequency of condition*
Feline infectious peritonitis (FIP)	Cerebellar disease Vestibular disease Seizures	Haematology, biochemistry Cerebrospinal fluid analysis (neutrophilic pleocytosis, cell count >100 cells/mm^3, protein >2 g/litre) Positive cerebrospinal fluid anti-FCoV titre MRI/CT (hydrocephalus, hydromyelia, meningitis, ependymitis, choroiditis) Ocular examination	Common
Feline immunodeficiency virus (FIV) encephalopathy	Behavioural changes, ataxia, visual deficits, seizures, polyneuropathy	Cerebrospinal fluid analysis (mild mononuclear pleocytosis) Cerebrospinal fluid/serum FIV titre Electroencephalography MRI	Occasional
Toxoplasmosis	Altered mental state Seizures Systemic signs Polyneuropathy	Cerebrospinal fluid analysis (mixed pleocytosis) Serum biochemistry Radiography Bronchoalveolar lavage Antibody titres Electromyography Electroneurography Ocular examination	Rare
***Cryptococcus* infection**	Seizures, cerebellar and vestibular disease, with or without systemic signs	Cerebrospinal fluid analysis (mixed pleocytosis) Demonstration of organisms by Indian ink stain CRAG titre (serum/cerebrospinal fluid) MRI/CT	Rare

FCoV Feline coronavirus, MRI Magnetic resonance imaging, CT Computed tomography, CRAG Cryptococcal antigen

Biochemical analysis is also useful for providing evidence of multisystemic disease. For example, it is very unusual for toxoplasmosis not to result in myositis (elevated creatine kinase) or hepatitis (elevated liver enzymes or bile acids). In addition, baseline parameters can be established for future monitoring and for assessing a patient's suitability for receiving antiepileptic drugs.

INVESTIGATION OF INTRACRANIAL DISEASE

Infectious disease

Screening for possible infectious disease is often advisable in cats with neurological disease (see table above). However, with the exception of feline leukaemia virus (FeLV) and feline immunodeficiency virus (FIV), this is usually only useful if there is some evidence of infectious disease following the clinical examination or other diagnostic tests. The clinician should also consider how helpful certain tests are. For example:

- An anti-feline coronavirus (FCoV) antibody titre in the serum is of limited diagnostic value, but a positive anti-FCoV antibody titre in the cerebrospinal fluid is highly suggestive of FIP;
- A serum immunoglobulin M (IgM) titre for *Toxoplasma* species implies recent exposure to the parasite and is more useful than a single IgG antibody titre;
- An antibody titre for *Cryptococcus* species is useless, as this fungus stimulates little immune response. The most appropriate test for this type of infection is a cryptococcal antigen (CRAG) titre.

The clinical history, neurological findings, facilities available and the owner's wishes/financial circumstances will all determine whether any or some of these tests are carried out.

Advanced diagnostic imaging

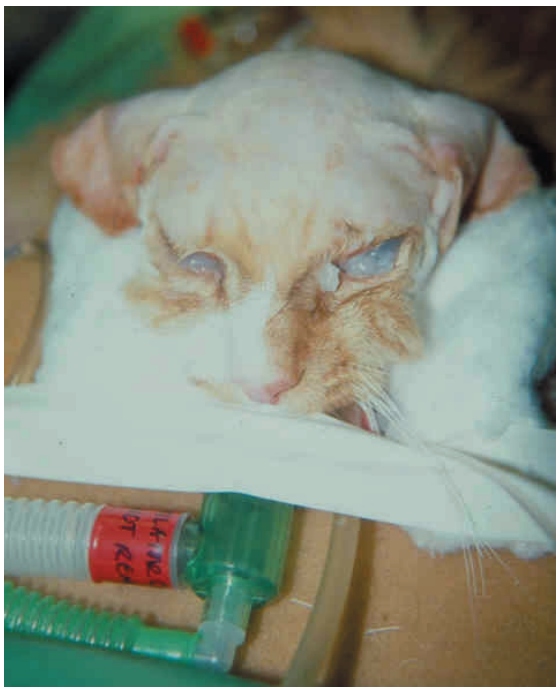
Following a neurological examination, MRI or computed tomography (CT) are particularly helpful for evaluating the epileptic patient. Both techniques allow the structure of the brain to be assessed, with the resulting information presented as a series of 'slices'. Disease processes can be identified by alterations in the symmetry of the brain, differences in intensity and their ability to be enhanced by contrast media. MRI has some advantages over CT in that it is multiplanar, provides superior soft tissue contrast and involves no ionising radiation.

Electroencephalography

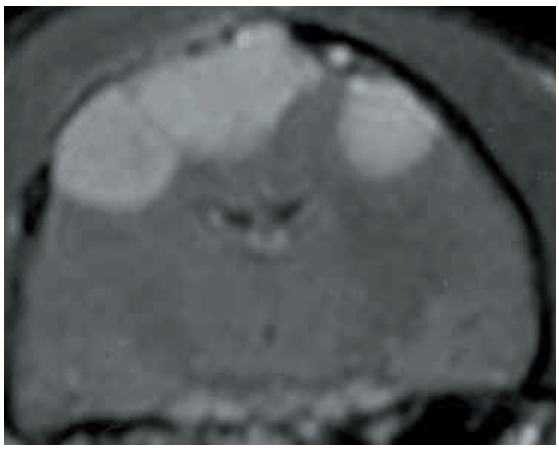
Electroencephalography provides a graphical recording of the electrical activity of the brain and in the past has been used to indicate the presence and rough location of an underlying pathology. Diseases such as encephalitis and hydrocephalus have specific wave patterns, while focal epilepsy is characterised by sporadic abnormal waveforms called 'spikes' over the area from which the seizures originate. Nowadays, few veterinary neurologists use electroencephalography because of its poor sensitivity and specificity in domestic animals.

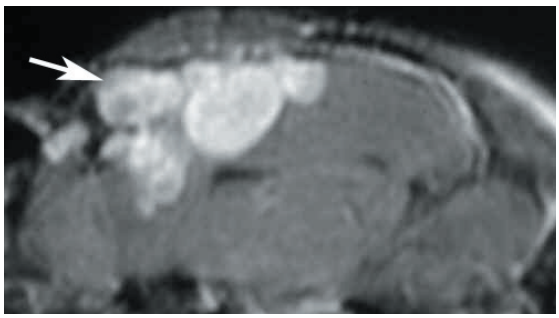
Cerebrospinal fluid analysis

Cerebrospinal fluid is normally clear and colourless, with a cell count of <6 cells/ml and a protein level of <0·3 g/litre. The normal cell population consists of monocytes, lymphocytes and, very rarely, neutrophils. The principles of obtaining cerebrospinal fluid and its analysis were discussed in an earlier article (see Rusbridge 1997). Infectious diseases that cause seizures and result in cerebrospinal fluid changes are listed in the table above.



Cat with a meningioma being prepared for brain surgery. This animal presented with a history of behavioural changes. It had become withdrawn and aggressive, and had exhibited a single seizure





Meningiomas are by far the most common type of feline primary brain tumour and are typically well circumscribed and slow growing. They arise from meningothelial arachnoid cap cells and usually occur in the forebrain in specific locations around the arachnoid villi. Meningiomas can often be surgically resected and affected cats have a fair prognosis. Many animals may survive with a reasonable quality of life when medicated with steroids alone (to decrease peritumour oedema). A number of cats have been known to have multiple meningiomas. Axial T1-weighted (above) and midline sagittal (below) gadolinium-enhanced MRI scans from a 14-year-old domestic shorthaired cat with tumour regrowth five years after primary tumour removal. The tumour is extending through the craniectomy site and into the frontal sinus (arrow)

TREATMENT

If a definitive cause of epilepsy in a cat can be determined, treatment should be aimed at removing this cause. Otherwise, antiepileptic drug therapy should be initiated.

WHEN SHOULD THERAPY BE STARTED?

While there is no precise answer to this question, generally treatment is initiated if:

- Seizures are more frequent than every 12 weeks;
- There are clusters of seizures/status epilepticus;
- Seizures last longer than five minutes;
- Seizure frequency is obviously increasing.

Repeated seizures damage the brain and lead to the phenomenon of 'kindling' (ie, make further seizures more likely). In the author's opinion, it is better to initiate therapy promptly and subsequently withdraw the antiepileptic drugs if they later prove to be unnecessary.

CHOICE OF ANTIEPILEPTIC DRUGS

There are no antiepileptic drugs licensed for use in the cat (see table below). Clients should be made aware of this and an appropriate disclaimer should be obtained from owners before treatment is instituted.

In cats, phenobarbital is the typical antiepileptic drug of choice (see table below). Phenobarbital solution (Epiphen solution; Vétoquinol) can make dosing easier. The alternative is to use generic 15 mg phenobarbital tablets, which may need to be divided for administration.

Diazepam can be very effective, but is more commonly associated with idiosyncratic hepatic necrosis than

PRIMARY ANTIEPILEPTIC DRUGS FOR USE IN THE CAT

Drug	*Advantages*	*Disadvantages*	*Dose rate*
Phenobarbital	Effective in the majority of cases	Initial sedation Polyuria/polydipsia Appetite stimulation Twice daily dosing Metabolised by the liver	1 to 3 mg/kg every 12 hours
Diazepam	Unlike dogs, tolerance does not develop in cats Effective in ~80% of cases Can be used in combination with phenobarbital	Sedation Appetite stimulation Idiosyncratic hepatic failure Potential for abuse (by owners) Serum concentration monitoring may be difficult	0·2 to 2 mg/kg twice or three times daily (can be used once daily in combination with phenobarbital)
Potassium bromide	Once daily dosing Used with/without phenobarbital Not metabolised by the liver Polyuria/polydipsia and sedation less than with phenobarbital	Eosinophilic bronchoalveolitis Bitter taste Takes a long time to achieve steady state Affected by dietary salt Polyuria/polydipsia and sedation May cause vomiting	30 to 40 mg/kg every 24 hours

NB None of these drugs are licensed for use in the cat

phenobarbital. Potassium bromide used as a single daily dose is an effective anticonvulsant, but causes eosinophilic bronchoalveolitis in about 50 per cent of cases and can be difficult to administer because of its bitter taste. It is usually used in combination with phenobarbital or diazepam in cats. The eosinophilic bronchoalveolitis is characterised by a cough, and is usually reversible on removal of the drug.

MONITORING

SEIZURE DIARY

The veterinary surgeon should advise the owner to keep a seizure diary, which should be brought to all consultations. A simple chart indicating the frequency of seizures is particularly useful, as it allows progress to be assessed quickly. Other notes, such as what time of day the seizure occurred, the length and severity of the seizure, and details about the pre- and postictal periods, can also be helpful. For example, an animal consistently having seizures when tablets are due to be given suggests that a 'trough' concentration of the drug may be inadequate.

SERUM ANTIEPILEPTIC DRUG CONCENTRATIONS

Monitoring the serum concentrations of antiepileptic drugs (see table, below right) enables:

- The lowest effective dose to be used;
- Dosing to be accurately adjusted;
- Possible toxicosis to be avoided;
- Better seizure control.

Serum concentrations should be measured:

- After initiating new drug therapy;
- After dosage changes;
- If breakdown in control occurs;
- Every six to 12 months.

LIVER FUNCTION TESTS

Potentially, antiepileptic drug therapy may damage the liver in two ways:

- CHRONIC DISEASE, characterised by hepatic cirrhosis due to a persistently high dose of antiepileptic drugs such as phenobarbital or phenytoin, which cause an ongoing sublethal injury. There have been no reports of chronic hepatic failure occurring secondarily to the use of antiepileptic drugs in cats, but this is more likely to be due to low case numbers, rather than low susceptibility;
- ACUTE INJURY, characterised by intrahepatic cholestasis. This is often classed as an idiosyncratic reaction. It has been described in cats following the administration of diazepam and typically occurs within two weeks of starting therapy.

Veterinary surgeons and owners are often very concerned about potential liver failure. In reality, this is rare, especially if the following guidelines are followed:

- Check liver enzymes in cats showing signs of anorexia, lethargy, marked polyuria/polydipsia or vomiting, especially within two weeks of initiating therapy;
- Monitor liver enzymes and function (ie, bile acids, albumin, etc) every six to 12 months;
- Do not exceed the therapeutic range and avoid prolonged administration of doses high within the therapeutic range (phenobarbital >30 µg/ml or >130 µmol/litre);
- Avoid administering phenobarbital at doses greater than 6 mg/kg twice daily;
- Avoid combination therapy (if possible).

OPTIONS FOR THE UNCONTROLLED EPILEPTIC CAT

IS THE DOSE ADEQUATE?

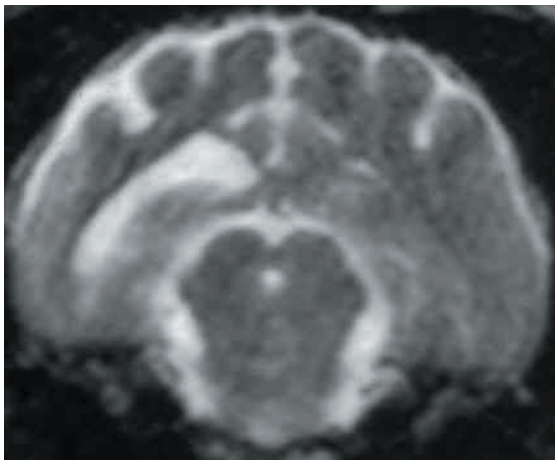
Check the serum concentration. One of the most common reasons for inadequate control is that the dose was reduced because of unacceptable sedation. Phenobarbital-induced sedation should wear off in a couple of weeks and it is important to make the client aware of this. If the sedation lasts for longer and is truly unacceptable, build up the dose slowly to the desired level and re-evaluate the serum concentration.

IS THE OWNER DOSING THE CAT CORRECTLY AND IS THE ANIMAL RECEIVING THE TABLET?

Veterinary surgeons should instruct owners that phenobarbital/diazepam should be dosed every 12 hours, as opposed to twice per day. Uneven dosing can lead to inadequate trough serum concentrations and seizures. The independent lifestyle of cats can sometimes make regular dosing difficult and, as is widely known, it can be very difficult to administer tablets to some cats.

ADD ANOTHER ANTICONVULSANT

In cats, diazepam and/or potassium bromide can be used in combination with phenobarbital. The author prefers to use phenobarbital initially and then add diazepam as the second agent. Often very small doses of diazepam (eg, 1 mg, once daily in the evening) can make a significant difference. Hepatic function should be routinely monitored as both drugs are metabolised by a similar route. Potassium bromide can also be used in combina-



MRI findings in an eight-year-old domestic shorthaired cat with refractory epilepsy as a consequence of cerebral toxoplasmosis two years previously. This transverse T2-weighted scan shows why the seizures were so poorly controlled: the right cerebral cortex is atrophied (note the widened subarachnoid space, sulci and ventricles). The cat had multiple daily seizures while receiving phenobarbital, diazepam and potassium bromide. It ultimately developed eosinophilic bronchoalveolitis, presumably as a result of the potassium bromide therapy

ANTIEPILEPTIC DRUG SERUM CONCENTRATIONS

Drug	*Therapeutic range*	*Sampling*	*Notes*
Phenobarbital	15 to 45 µg/ml (40 to 160 µmol/litre)	7 to 14 days after first dose	Most cats require at least 20 µg/ml (100 µmol/litre) for seizure control The author recommends avoiding prolonged administration of >30 µg/ml
Diazepam	0·5 µg/ml (human)	14 days after first dose	Measured serum concentration includes diazepam and its metabolites as an equivalent of diazepam
Potassium bromide	800 to 2500 mg/litre (15 to 20 mmol/litre)	12 to 16 weeks after first dose	Takes a long time to achieve steady state
Phenytoin	1 to 8 mg/litre (dog) Therapeutic range for cats has not been established	14 days after first dose	Frequent monitoring is required in the cat Long half-life means drug can accumulate in cats

tion with phenobarbital, but clinicians should bear in mind the risk of eosinophilic bronchoalveolitis.

Although not licensed for use in the cat, propentofylline (Vivitonin; Intervet) may have some antiepileptic function and may be useful in difficult cases. It can also be used in addition to existing drugs. A suitable dose is 5 mg/kg twice daily, which must be administered on an empty stomach.

Taurine is an inhibitory amino acid and has some anticonvulsant properties. It has been suggested that taurine supplementation may reduce the frequency of seizures in epileptic cats (van Gelder and others 1977), but this has yet to be proven.

INCREASE CURRENT THERAPY TO KEEP SERUM CONCENTRATIONS HIGH WITHIN THE THERAPEUTIC RANGE

Unacceptable side effects of sedation and pelvic limb ataxia usually prevent significant increases in dosage.

CHANGE TO A DIFFERENT ANTIEPILEPTIC DRUG

Phenytoin has a half-life of 40 hours in the cat. Therefore, it can accumulate in an animal and can be toxic. Unlike phenobarbital it cannot be excreted unchanged as it has two phenyl rings rather than one, and must be hydroxylated and conjugated for excretion, which is a slow process in the cat. However, in cases of refractory epilepsy, phenytoin may be useful at a dose rate of 1·5 mg/kg/day (use phenytoin elixir). Frequent monitoring of the serum concentration is strongly advisable and drugs metabolised by the same route (ie, phenobarbital and diazepam) should be withdrawn. Phenytoin may also be useful in cats where the administration of tablets every 12 hours is particularly difficult. An overdose of phenytoin may result in sialosis, frequent vomiting and weight loss.

The author currently uses levetiracetam (Keppra; UCB Pharma) at a dose rate of 10 to 20 mg/kg twice daily in: cases of refractory epilepsy; in animals with adverse effects following the administration of phenobarbital alone; or in cats with liver compromise. Levetiracetam is a novel antiepileptic drug, which has been shown to be one of the best tolerated antiepileptic drugs in human trials. It causes limited induction of cytochrome P450 enzymes (ie, is less challenging to the liver). The author uses levetiracetam either as a monotherapy or in combination with phenobarbital and/or propentofylline. However, it is too early as yet to determine the effectiveness and safety of this drug for use in the cat.

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