

Seizures and Epilepsy

What is a seizure

A seizure is caused by abnormal electrical activity in the brain and is characterised by a sudden episode of transient neurologic symptoms such as involuntary muscle movements, sensory disturbances and altered consciousness.

Types of seizure

Generalised

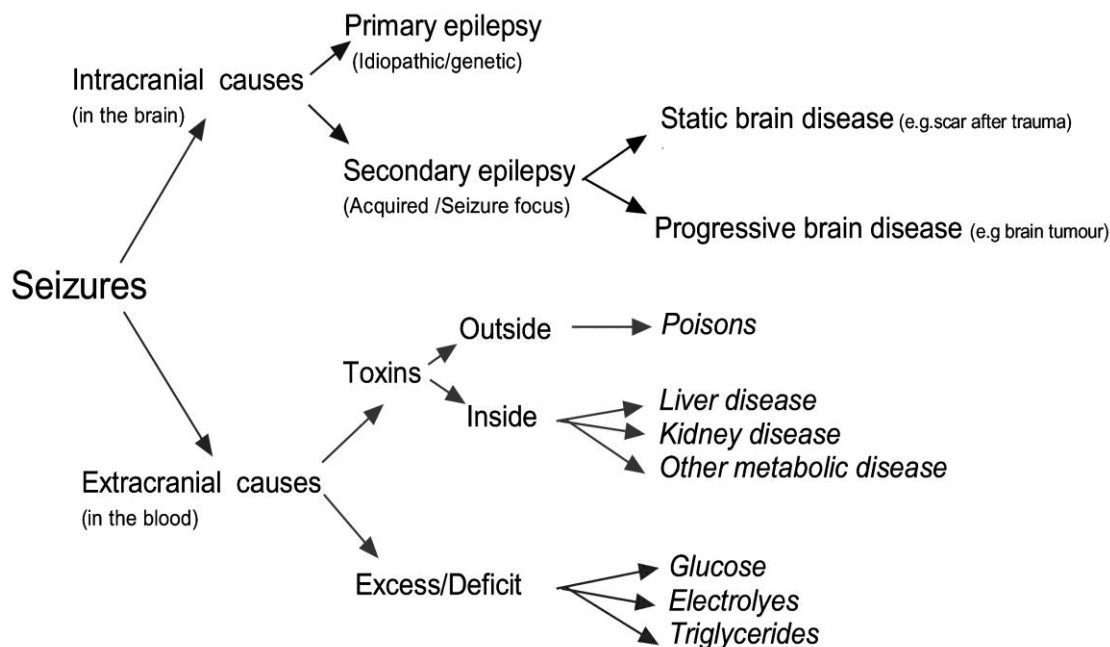
Generalized seizures affect both cerebral hemispheres (sides of the brain) from the beginning of the seizure. They produce loss of consciousness, either briefly or for a longer period of time, and are sub-categorized into several major types: generalized tonic clonic; myoclonic (jerking); absence; and atonic. Generalised tonic clonic characterised by stiffening of the limbs (the tonic phase), followed by jerking of the limbs and jaw (the clonic phase) is the most common seizure type in the dog.

Focal (partial)

With focal (partial) seizures the electrical disturbance is limited to a specific area of one cerebral hemisphere (side of the brain). Focal seizures can be subdivided into simple focal seizures (in which consciousness is retained); and complex focal seizures (in which consciousness is impaired or lost). In reality in cats it can be very difficult to distinguish complex and simple focal seizures as cats are not able to report subjective symptoms. Focal seizures may spread to cause a generalized seizure, in which case the classification category is focal seizures secondarily generalized. In the authors experience the most common seizure type in the cat is complex focal with or without secondary generalisation.

Causes of seizures.

Seizures are traditionally divided into intracranial (i.e. head) and extracranial (i.e. blood) causes. Intracranial causes of epilepsy can be separated into primary (AKA idiopathic / genetic epilepsy) and secondary (AKA acquired, symptomatic, cryptogenic) epilepsy. For prognostic purposes it is useful to divide secondary epilepsy into static and progressive brain disease.



The differential diagnosis (i.e. possible causes) of seizures is huge and, as with most of neurology, it is easiest to subcategorise them with the DAMMIT (V) format.

		Examples
D	Degenerative	Mitochondrial encephalopathies, storage diseases such as ceroid lipofuscinosis, , fucosidosis
A	Anomalous	Hydrocephalus, Neuronal migration disorders e.g. lissencephaly or cortical heterotopia
M	Metabolic	Hypoglycaemia, hypocalcaemia, hepatic encephalopathy, uraemia, hypertriglyceridaemia, hypodipsia, post metabolic acquired epilepsy, hypoxia,
N	Neoplastic	Primary or secondary tumour in cerebrum or diencephalon
	Nutritional	Thiamine deficiency
I	Inflammatory	Granulomatous meningoencephalomyelitis, eosinophilic meningoencephalomyelitis,
	Infectious	FIP, Toxoplasma, FIV, Cryptococcus, post-infection acquired epilepsy, Cat bite or other abscess, fungal infections
	Idiopathic	i.e. primary epilepsy
	Iatrogenic	Post-surgical acquired epilepsy
T	Traumatic	Trauma to cerebrum or diencephalon, post-traumatic epilepsy
	Toxic	Lead, organoarsenicals, organomercurials, organophosphates, chlorinated hydrocarbons, bromethalin, pyrethrins, metaldehyde, strychnine, metronidazole
V	Vascular	Infarction, aneurysm, extramedullary haematopoiesis in the choroid plexus, meningoangiomas

Work up of a cat with seizures.

The list of possible causes of seizures is a daunting list and when working up an epileptic cat a systemic approach is advisable to “narrow down” the likely possibilities. The cat’s signalment (i.e. breed, age and history) is important in establishing a differential diagnosis for example brain tumours are uncommon in cats less than five years old.

1. History

It is vital to obtain a good history as seizures can be easily confused with other causes of collapse or movement disorders. In addition the timing and nature of the seizure may provide clues as to the aetiology. The following are examples of the type of questions, which might be a clue to intra-cranial disease. If possible it is helpful to obtain video clips of the episodes

Question	Reason
What does the seizure look like from start to finish?	To establish whether the cat is having a seizure and what type it is– video clips are invaluable. A partial seizure with secondary generalisation suggests a focal lesion. Hypersalivation is common during feline seizures
Is the seizure symmetrical?	Asymmetry suggests a focal lesion

When do they occur?

Many cats with epilepsy have seizures when they are resting especially during the evening and early morning.

Collapse or seizures during exertion could suggest syncope (rare in cat) or metabolic problems

How long does it last?

Most generalised seizures last 2-3 minutes; longer episodes may be something else

Is the cat normal in between the seizures?

Abnormal behaviour in the interictal period e.g. lethargy, stereotypic pacing, loss of training suggests intracranial pathology

Any other medical history?

To help rule out underlying causes e.g. a history of head trauma

2) Neurological examination

There are three objectives.



- i. **Is the cat normal?** Cats with progressive brain disease generally have an abnormal neurological examination or behaviour/ personality change. In the instance of progressive disease, e.g. slow growing neoplasm, motor and sensory deficits may develop with time so it is therefore important to repeat the neurological examination after a few weeks especially if other diagnostic tests such as MRI, CT and EEG are not available.

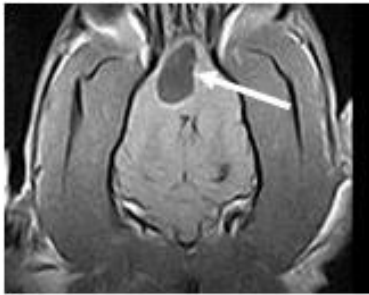


Prior to having seizures this cat started behaving oddly including hiding in atypical locations – his owners found him next to a hot water pipe. He was apparently unaware of the fur scorching and burns he suffered. MRI revealed a brain tumour (meningioma) which was successfully removed.

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

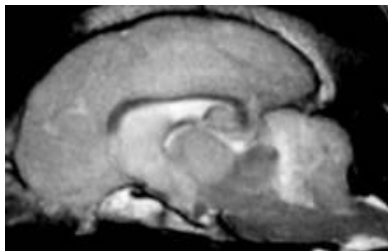
e.g. Behavioural changes,
Depression/stupor/coma,
Circling (towards side of lesion),
Postural deficits (contralateral to lesion),
Visual deficits (contralateral to lesion, normal pupillary light responses).

In the absence of metabolic disease, seizures indicate disease of the cerebrum or diencephalon and any of the above deficits would suggest intra-cranial pathology. The side and location of pathology can also be established. Asymmetrical forebrain disease is most likely to have a neoplastic aetiology.



Brain MRI from a 10 year old Golden Retriever with seizures and personality change. There is a large cystic brain tumour (white arrow).

- iii. Is there multifocal disease?** i.e. are there deficits relating to pathology of more than one area of the nervous system? This would either suggest an inflammatory process, metabolic disease or a multifocal tumour such as lymphoma. For example head tilt, balance problems or cranial nerve deficits suggest brain stem disease. Hyperaesthesia, dysmetria or an intention tremor suggests cerebellar disease. CNS inflammatory disease (and occasionally lymphoma) is typically associated with spinal pain.



Brain MRI from a 5 month old Staffordshire bull terrier with the metabolic brain disease L-Hydroxyglutaric aciduria. There is extensive oedema (swelling) through the cerebral and cerebellar cortex. In addition to seizures the dog was also presented with a abnormal high stepping gait characteristic of cerebellar disease.

3) Clinical examination

The veterinary surgeon will also perform a general clinical examination to look for another indications of disease which could be associated with or confused with seizures e.g. heart disease

4) Rule out extracranial causes

The majority of the extracranial (i.e. blood) causes of seizures can be identified by a routine biochemistry (blood sample) that includes glucose, electrolytes, bile acids and triglycerides.

5) Further investigation of intracranial disease

Whether these tests are performed depend on the clinical history, signalment of patient, neurological findings, facilities available and whether they are affordable.

a) Advanced diagnostic imaging (MRI and CT)

After neurological examination, MRI or CT are the most helpful tests to evaluate the epileptic patient. Both techniques allow viewing of the structure of the brain; the information is presented in a series of “slices”. Disease processes can be identified by alterations in the symmetry of the brain, differences in intensity and the ability to enhance with contrast media. MRI has advantages over CT in that it gives superior soft tissue contrast.

Whether or not to MRI the epileptic pet

Advantage

- Rules out many diseases with a poorer prognosis e.g. brain tumour
- Can help with decision making for treatment

Disadvantage

- Expensive
- Not a specific test for idiopathic epilepsy
- For cats with “idiopathic” epilepsy does not necessarily help with prognosis or treatment
- Requires general anaesthetic

CSF analysis

CSF analysis, although a non-specific test, can provide vital clues with regard to the disease process. CSF is normally a clear colourless fluid with a cell count of <6 cells/ μ l and a protein of <0.3 g/l. The normal cell population consists of monocytes, lymphocytes and very rarely neutrophils.

b) EEG

The EEG is a graph of the electrical activity of brain, which can indicate the presence, and rough location of an underlying pathology. Performing and interpreting an EEG requires a skilled operator, as artefacts are common. Focal epilepsy is characterised by sporadic abnormal waveforms called “spikes” over the area from which the seizures originate. Primary/idiopathic epilepsy typically has a normal EEG pattern inter-ictally, occasionally paroxysmal spindles are recorded. Diseases such as encephalitis and hydrocephalous have characteristic wave patterns and other pathology such tumours will also create an abnormal pattern. This disadvantage of an EEG is that it doesn’t exclude the need for other diagnostic techniques. A normal trace does not guarantee absence of underlying pathology and the changes are often non-specific e.g. there may be an indication of hydrocephalus but not the aetiology of the hydrocephalus.

EEG trace of a complex partial seizure

