Generalised seizures (where there is impairment of consciousness) are the most common type of epileptic seizure in dogs, while partial seizures are more common in cats. The accurate description of generalised seizures is important: 1) in order to differentiate them from other causes of collapse (e.g. syncope), and 2) because the presence of generalised seizures is one of the criteria for making a diagnosis of idiopathic epilepsy.

What is an Epileptic Seizure?

It is important to clarify that what an owner describes as a seizure does in fact represent an epileptic seizure: many lay people will use the term seizure or convulsion to describe a wide spectrum of non-neurological diseases.

An epileptic seizure is not a disease entity in itself but a clinical sign usually indicating a forebrain, metabolic or toxic disorder.

**Seizure:** The term seizure means a sudden attack or recurrence of disease and as such the term is non-specific. It also describes an epileptic seizure and used interchangeably with convulsion.

**Epileptic seizure:** The physical manifestation of paroxysmal transient disturbance of central nervous system function resulting from excessive and/or hypersynchronous abnormal neuronal activity within the cerebral cortex.

**Epilepsy:** Epilepsy is not a specific disease but a chronic condition characterised by recurrent epileptic seizures.
Classification by type of seizure

Epileptic seizure types can be classified based on their appearance into two major categories:

**Generalised Seizures:** In dogs, generalised seizures or partial seizures with secondary generalisation are the most common type. No localised signs and indicate involvement of both cerebral hemispheres. Consciousness is impaired and motor manifestations are bilateral.

**Partial seizures:** Compared to dogs, cats commonly exhibit partial seizures. This type of seizure indicates abnormal neuronal activity in a localised region of the cerebral hemisphere. Any portion of the body can be involved during a focal seizure depending on the region of the brain affected. The various forms of partial seizures include:

- Focal (partial motor) seizures: unaltered consciousness with asymmetric localised motor signs such as eyelid or facial twitching, clonus of muscle groups of one limb.
- Psychomotor (complex partial) seizures: behavioural seizures pattern which may present as rage, aggression, fly-catching, running in circles, floor licking, vocalisation, tail chasing, etc.

*Seizures may start focally and spread throughout both cerebral hemispheres: termed a focal seizure with secondary generalisation.*

Classification of seizure disorders by anatomical localisation of the underlying cause

The presence of epileptic seizures implies a forebrain disorder. Their causes may originate outside (extra-cranial) or inside (intra-cranial) the brain. Intra-cranial causes may be further subdivided into functional disorders (where no gross structural changes are evident in the brain) and structural disorders (where there is a gross structural cause within the brain, e.g. a brain tumour). The most common functional cause of seizures is idiopathic epilepsy.
**Important extra-cranial causes of epileptic seizures:**

Extracranial causes of epileptic seizures (also known as reactive seizures) represent a reaction of the normal brain to a systemic insult or metabolic or physiological stress. Reactive seizures differ from intra-cranial causes of epileptic seizures, as no primary chronic brain disorder (functional or structural) underlies the seizures.

Secondary changes may be present within the brain, most commonly identified by MRI, occurring as a consequence of severe seizures (irrespective of whether the underlying cause of the seizures originates within or outside the brain). It is important to recognise these secondary changes as such, so as not to misinterpret them as the primary cause of the seizures.

Extra-cranial causes of seizures may originate from outside the body (toxic disorders) or within the body (metabolic disorders). In both instances, the neurological examination may be either normal or abnormal in the inter-ictal period. **If neurological deficits are present in the inter-ictal period, then they are typically bilaterally symmetrical, often associated with a reduced level of awareness (stuporous or obtunded), and are non-localising in terms of the anatomic diagnosis.**

- **Hepatic encephalopathy:** hepatic encephalopathy secondary to a porto-systemic shunt is the most common extra-cranial cause of seizures in young dogs (in particular less than a year of age). Hepatic encephalopathy most commonly occurs secondary to a porto-systemic shunt (congenital or acquired) or to hepatic cirrhosis. Seizures secondary to hepatic encephalopathy are often associated with an altered mental status and/or behaviour in the inter-ictal period. This evidence of altered mental status and behaviour usually waxes
and wanes in severity over time. Other signs of symmetrical forebrain involvement can be observed (central blindness, symmetrical ataxia in all four limbs, head pressing, pacing and aimlessly wandering).

- **Hypoglycaemia:** hypoglycaemia secondary to an insulinoma is one of the most common extra-cranial causes of seizures in dogs over 6-years of age. Hypoglycaemia may cause weakness, syncope or seizures depending on the degree of hypoglycaemia, but more importantly the rate at which the hypoglycaemia fluctuates. The most common cause in adult and geriatric dogs is a functional pancreatic tumour (insulinoma) or other insulin-like producing tumour. Less commonly hypoglycaemia may also be associated with (among others) severe sepsis, pyometra, hypoadrenocorticism, insulin overdose and hepatic insufficiency.

- **Toxic causes:** including carbamates, organophosphates, lead poisoning, ethylene glycol toxicity, methaldehyde (slug bait), strychnine, etc.

- **Ionic imbalance:** hypocalcaemia (post-partum or hypoparathyroidism), hyponatraemia, etc.

- **Thiamine deficiency:** thiamine deficiency may cause seizures in cats exclusively fed on fresh fish diets (with high dietary levels of thiaminase), fed exclusively on diets where the thiamine has been destroyed (cooked food) or in cats that are anorexic/polyuric. Thiamine has also been reported in dogs in associated with severe seizures. Other clinical signs are invariably present in associated with thiamine deficiency in both cats and dogs, most commonly vestibular signs, but also including ataxia, dilated and unresponsive pupils, mentation changes and decreased gag reflex.

### Important structural intra-cranial causes of epileptic seizures:

*Most animals demonstrate neurological deficits in the inter-ictal period which are often asymmetrical.* Because these deficits are often asymmetrical they are useful in localising the site of the lesion. The most common localisation is that of a focal forebrain disorder.

There are exceptions to this in that in some cases the lesion causing the seizures lies in an otherwise “silent” region of the brain (causing only seizures but no other localising neurological deficits) - most commonly in the olfactory lobe or prefrontal lobes. During the early stages of a slowly enlarging mass within one of these silent regions only seizures may be evident, but with time other neurological deficits related to the site of the mass will develop.

*The most common structural intra-cranial causes of epileptic seizures include:*
- Brain tumours
- Inflammatory (immune-mediated) CNS disease: e.g. granulomatous meningoencephalitis (GME).
- Infectious CNS diseases (particularly in cats): including FIP, Toxoplasmosis, FeLV, Cryptococcus and FIV in cats and distemper virus and Neosporosis in dogs.
- (Head trauma; Congenital: e.g. congenital hydrocephalus).

**Seizures due to functional intra-cranial causes**

The term primary or idiopathic epilepsy implies a functional forebrain disorder causing recurrent epileptic seizures with a normal interictal period and no identifiable toxic, metabolic or structural intracranial cause. **Idiopathic epilepsy is the most important cause of seizures in dogs and an important cause in cats.** The diagnosis of idiopathic epilepsy is a diagnosis of exclusion as there is currently no definitive diagnostic test.

**Although idiopathic epilepsy is a diagnosis of exclusion there are certain clinical characteristics in dogs that make it more likely:**

- Most affected dogs have their first seizure between 1 and 3 years of age, but the accepted range with a high likelihood of being idiopathic epilepsy is **the first seizure between 6 months to 6 years of age.** In one study (Podell 1995) 2 out of 3 dogs with a seizure onset between 1 and 5 years of age had no identifiable cause for the seizures (i.e. a diagnosis of idiopathic epilepsy).
- The seizures tend to be **generalised tonic-clonic seizures or partial seizures with rapid secondary generalisation** (usually characterised by autonomic signs of hypersalivation and in many cases urination).
- The seizures tend to **occur while the dogs are relaxed in the house or from sleep** (and therefore often at night).
- There are **no abnormalities in the inter-ictal period.**
- There is **no evidence of haematological or biochemical abnormalities.**
• While idiopathic epilepsy occurs in all breeds, certain breeds are over-represented, including: collies (in particular Border collies), Labrador retrievers, golden retrievers, Irish setters and German shepherd dogs.

95% of dogs with a seizure onset between 6 months and 6 years of age, that have a normal physical and neurological examination and have generalised epileptic seizures will have idiopathic epilepsy.

Investigation of seizure disorders

When deciding on appropriate tests to investigate the causes of seizures, consideration should be taken of the animal’s age, the suspected anatomical localisation of the underlying cause and presence or absence of inter-ictal neurological deficits in formulating the diagnostic plan. Routine haematology and biochemistry (including a glucose determination) should be performed in all dogs. In dogs less than a year of age a pre- and post-prandial bile acid assay should also be performed. If these tests are normal and the dog fits the criteria for idiopathic epilepsy, then a diagnosis of idiopathic epilepsy would not be unreasonable at this stage: the diagnosis could always be revisited later.

It would not be unreasonable to make a diagnosis of Idiopathic Epilepsy in a dog (and to a lesser extent a cat) demonstrating:

• The right age and signalment (particularly in a breed with a high incidence of idiopathic epilepsy).
• The presence a normal haematological and biochemical evaluation.
• History and seizure characteristics consistent with Idiopathic Epilepsy (generalised tonic-clonic seizures from rest and with the seizure onset between one and three years of age – but from 6 months to 6-years is acceptable).
• No abnormalities in the inter-ictal period.

If these cases later developed further clinical signs to suggest an alternative diagnosis, or if the seizure control was poor, then further investigation would be justified.

• First investigate for possible extra-cranial causes:
  • Complete haematology
• Comprehensive biochemistry including pre- and post-prandial bile acid assay
• Urinalysis
• Total T4 in adult cat suspected of hyperthyroidism, Total T4, Free T4 and endogenous TSH in dogs
• FeLV, FIV and FIP tests
• Toxoplasma serology (IgM and IgG), Neospora serology

• Then consider investigation of intra-cranial causes (unless the diagnosis is very likely to be that of idiopathic epilepsy)
  • Thoracic radiographs
  • MRI or CT of the brain
  • CSF analysis (protein quantification, complete and differential cell count)
  • In those case with inflammatory CSF or imaging findings consideration should be give to performing serology for and/or CSF PCR for: distemper virus, coronavirus, Toxoplasmosis, Neosporosis, FeLV and/or FIV.