# MAJOR NEUROLOGICAL DISEASES IN SMALL ANIMALS

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## ABSTRACT

The incidence of neurological diseases in dogs and cats is high, leading to several complications that impair the quality of life of animals. Epilepsy, which is characterized by frequent seizures, herniated discs, which can result in spinal cord compression, and hepatic encephalopathy, commonly linked to severe liver problems, are the most common conditions. Managing these conditions requires early recognition of complications and transparent communication between the veterinarian and the owner, which is crucial to ensure appropriate care. Often, treatment of epilepsy includes the use of phenobarbital and potassium bromide. However, about 25% of patients may require additional therapies due to resistance. A herniated disc, on the other hand, needs a thorough diagnosis and can be treated through medications or surgical procedures, depending on their severity. In addition, the treatment of hepatic encephalopathy involves decreasing ammonia absorption and correcting metabolic disorders. In all situations, intensive care and meticulous management are essential for recovery, highlighting the relevance of prevention and appropriate treatment of neurological diseases in small animals

**Keywords:** Epilepsy. Herniated Disc. Hepatic encephalopathy. Veterinary neurology. Intensive treatment.

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## INTRODUCTION

In the routine of small animals, the prevalence of neurological diseases in dogs and cats is extremely high (SANTORO AND BAHR ARIAS, 2018; DE LAHUNTA & GLASS, 2015a). Given that most diseases cause motor, sensory and visceral changes, several complications can arise, especially decubitus ulcers, caused by loss of sensitivity, urinary retention or incontinence, urinary tract infection, diaper rash, muscle contractures, ankylosis, muscle atrophy and gastrointestinal and respiratory problems (SANTORO AND BAHR ARIAS, 2018).

The maintenance of the animal may be unfeasible due to present or future problems, and communication with the owner is crucial to minimize the chances of conflicts and improve the patient's quality of life. The veterinarian is responsible for identifying the possibility of complications, informing the owner about the clinical status and, above all, educating him about the relevance of preventing complications and actions to prevent or treat them (SANTORO AND BAHR ARIAS, 2018).

Most of the success in the treatment of neurological diseases is due to appropriate management, which requires special commitment and intensive care. This depends mainly on the commitment and availability of the tutor to ensure the necessary nursing care, such as keeping the animal in a dry and padded place, taking proper care of urination and defecation, changing the animal's position frequently and performing physiotherapy (SANTORO AND BAHR ARIAS, 2018).

Some of the main neurological diseases that affect dogs and cats are: epilepsy, a chronic condition characterized by recurrent seizures; herniated discs, which can cause spinal cord compression and result in pain, paralysis and loss of sensation; and hepatic encephalopathy, a brain dysfunction resulting from problems in liver metabolism, among others. Each of these diseases requires specialized management, aiming not only at controlling symptoms, but also at preventing complications that may impair the quality of life of patients (DE LAHUNTA & GLASS, 2015a).

## LITERATURE REVIEW

### EPILEPSIA

Epileptic seizures are the most frequentes.na clinical neurological problems of small animals (CHANDLER, 2006). These are clinical signs resulting from abnormal and hypersynchronous neuronal discharges, which are manifested by stereotyped and paroxysmal behavioral changes, usually of an idiopathic nature (KNOWLES, 1998; FISHER ET AL 2005; LORENZ AND KORNEGAY, 2006). Epilepsy is a brain condition marked by

abnormal and unpredictable interruptions of brain function, which favor the appearance of recurrent epileptic seizures (FISHER et al, 2005; LORENZ AND KORNEGAY, 2006).

According to etiology, it can be categorized into idiopathic epilepsy, which has no known cause; symptomatic, which is secondary to an alteration in brain structure; and cryptogenic, which probably has symptoms but cannot establish a cause (CHANDLEr, 2006). The classification of epileptic seizures can also be made based on the epileptiform focus (focal or generalized). Focal seizures are restricted to specific regions of the brain, while generalized seizures impact both hemispheres. It is crucial that the veterinarian receives a detailed description of the owner's seizures, as clinical observation can be restricted (CHANDLER, 2006; THOMAS, 2010).

Normal neural communication is mediated by synapses that predominantly use excitatory neurotransmitters, such as glutamate, and inhibitory neurotransmitters, such as gamma-aminobutyric acid (GABA). An imbalance in the activity of these neurotransmitters, either due to excessive excitation or insufficient inhibition, can lead to abnormal neuronal activity patterns, resulting in epileptic seizures (PLATT AND OLBY, 2004). Another type of existing pattern is "status epilepticus", which is an emergency condition characterized by continuous or repeated seizures that last more than 30 minutes, with the risk of irreversible brain damage and death. Treatment involves the immediate use of intravenous diazepam, followed by phenobarbital for long-term control (MARTINS, 2011).

The evaluation of epileptic seizures includes a thorough clinical history, in addition to additional tests such as blood count, biochemical profile and, in certain situations, electroencephalography. Cerebrospinal fluid analysis may be helpful in ruling out inflammation in the nervous system. With regard to treatment, phenobarbital is the preferred drug for the control of epileptic seizures, thanks to its effectiveness and affordable price. The suggested starting dose is 3-5 mg/kg every 12 hours, with modifications made after blood concentration measurement. The goal of antiepileptic treatment is to reduce the frequency and severity of seizures, minimizing adverse effects as much as possible. The use of potassium bromide as an alternative therapy in situations of phenobarbital resistance is possible (MARTINS, 2011).

Although many animals are able to control epileptic seizures with conventional therapies, approximately 25% do not respond adequately, which may require the addition of additional medications. There are few antiepileptics available for complementary use to phenobarbital and potassium bromide, mainly because of their short half-life, lack of knowledge about their effects on pets, and high costs (DEWEY, et al, 2004; ARIAS, 2009). Felbamate represents an option that enhances the inhibitory action of GABA and blocks

sodium channels. About 70% of the ingested dose is eliminated unchanged, while 30% is processed by the liver. The suggested dose for adult dogs is 20 mg/kg every eight hours, because of its short half-life. Although it rarely causes side effects, they can include liver disorders. The main advantage is that it does not cause sedation, but its high cost and the need for frequent administration are significant disadvantages (THOMAS, 2010). Gabapentin, acting as an analogue of GABA, potentiates the release and effect of GABA in the brain, as well as blocking sodium channels. It is metabolized by the liver by 30-40%, but does not significantly stimulate liver enzymes, reducing the possibility of interactions with other medications. Gabapentin has a half-life of approximately 4 hours, requiring administration every 6-8 hours at a concentration of 25-60 mg/kg. Side effects that may occur include sedation and increased appetite, resulting in weight gain (DEWEY, 2006).

Levetiracetam is an antiepileptic drug whose effectiveness has not yet been fully elucidated. When taken orally, it has a bioavailability close to 100% and a half-life of approximately 3-4 hours. The suggested starting dose is 20 mg/kg every eight hours. Observations suggest that this medication is safe for continuous administration in dogs and may be a good alternative in complementary therapies, particularly for those suffering from liver problems. Levetiracetam has been shown to be effective in cats using phenobarbital, with few adverse effects (DEWEY, 2006). Zonisamide, on the other hand, is a drug processed in the liver and has good tolerability in dogs, even at high doses and for a prolonged period. The suggested dose is 5-10 mg/kg, administered every 12 hours, aiming to achieve therapeutic concentrations of 10-40 mcg/mL. With a half-life of about 15 hours, this medication is also linked to a higher cost than conventional treatments, however, few adverse effects have been reported (DEWEY, 2006).

Animals that remain seizure-free for one year or more may be considered for phasing out of antiepileptic medication. This reduction should occur every two weeks, decreasing from 10% to 25% of the dose, but if there are relapses, the previous therapy should be reinstated. For dogs with idiopathic epilepsy, it is recommended to continue treatment, even after long periods without seizures (MARTINS, 2011).

## DISCO HERNIA

Herniated discs, also called Intervertebral Disc Disease, are the main cause of canine spinal cord injuries, usually linked to neurological changes (ALVES, 2018; SILVA, 2017). This condition occurs due to degradation or damage to the structures of the intervertebral disc, which encompass the nucleus pulposus and the annulus fibrosum, impacting both chondrodystrophic and non-chondrodystrophic breeds. In chondrodystrophic

breeds, such as Dachshund, Beagle and Poodle, it is possible to notice changes in the nucleus pulposus as early as three months of age (CECIM, 2019), which increases the danger of exteriorization after the fibrous ring breaks. On the other hand, non-chondrodystrophic breeds generally manifest this condition at older ages, usually presenting only disc protrusions (COELHO et al., 2016; Jones et al., 2000; MCGAVIN & ZACHAY, 2014).

Hansen Intervertebral Disc Disease (IVDD) type I is more common in chondrodystrophic breeds, but it can also manifest in animals without this tendency (THRALL, 2019; GUIDI et al., 2021). On the other hand, Hansen's IVDD type II arises from fiber degeneration and metaplasia. In addition, trauma can result in the appearance of type 3 hernias, particularly in dystrophic dogs of advanced age (NERONE & DIAMANTE, 2018). It can also happen that they manifest as annular or nuclear material in the spinal canal, which characterizes the sequestered hernia (VILANOVA JUNIOR et al., 2019).

IVDD is caused by a degenerative process that is accentuated with the aging of the animal, being influenced by genetic factors and can be accelerated by trauma and biomechanical failures (FENN et al., 2020). Intervertebral disc degeneration results from the loss of the nucleus pulposus (PN) ability to retain water, which leads to its degradation (DEWEY & DA COSTA, 2015; FOSSUM, 2021). In Hansen's hernia type I, the PN is extruded to both lateral and dorsal, thus compressing the spinal canal. The symptoms of IVDD vary depending on the location of the spinal cord injury, the amount of material in the spinal canal, and how quickly this material is expelled (LAHUNTA, GLASS, AND KENT, 2020). These signs can range from spinal cord hyperesthesia to paraplegia with profound pain loss (BRISSON, 2010; FINGEROTH & THOMAS, 2015). Injuries to the thoracolumbar segment do not compromise the functionality of the forelimbs, but can affect the upper motor neurons and pelvic limbs (PM), resulting in spasticity and paralysis (SHARP & WHEELER, 2005). Pain often leads the animal to adopt a kyphotic posture, arching its back (SHARP & WHEELER, 2005).

The diagnosis is made through a detailed anamnesis and evaluation of the patient's history, considering the predisposition of the breed and species. A thorough neurological examination is also conducted to assess the integrity of the nervous systems and identify the existence, location, and severity of any disorder (SILVEIRA et al., 2020). When planning alternative diagnoses, it is essential to consider inflammatory diseases, such as meningitis or granulomatous meningoencephalitis, which justifies hematological tests and evaluation of cerebrospinal fluid (CESCA, 2018). Imaging tests, such as radiography, computed tomography, myelography, and magnetic resonance imaging, are crucial for an accurate

diagnosis (ALVES, 2018; CESCA, 2018). Among these options, magnetic resonance imaging is the most recommended, as it provides cross-sections that help in the identification and quantification of spinal cord compression, in addition to offering superior anatomical details compared to other methods (ALVES, 2018; CESCA, 2018). This examination also makes it possible to identify one or more herniated discs.

It is important to note that radiography is the most accessible imaging test in Brazil, both in terms of availability and cost, as few cities have MRI or CT scanners. However, myelography poses risks to patients, as it requires general anesthesia and the use of iodine-based contrast. In addition, myelography may not provide an accurate diagnosis, especially in cases of spinal cord edema, making it difficult to locate the affected area (CESCA, 2018). Thus, it is often not possible to access a complete diagnosis of IVDD, as the X-ray can only show a decrease in the intervertebral space, which does not necessarily indicate the presence of a hernia (ALVES, 2018; CESCA, 2018).

Regarding treatment, surgery is indicated when drug therapy does not present satisfactory results, especially when spinal cord compression compromises the animal's quality of life. The goal of surgery is to remove the damaged material and unclog the spinal canal. There are several surgical options available, including the ventral slit, which allows you to visualize the affected area, although it is not suitable for lateralized lesions; dorsal laminectomy, which involves removing structures from two vertebrae in sequence, but can lead to partial removal of herniated material; and hemilaminectomy, which excises one of the joint processes, resulting in less trauma and easier access to the spinal cord. Mini-hemilaminectomy, in turn, uses incisions in adjacent vertebrae, facilitating access to surgical material (GUIDI, 2021).

Physical therapy can play a key role in postoperative treatment, and should be started as early as possible to strengthen the muscles and improve the functionality of the limbs. In the first days after surgery, the focus is on preserving urinary and fecal functions, while after ten days, physical activities begin to be introduced to speed up recovery. Physical therapy can include stretching exercises, massages, and techniques such as electrical stimulation and laser therapy, which help reduce pain and facilitate the recovery process (GUIDI, 2021).

## HEPATIC ENCEPHALOPATHY

Hepatic encephalopathy (HE) is a condition that can manifest in dogs with severe liver conditions, such as portosystemic shunts, acute liver failure, and cirrhosis. Although the pathophysiology of canine HS is not fully understood, it is known that it is the result of

several factors.  HS is defined as a reversible change in neuronal activity, which arises when the central nervous system is exposed to neurotoxic substances. This exposure may occur as a result of severe primary liver disease or a deviation of the portal circulation of the liver, as occurs in cases of portosystemic shunts (DUARTE, 2005).

The most common neurological manifestations include a decrease in mental activity and receptivity, which can range from mild depression to coma. Other correlated signs may include dementia, seizures, lethargy, behavioral changes (such as aggressiveness or hysteria), difficulty walking, uncontrolled gait, anorexia, vomiting, diarrhea, and hypersalivation, the latter being more frequent in felines. Although the symptoms can be associated with diet, the severity of the symptoms is not always directly linked to the severity of the liver injury (DUARTE, 2005).

Several factors influence the pathophysiology of hepatic encephalopathy, many of them linked to the accumulation of substances that, after being absorbed in the intestine, are not properly metabolized by the liver. Compounds such as ammonia, substances that look like benzodiazepines, false neurotransmitters such as tyramine, tryptophan and octopamine, mercaptans (such as methanethiol) and short-chain fatty acids such as octanoic acid are included. In addition, other causes may include changes in the blood-brain barrier, neurotransmitter dysregulations and metabolic irregularities (BUNCH, 1991).

In addition to the direct consequences of these encephalopathic toxins, several metabolic changes can contribute to intensifying symptoms. These changes include azotemia, hypoxia, electrolyte imbalances, hypoglycemia, alkalosis, and hypovolemia. Patients with these irregularities are more likely to develop encephalopathy, and correction of these conditions may improve clinical status. For example, hypokalemia, commonly seen in situations of liver failure, is a frequent condition that favors depression and anorexia. Several elements can cause these metabolic changes and lead to encephalopathy, such as high protein consumption, gastrointestinal bleeding, use of diuretics, administration of sedatives or tranquilizers, hyperuricemia, infections, constipation and the administration of methionine (DUARTE, 2005).

The disease is often linked to portosystemic anastomoses, acute liver failure, or cirrhosis. The goal of treatment is to decrease the production and absorption of ammonia generated by the breakdown of proteins by bacteria in the colon. The usual treatments include lactulose, antibiotics such as metronidazole and the inclusion of fibre in the diet, often in conjunction with protein limitation. However, meals with a high fiber content can affect nutrient absorption (BRUNCH, 1991).

The composition of amino acids in the diet is equally relevant. Decreased branched-chain amino acids and increased aromatic amino acids may contribute to HS, although branched-chain amino acid supplementation has not been shown to benefit individuals with the condition (RIORDAN AND WILLIAMS, 1997). Because they are rich in branched-chain amino acids, protein sources such as cottage cheese and soy are recommended.

Patients who do not respond to treatment need to be re-examined for HS-related conditions such as dehydration and infections. Individuals with severe levels of the disease need intensive care and correction of electrolyte problems. Lactulose is the usual treatment, as it contributes to the reduction of intestinal pH, transforming ammonia into insoluble ions and accelerating the digestive process (RIORDAN AND WILLIAMS, 1997).

## FINAL CONSIDERATIONS

Neurological diseases in dogs and cats, including epilepsy, herniated discs, and hepatic encephalopathy, present significant challenges for veterinarians and owners. The management of these problems requires not only an accurate diagnosis, but also intensive treatment and efficient communication between the veterinarian and the owner, to ensure the quality of life of the animals. Early detection of complications and the application of appropriate therapeutic tactics are essential to reduce the effect of neurological diseases. In epilepsy, the selection of antiepileptic drugs must be individualized, taking into account the animal's reaction to conventional treatments and the need to include additional medications. Herniated discs, in turn, require a rigorous diagnostic approach and treatment that can range from drug to surgical, depending on the severity of the condition. Hepatic encephalopathy, finally, highlights the importance of monitoring metabolic factors and adjusting diet to reduce the production of neurotoxic substances.

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