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Intracranial neoplasms in small animals: Literature review

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ABSTRACT
Intracranial neoplasms are frequent tumors in the nervous system of elderly animals, diagnosed mainly by magnetic resonance imaging and tomography. The main types include meningioma, glioma and neuroepithelial tumors. Clinical signs vary according to the location of the tumor, including seizures, ataxia and behavioral changes. Treatment involves surgery, radiotherapy and chemotherapy to reduce the size of the tumor and relieve symptoms such as cerebral edema and increased intracranial pressure.

Keywords: Intracranial neoplasms, Diagnosis, Treatment.

INTRODUCTION

Intracranial neoplasms are one of the major causes of neuropathies in elderly animals and the main tumors of the nervous system. They are often considered rare due to the lack of resources for diagnosis, as they require more advanced methods, such as magnetic resonance imaging and tomography, both of which are difficult to request by the veterinary clinician, giving the impression of rarity to neoplasms (Dalek *et al*., 2016).

According to Long (2004), intracranial neoplasms can be divided into primary brain tumors (PTE), which originate from the brain parenchyma, and secondary brain tumors (PET), which are metastases from other tumors. The etiology is not yet confirmed, but several factors may predispose to the disease, such as environment, diet, and genetics (Withrow and Vail, 2007). According to Dalek *et al.* (2016), the main PTE are: meningioma, astrocytoma and oligodendroglioma, choroid plexus papilloma, and ependymoma.

Initially, the signs are nonspecific, increasing progressively over the months, until the animal presents a neurological dysfunction. It is common for there to be behavioral changes, seizures, peritumoral edema (Schwartz, 2011), depression, ataxia, and visual deficit (Withrow and Vail, 2007). Despite being the most common clinical signs, behavioral changes are often unnoticed by tutors, requiring a drastic change in perception, requiring a very careful anamnesis (Dalek *et al*., 2016).

In view of the above, the objective of this study is to present the main intracranial neoplasms, their diagnoses and treatments.

OBJECTIVE

The objective of this study is to analyze the main literature on intracranial neoplasms, identifying the most common types, diagnostic methods, and treatment options, focusing on clinical efficacy and quality of life of patients.

METHODOLOGY

For the development of the study, Portuguese and English literature were collected from the following electronic journals: Google Scholar, PubVet, Scientific Electronic Library Online (ScieELO), Brazilian Journal of Veterinary Medicine and BSV Virtual Health Library. For the reference years, they were from 2000 to 2024 and the keywords used for the search were: intracranial neoplasms; veterinary oncology; Meningioma; Glioma; neuroepithelial tumor.

DEVELOPMENT

MENINGIOMA

Meningioma is the most common intracranial tumor among elderly dogs and cats, mainly affecting animals between 12 and 14 years of age, originating in any of the three meninges (Song *et al.*, 2013), with arachnoid being the most affected (Saunders, 2005 *apud* Garden *et al.*, 2013). The breeds with the highest incidence of this tumor are: Mixed Breed, Golden Retriever and Labrador Retriever (Song *et al.*, 2013). In an epidemiological study carried out by Magalhães *et al.* (2017) with 32 dogs, hemangioma showed a sexual predisposition to females. In general, meningiomas are benign, however, due to the severe secondary lesions they cause in adjacent tissues, they can be classified as malignant (LeCouteur, 2011 *apud* Sessums and Mariani, 2009), such as increased intracranial pressure, obstruction to the flow of cerebrospinal fluid (CEF), herniation, hemorrhage, and edema (Withrow and Vail, 2007).

In dogs, meningiomas can swelling or invade the Virchow-Robin space, which makes surgical excision difficult, as there is a loss of the demarcation between the tumor and the brain. It is different in felines, where the tumor is usually well defined and rarely grows to other spaces compared to canines (Dalek *et al.*, 2016; Forterre *et al.*, 2007; Greco *et al*., 2006).

In cats, the nodules are usually firmer and better defined, making surgery easier. In these animals, anemia is the most relevant postoperative complication. However, in dogs the procedure is more complicated, due to the difficulty of distinguishing the tumor from the brain tissue (Sessums and Mariani, 2009).

GLIOMAS

Gliomas are very common intracranial tumors in dogs and cats, affecting breeds such as Boxers, Boston Terriers, French Bulldogs and English Bulldogs (Dalek *et al.*, 2016; Song *et al.*, 2013). Withrow and Vail (2007) state that there is no breed predisposition in cats. In an epidemiological study by Magalhães *et al.* (2017) with 32 dogs, gliomas showed a sexual predisposition towards males. They are located mainly in the diencephalon and telencephalon (Dalek et al., 2016).

Its classification is according to its predominant cell type, the main ones being oligodendroglioma the tumor of oligodendrocytes, and astrocytoma the tumor of astrocytes, and there may also be "mixed" tumors with mixtures of the two neoplasms, called oligoastrocytoma (Withrow and Vail, 2007).

On astrocytomas, Dalek *et al*. (2016) states that:

> Tumors are classified as astrocytoma, anaplastic astrocytoma and glioblastoma multiforme. The difference between these three subtypes is based on the degree of cellular hypercellularity and pleomorphism, the presence or absence of mitosis, vascular proliferation, and mitosis. The greater the presence of these alterations, the more malignant the tumor, with glioblastoma multiforme being the most malignant (Dalek *et al.*, 2016, p. 865).

TUMORES IN NEUROEPITHELES

According to Dalek *et al.* (2016), neuroepithelial tumors originate from the cells of the choroid plexus or the ependyma, which are the choroid plexus papilloma (PCP) and the ependymoma, respectively. PCP is usually developed in the lateral, third, and fourth ventricles, which leads to involvement of the brainstem and cerebellum with some frequency. It has no racial prevalence, but males are more affected than females. In a survey of data carried out by Song *et al.* (2013) between 1986 and 2010, 12 dogs were diagnosed with PCP and only 1 with ependymoma. If there is proliferation to the ventricular system and subarachnoid space, it is called choroid plexus carcinoma, this one malignant histology; if the meninges are affected secondary to this tumor, it may be called meningeal carcinomatosis (Dalek *et al*., 2016). PCP can cause an obstruction of the ventricles and hypersecretion of CSF, leading to obstructive hydrocephalus (Long, 2004).

Ependymoma is much rarer than PCP, being located in either ventricle or central canal of the spinal cord (Dalek *et al*., 2016). This neoplasm occurs mainly in brachycephalic dogs and Domestic Shorthaired cats. It is possible for these tumors to spread through the CSF and invade the spinal cord. This mechanism is called *drop metastasis*. (Platt and Garosi, 2012). If located in the fourth ventricle and growing too large, it can reach the brainstem and generate mesencephalic and diencephalic syndromes (Long, 2004).

CLINICAL SIGNS

According to Sessums and Mariani (2009), seizures are the most common clinical sign presented in dogs with intracrnal neoplasms, and may also occur in cats, but less frequently. In addition, animals may demonstrate ataxia, blindness, changes in behavior that hangs over months, walking in circles, altered posture, *head tilt*, ataxia, depression, and incontinence (Withrow and Vail, 2007). Any seizure in animals older than 5 years should be suspected of brain neoplasms. Unlike dogs, cats usually have asymptomatic intracranial meningioma, which is only found later at necropsy (Forterre *et al*., 2007).

DIAGNOSIS

The diagnosis is made through an MRI or CT scan, in which they depend on the tumor mass, which needs to be outside the brain parenchyma. However, for definitive diagnosis, it is necessary to collect a sample for biopsy during surgery or by stereotactic. Complementary tests include blood count, complete biochemistry, urinalysis, abdominal ultrasound, and chest X-ray (Sessums and Mariani, 2009; Withrow and Vail, 2007). Associating these exams with the animal's clinical history is of paramount importance to rule out tumors of extracranial origin or other pathologies (Lira *et al*., 2022).

Magnetic resonance imaging of meningioma shows isointense signal areas on T1-weighted sequences and hyperintense to isointense signal intensity on T2-weighted sequences; magnetic resonance imaging of astrocytoma, oligodendrocytoma, and ependymoma shows hypointense to isointense signal areas on T1-weighted sequences and hyperintense to isointense signal intensity on T2-weighted sequences (Wisner *et al.*, 2011).

TREATMENT

Reducing the size of the tumor and controlling side effects is the main goal of treatment for neoplasms, such as increased intracranial pressure (ICP) and cerebral edema, using anticonvulsants and glucocorticoids. Currently, it is also possible to treat through surgery, radiotherapy, chemotherapy and immunotherapy (Withrow and Vail, 2007).

For palliative treatment, Sessums and Mariani (2009) indicate glucocorticoids to reduce cerebral edema and anticonvulsants in cases of seizures, such as phenobarbital and potassium bromide. However, Platt and Garosi (2012) recommend mannitol (0.5-2g/kg/IV in bolus for 10 to 20 minutes, every 4 to 6 hours) to treat cerebral edema and decrease intracranial pressure (ICP), furosemide (0.5-1mg/kg/IV) to have synergistic action with mannitol, diazepam (0.5-2mg/kg/IV) if seizures occur and continue phenobarbital treatment, and prednisone or dexamethasone (0.5mg/kg/IV/BID) for edema.

As a definitive treatment, surgery is the first choice. In cases where surgery is not possible, radiotherapy is recommended, where there may even be regression and elimination of the tumor, and

chemotherapy, which has its effectiveness decreased because it does not cross the blood-brain barrier (Dalek et al., 2016). However, Van Meervenne (2006 *apud* Van Meervenne, 2014) states that chemotherapy can be used as an adjuvant therapy, as the neoplasm damages the blood-brain barrier, allowing the passage of some drugs, such as lomustine, which is an agent belonging to the class of nitrosuureas, in which they are highly fat-soluble and have their passage facilitated.

FINAL CONSIDERATIONS

It is concluded that the study of intracranial neoplasms is very important for veterinarians, because, as they are often underdiagnosed, expanding knowledge in this area makes the professional seek to improve their clinical conduct and, consequently, recognize the ideal treatment for each animal.

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