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SUMMARY

The doctoral thesis entitled “***Diagnosis of encephalopathies in dogs***” aimed to describe the most commonly seen disorders of the dog’s brain and finding the most efficient ways of diagnosing them.

The thesis includes 249 pages and is made up of two representative parts: the first part, the bibliographical study of the theme, represents 28.11% of the paper and the second part, of personal researches, takes up 71.79% of the work. The obtained results are supported by 74 figures and 30 tables.

The first part entitled „***Current state of knowledge***” represents a brief bibliographical study regarding the diagnosis techniques used for brain disorders in dogs. This part is structured into four chapters describing the importance of signalments and history for the clinical evaluation of the dog with intracranial disease, the use of laboratory investigation, advanced imaging (computer tomography and magnetic resonance imaging) and electrodiagnosis for investigating dogs with encephalopathy. The information obtained after this study were later used for elaborating, interpreting and comparing the results obtained in the personal researches.

The first chapter entitled “*The importance of signalments and history for the clinical evaluation of dogs with intracranial disease*” is a brief description of predispositions related to breed, age and sex to develop certain encephalopathies, as well as a review of the role a thorough history has in orienting the diagnosis of intracerebral disease. It also includes the classification of neurological diseases according to the age and mode of appearance and the evolution of clinical signs.

Chapter II entitled “*The importance of paraclinical tests for the diagnosis of intracranial diseases in dogs*” presents the changes in blood and cerebrospinal fluid composition that appear in different types of encephalopathies.

Chapter III is an approach to “*The importance of advanced imaging in the diagnosis of intracranial diseases in dogs*”, also presenting a comparison of the advantages and disadvantages offered by computer tomography and magnetic resonance imaging for the exploration of the brain.

Chapter IV “*The importance of electrophysiological examination in the diagnosis of intracranial diseases in dogs*”, makes a brief review of the information we can obtain from



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auditory evoked potentials (BAER) and electroencephalography (EEG), as well as the main factors influencing the results gathered.

Part II „*Personal researches*” is made up of four chapters presenting and discussing the results of the researches undertaken.

Chapter V „*Researches regarding the incidence of intracerebral diseases in dogs and description of the clinical signs observed*” is a study done between October 2009 –July 2013 on a total of 2407 dogs of which 82 with encephalopathies, presented to the Clinic of Internal Medicine of the Faculty of Veterinary Medicine in Iasi. During this period, the prevalence of encephalopathies in dogs, compared to total morbidity was of 3.47% (82 out of 2366 dogs) and compared to neurological morbidity was of 19.34% (82 out of 424 dogs). Of the total number of encephalopathies, the diseases of the cerebral hemispheres and thalamus were predominant, with 51.22% of the cases, followed by multifocal intracranial diseases in 25.61% of the patients and vestibular syndrome in 21.95%. The lowest share was cerebellar atrophy diagnosed in 1.22 % of the dogs. Among the patients with diseases of the cerebral hemispheres and the thalamus, epilepsy of unknown origin (EON) was diagnosed in the most individuals (40.48 % of the cases), followed by tumors (30.95 % of the dogs) and congenital hydrocephalus (16.67 % of the animals). Lower percentages were seen for cerebral atrophy (7.14%) and traumatic disorders (4.76%). The data regarding the distribution of categories of diseases of the cerebral hemispheres and thalamus according to age of presentation for consultation were similar to those presented in literature. Thus, we noticed that in congenital hydrocephalus the average age was the lowest (3.85 months), followed by that of dogs diagnosed with EON (41.58 months) and that of patients with cerebral tumors (113.54 months). The highest average age was that of patients with atrophic encephalopathy (180 months). Among the dogs with multifocal intracranial diseases, 42.86% of the cases presented cerebral trauma, and 38.1% of the patients were diagnosed with inflammatory encephalopathies. Tumoral diseases were present in three patients (14.28%), and vascular ones in one case (4.76%). Regarding clinical signs, in most dogs, they were characteristic of each type of encephalopathy, but some dogs presented nonspecific clinical presentations. Thus, in one patient with congenital hydrocephalus, the only neurological deficits appeared at the age of 42 months, localized in the right rear limb. This proved that in some cases, congenital hydrocephalus can evolve asymptotically or with nonspecific neurological signs. Interesting neurological symptoms were seen in a dog with cystic meningioma, showing anisocoria, with right pupil mydriasis, protrusion of the third eyelid and a discreet ptosis of the



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right inferior eyelid, without any deficit of the facial nerve or the motor branch of the trigeminal nerve. The neurological signs of this dog were attributed to unilateral cerebellar lesions, particularly those affecting the medial cerebellar nuclei. In the case of distemper disease, intracerebral lesions were present even in the absence of clinical signs of brain involvement. Moreover, in the absence of neural signs, there were changes in the composition of CSF. In necrotising encephalitis the clinical signs showed the concomitant impairment of the cerebral hemispheres and the brainstem, but the brainstem lesions could not be seen on CT due to numerous artifacts present at this level. This proves the importance of neurological examination in establishing the location of lesions in encephalopathies.

Chapter VI describes a *“Study regarding the importance of signalments, history and neurological examination in establishing the predictability of different types of intracranial diseases in dogs with epileptic seizures”*. This retrospective study was done in the “Queen Mother Hospital, The Royal Veterinary College of London”, by consulting their medical archive between January 2008- February 2012. We identified a number of 404 dogs presenting epileptic seizures, of which 258 had functional diseases and 146 had structural brain lesions. Of the latter, 11 dogs were diagnosed with symmetric structural lesions and 135 with asymmetrical lesions. Identifying the various factors associated to a certain type of intracranial encephalopathy was based solely on using the signalments of the animal, the description of seizures by the owner and neurological examination. The factors with the highest degree of predictability for functional encephalic lesions (sensitivity 82.1%, specificity 83.9%) were: age of onset of the seizures under 72 months, appearance of episodes of singular, symmetrical seizures, and a normal result of the interictal neurological exam. A contrary situation was signaled in the case of structural asymmetrical seizures where an age of appearance of seizures higher than 72 months, episodes of cluster, asymmetrical seizures and a symmetrical or asymmetrical modified result of the interictal neurological exam, have the highest degree of predictability (92.3% sensibility and 72.7% specificity). The factors identified with the highest degree of predictability of symmetrical structural lesions were the age of onset of seizures and the results of interictal neurological examination symmetrically modified. The only breed predisposed to a high risk of development of asymmetrical encephalic lesions was Boxer. When Boxers had their first seizure over the age of 72 months, they manifested asymmetrical cluster seizures and the neurological exam was modified, asymmetrical structural lesions were predicted with a sensibility of 92.7% and a specificity of 75.8%. This study proved that the age of onset of seizures and breed alone can not



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be used to distinguish epilepsy of unknown origin from symmetrical or asymmetrical encephalic lesions. The clinician can predict with great accuracy the type of encephalopathy using a detailed history including information about the laterality of the seizures as well as the results of a rigorous neurological examination.

Chapter VII entitled „*Study regarding the importance of imaging examination in the diagnosis of intracranial diseases in dogs*” is made up of 3 subchapters. The first subchapter represents a „Study regarding the importance of computer-tomography in the diagnosis of intracranial diseases in dogs” and it was done on a number of 22 dogs of which 45.45% were diagnosed with neoplastic encephalopathies, 13.64% had congenital anomalies, inflammatory encephalopathies or EON, 9.09% with degenerative encephalopathies and 4.54% with traumatic encephalopathies. The diagnosis of congenital hydrocephalus could not be established solely based on the existence of enlarged ventricles on CT in the absence of a process to generate an increase in ventricular size, but by corroborating these imaging aspects to the neurological signs specific to cerebral pathology. Cerebral atrophy was characterized in the CT images by enlarged cerebral ventricles and mesencephalic aqueduct, the presence of CSF gaps within the cerebral substance, enlarged cerebral gyrus and subarachnoid space. In traumatic encephalopathy, the CT images showed a widening of the mesencephalic aqueduct, due either to a posterior obstruction of the ventricular system, or to the ex vacuo hydrocephalus resulted from primary or secondary tissue destructions caused by the trauma. The CT images from necrotising encephalitis showed the presence of numerous areas disseminated in both cerebral hemispheres, hypodense as compared to the surrounding parenchyma which did not intensify after contrast substance. One of these areas was located beyond the right lateral ventricle. Also, we noticed an enlarged subarachnoid space and wider cerebral gyrus. Meningioma was characterized on CT by an extra-axial location, in the frontal lobes, with a wide implantation area, a hyperdense aspect compared to the surrounding parenchyma and showing an extended peritumoral edema. A particular aspect was seen in the uneven charge with contrast substance, although a post-contrast CT image of a meningioma is normally homogeneous. The cystic meningioma was large, reaching from the infratentorial level to the left temporal lobe. The CT images showed the presence of a tumoral component (isodense with the cerebral tissue and taking up the contrast substance homogeneously) and of a hypodense cyst. CT imaging in the case of hemangiosarcoma was unusual due to the lack of intensification on contrast substance administration. In the case of seven cerebral tumors, the CT images were polymorphous compared to cerebral parenchyma



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(hypo, iso and hyperdense) therefore common to other diseases. In these cases, in order to establish a diagnosis of tumoral encephalopathy a corroboration of data from the neurological and/or CSF examination and imaging tests with life expectancy and the evolution of clinical signs following diagnosis is necessary. In epilepsy of unknown origin and in two dogs with inflammatory encephalopathy showing epileptic seizures exclusively, the CT images showed a normal brain anatomy, the differentiation of the two diseases was based on CSF examination and further development of neurological signs.

The second subchapter „Study regarding the importance of magnetic resonance imaging in the diagnosis of intracranial diseases in dogs”, was done on 8 dogs with encephalopathy, of which 2 with hydrocephalus, 2 with cerebral masses, and in 4 cases MRI showed no anomaly. Hydrocephalus associated to syringomyelia was characterized on MRI by an increase in volume of all cerebral ventricles and the presence of lesions hypointense in T₁ and hyperintense in T₂ more enhanced in the cervical C₃, C₄ vertebrae and the first two thoracic vertebrae. In one patient the MRI showed a hyperdense area in T₁ which did not intensify on administration of gadolinium, located after the tentorium cerebelli bone, compressing the cerebellar tissue and the right occipital lobe and deviating the median line to the right. The differential diagnosis was made between a bony proliferation of the tentorium cerebelli bone and a meningioma appearing at this level. In tumoral encephalopathy the T₁ sequence showed the presence of a circular, hypointense which intensified post-contrast and created pressure on the left lateral ventricle and deviating the cerebral falx to the left. In T₂, the formation showed moderate hyperintensity, and on the outside it had a ring of more accented hyperintensity.

The last subchapter entitled “Study regarding the importance of ultrasonography in the diagnosis of intracranial diseases in dogs” presents the ultrasonographical images taken through the window of the open fronto-parietal fontanelle in 4 dogs suspected of congenital hydrocephalus. In advanced hydrocephalus we noticed the lateral ventricles occupying almost all of the cranial volume, the cerebral parenchyma showing as a hyperechoic band in the cerebral falx. We also noticed the absence of the septum pellucidum, and the lack of individualisation of the third ventricle and of the surrounding cerebral tissue. In the early stage of congenital hydrocephalus we noticed a dilation of the third ventricle, apparent even when the distention of the lateral ventricles was not marked. In the inter-hemispheric scissure the delimitation was made by a narrow hyperechoic band.



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Chapter VIII „*Study regarding the importance of electrodiagnosis in intracranial diseases in dogs*” is made up of two parts. The first part presents the results obtained on recording of the brainstem auditory evoked potentials (BAER test) of 11 dogs diagnosed with central vestibular syndrome, in 5 dogs with cranial trauma, 3 dogs with congenital hydrocephalus and 7 dogs presenting epileptic seizures. In dogs with vestibular syndrome, the morphological changes of the waves were present only in patients with tumoral encephalopathy, proving that these disorders caused the most profound changes in the BAER trace. A decrease in amplitude of wave I in dogs with vestibular syndrome has never before been described in veterinary medicine. This change was attributed to ischemia or infarctions in the cochlea, caused by compression on the labyrinthic or basilar artery. In dogs with hydrocephalus, the BAER test showed values for the amplitudes of waves III and V higher than reference, regardless of the degree of hydrocephalus (incipient or advanced). These results have not been noted in veterinary medicine and were attributed to the inhibition of the neurons in the auditory cortex and descending auditory paths. In post vaccine encephalopathy the disappearance of changes in latencies and amplitudes of the BAER waves within 1.5 months of the first testing proved the remission of lesions in the auditory pathways in the brainstem. This shows that BAER testing can be used as a cheap procedure (compared to imaging tests – MRI) for supervising the evolution of a disease. Furthermore, BAER examination proved to be superior to CT in detecting lesions of the auditory pathways in the brainstem as it can identify even small lesions (< 3 mm) found at this level. In the dog with vascular disease, the change in latency of wave V was significant to the evolution of the disease, as the presence of anomalies of the BAER test was associated to a bad prognosis. Following this study we can conclude that BAER testing in patients with vestibular syndrome had a sensibility of 54.55% and a specificity of 45.45%, in patients with cranio-cerebral trauma a sensibility of 60% and a specificity of 40 %, and in those with epileptic seizures a sensibility of 57.14% and a specificity of 42.86%.

The second part of this chapter is a “Study regarding the importance of electroencephalography in intracranial diseases in dogs (EEG)” which was done on 9 dogs presenting epileptic seizures. The EEG examination showed the presence of changes specific to epileptic seizures in 2 cases with EON and 2 dogs with symptomatic epilepsy. Of all the interictal discharges, only generalized peaks were identified, none of the patients showing sharp waves or peak-wave complexes. The background activity of EEG consecutive to sedation with medetomidine was dominated by the presence of theta and delta waves, while alpha and beta



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waves were less common. Inter-ictal paroxysmal discharges located within wide margins in veterinary medicine compared to human medicine are due to the use of different anesthetic protocols, of different doses of anesthetic, of different protocols of recording the EEG waves (different number of electrodes and different times for recording), as well as the use of a certain medication for the treatment of epilepsy.

Chapter IX contains “*Conclusions and recommendations*” that result from studies that compose the thesis.