Scientific Works. Series C. Veterinary Medicine. Vol. LXIX (1), 2023
ISSN 2065-1295; ISSN 2343-9394 (CD-ROM); ISSN 2067-3663 (Online); ISSN-L 2065-1295

DIAGNOSTIC APPROACH TO BRAINSTEM DYSFUNCTION IN DOGS AND CATS - A CASE SERIES REPORT

Raluca Mihaela TURBATU, Cristina FERNOAGĂ, Alexandru Gabriel NEAGU, Roxana-Mariana IGNĂTESCU (ȚÎMPĂU), Constantin VLĂGIOIU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Veterinary Medicine, 105 Splaiul Independenței, District 5, Bucharest, Romania

Corresponding author email: raluca.tbt@gmail.com

Abstract

Neurological pathology has known a marked expansion in recent years in veterinary practice in Romania, the diversity and complexity of cases representing a constant challenge for clinicians. Consequently, the diagnostic methodology was in a continuous dynamic, being influenced by the particularities of each patient and the accuracy of the available diagnostic methods. However, identifying the localisation of the lesion according to the correspondence of the neurological deficits with the functional segment of the brain (forebrain, brainstem, cerebellum, vestibular apparatus) remained an essential stage. Decerebrate rigidity, a comatose mental status accompanied by a decrease in the activity of the vital centres, and multiple deficits of the cranial nerves are cardinal signs of a brain stem lesion. This paper aims to present the clinical, neurological, and imaging features of 15 patients (dogs and cats) diagnosed with brainstem deficits in the Faculty of Veterinary Medicine of Bucharest, in 2021. Each case was conducted according to a standard protocol and the results were analysed to observe the population dynamics and possible predisposing factors.

Key words*: neurological examination, brainstem, decerebrate rigidity, nervous system, MRI.*

INTRODUCTION

Brainstem dysfunctions resulting from trauma, anomaly or central extension of infections are life-threatening conditions, which have been rarely described in the scientific articles related to the neuropathology of domestic carnivores (Sturges et al., 2016). An explanation for the absence of this data could be given by the fact that, in most cases, lesions that affect the brainstem are associated with a significant rate of mortality, which prevents the dynamic study of patients and a gap in relevant analytical data.
From a clinical point of view, brainstem diseases are expressed in the form of a syndrome characterized by the presence of a markedly depressed mental status (stupor or coma), a decerebrate posture (opisthotonos and extension of all four limbs), ipsilateral hemiparesis/hemiplegia or tetraparesis/tetraplegia, several cranial nerves (CN) deficits, delayed proprioception responses that could affect all limbs or only the ipsilateral limbs, with normal or exaggerated spinal reflexes (associated with muscle hypertonicity). Lesions affecting the cranial nerves or their nuclei can manifest in different clinical forms, such as ventrolateral strabismus, bilateral non-reactive mydriasis and ptosis of the lower eyelid (CN III), mandibular paralysis and facial hypoesthesia (CN V), a diminished palpebral reflex (CN V and VII), facial paralysis (CN VII), nystagmus, head tilt, rolling (CN VIII), pharynx, oesophagus or larynx paralysis (CN IX and X), lingual paralysis (CN XII) (Thomas, 2010).
Knowing that the respiratory centres are in the brainstem, along with the neurological symptoms, clinical assessment of the patient will reveal modified respiration, which may take the form of neurogenic central hyperventilation, apneustic breathing, or central alveolar hypoventilation (Braund, 1994; Kornegay, 1997). In addition to breathing problems, the animal can also show cardiovascular changes, manifested as bradycardia or arrhythmias.
All these cardinal symptoms should lead to a precise differentiation between lesions that affect the brainstem and lesions located at the level of the other intracranial structures, such as the forebrain, cerebellum, or vestibular

apparatus. However, if the neurological deficits cannot be attributed to a single lesion, then the disease should be considered multifocal or diffuse, with inflammatory, congenital, metabolic, or degenerative causes.
The differential diagnosis will be made according to the acronym "VITAMIND", as it is shown in Table 1 (Jaggy & Spiess, 2010; Garosi, 2019), and the confirmation will be made using advanced imagistic techniques given that the development and availability of magnetic resonance imaging (MRI) in veterinary medicine have greatly improved structural evaluation of the brain.

Table 1. Brainstem main diseases according to "VITAMIND" acronym (Jaggy & Spiess, 2010)

VASCULAR	Infarction, cerebral haemorrhage
INFLAMATION/ INFECTION	Abscess, Babesiosis, Distemper, Feline Infectious Peritonitis (FIP), Rabies, Toxoplasmosis, Neosporosis, Parasitic / Rickettsia Meningoencephalitis, Mycoses
TRAUMA	Compressions, haemorrhages
ANOMALY	Chiari Malformation, Hydrocephalus, Intraarachnoid cyst
METABOLIC	Encephalopathies, Metronidazole Intoxication
NEOPLASTIC	Brain tumours
DEGENERATIVE	Storage diseases

This article presents the main aspects of the clinical, neurological, and imaging features of a series of 15 patients who were diagnosed with brainstem deficits in the Faculty of Veterinary Medicine of Bucharest.

MATERIALS AND METHODS

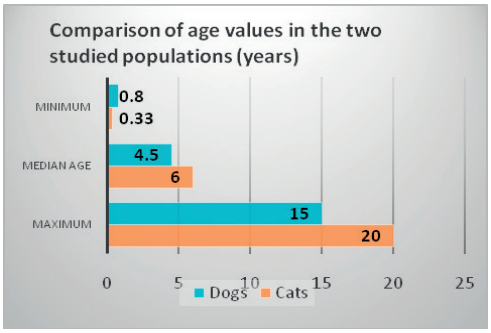
The study was conducted between January 2021 and December 2021 on 15 domestic carnivores (eight dogs and seven cats) diagnosed with brainstem pathologies at the Clinic of the Faculty of Veterinary Medicine in Bucharest. Each case was conducted according to the protocol already implemented in our clinic, in which medical history, clinical and neurological examination were indispensable stages, which preceded the neurolocalisation. For this study, the inclusion criteria were the localization of the lesion within the brainstem, both in unifocal and diffuse form. Differential diagnosis and choice of paraclinical investigations were made using the acronym "VITAMIND" (vascular/inflammatory/trauma/ anomaly/metabolic/idiopathic/neoplastic/degenerative) (Dewey & da Costa, 2016). All 15 selected cases were submitted to magnetic resonance investigation MRI (performed with the VET MR GRANDE machine from ESAOTE with a power of 0.3 Tesla using T1 Spin Eco (SE) and T2 Fast Spin Eco (FSE) protocols in three sequences - sagittal, transverse, and dorsal) which allowed confirmation of etiological diagnosis.
The obtained data were manually collected and revised from the Consultation Register. The analysis regarding significant information about signalment, clinical abnormalities and neurological deficits will be discussed in the following sections.

RESULTS AND DISCUSSIONS

Signalment information like species, breed, age, and sex was compared to describe the epidemiological features of the studied population.
Regarding the species impact on the obtained results, the number of affected dogs (53.33%, n=8) was almost equal to the number of affected cats (46.66%, n=7), which suggests that brainstem pathology evolved almost with the same morbidity in both populations of domestic carnivores.
The two populations were characterized by different breed structures. Thus, within the dog population, purebred specimens predominated (87.5 %, n=7), as follows: Bichon (n=2), Yorkshire (n=1), French Bulldog (n=1), Husky (n=1), German Wirehaired Pointer (n=1) and Poodle (12.5%, n=1) breeds. Only one investigated dog was crossbred.
In contrast, the European breed predominated in the feline population (85.71%, n=6) and only one specimen belonged to a purebred - Burmese (14.21%, n=1).
The average age in the canine population was 4.5 years, with patients belonging to an age range of 8 months - 15 years. The two dogs younger than 1-year-old (German Wirehaired Pointer - 10 months, Husky - 11 months) were diagnosed with congenital anomalies at the level of the brainstem, which confirms the prevalence of this aetiology in juvenile animals (Schrauwen et al., 2014; Turbatu et al., 2019). On the other hand, patients belonging to small breeds (Bichon, Yorkshire, French Bulldog)

had an age limit of 3.5 years and a diagnosis of encephalitis, which also emphasises the high incidence of this type of inflammation in young dogs belonging to breeds with a genetic predisposition. Compared to the data obtained in the canine population (Chart 1), the average age in the feline population was slightly higher, up to a value of 6 years, and the age limits belonged to a wider range, from 4 months to 20 years. As in the canine population, age under 1 year was associated with congenital anomalies (n=1), and geriatric cats were diagnosed with neoplastic pathologies (n=2).

Chart 1. Comparison of age values in the two studied populations (years)



Analysis of gender distribution showed that males were better represented in both species, with a percentage of 62.5% in dogs (n=5) and 71.42% (n=5) in the feline population.
Considering that the examined patients presented brainstem dysfunctions caused by various etiologies, the anamnesis revealed different aspects, as follows:

- There were three cases (two cats, one dog) of traumatic etiologies precisely described by the owners (two falls from a height, one household accident);
- For nine cases (five dogs, four cats) the symptoms observed by the owners were behaviour changes (depression, vocalizations), circling, instability, and epileptiform seizures. Clinical signs started, on average, 3-10 days before presentation and had a progressive evolution. In addition, non-specific clinical signs were observed in some patients, like progressive emaciation, decreased appetite, and apathy.
- In patients under the age of 1 year (n=3, two dogs, one cat), the owners noticed a delay in the growth process, accompanied by apathy, incoordination, visual or auditory deficiencies and the appearance of epileptiform seizures.

Clinical examination revealed the presence of permanent decubitus, changes in breathing, such as bradypnea, dyspnoea or cardiovascular abnormalities (bradycardia and murmurs).
The neurological examination was carried out according to the protocol already implemented in the clinic to our protocol and revealed a severe depressed mental status (stupor), abnormal posture - the presence of decerebrate rigidity (flexion of all limbs, sometimes opisthotonos - Figure 1) and permanent decubitus, several cranial nerves deficits, like bilateral non-reactive mydriasis and anisocoria (Figure 2), facial hypoesthesia, tongue protrusion (Figure 3), and delayed or absent proprioceptive responses (Figure 4).

Figure 1. Decerebrate rigidity in two dogs with brainstem inflammatory lesions

Figure 2. Non-responsive mydriasis and anisocoria in two feline patients with brainstem lesions

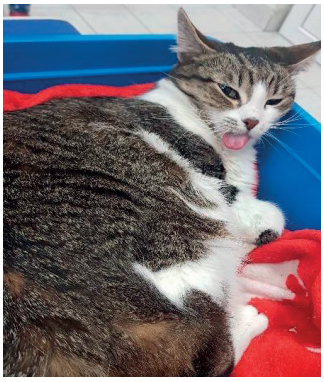


Figure 3. Permanent decubitus, tongue protrusion and facial hypoesthesia in a feline patient with neoplastic brainstem lesion

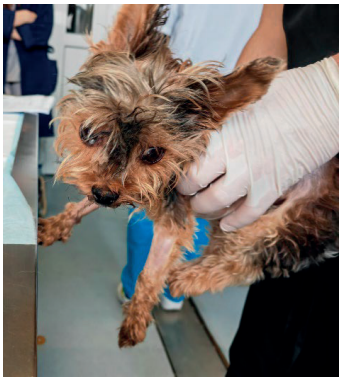


Figure 4. Head tilt on the left side, strabismus, and absent proprioceptive reaction in a dog with brainstem traumatic lesion

The correlation of the data from the anamnesis with the deficits recorded in the neurological examination and the impairment of the respiratory and cardiovascular functions led to a neurolocalisation compatible with brainstem lesions. For 11 cases, the neurological deficits could not be associated with a single location, so the disease was classified as multifocal, affecting the brainstem and the forebrain (n=9) or the brainstem and the vestibular apparatus (n=2). The differential diagnosis was made based on the acronym "VITAMIND", the highest weight being registered by inflammation (n=6), followed by trauma, anomaly, and neoplasia, each diagnosed in 3 cases, as shown in Chart 2.

For all cases, confirmation of the neurolocalisation established in the previous stages was performed using the imagistic technique (MRI) (Figure 5 A, B).

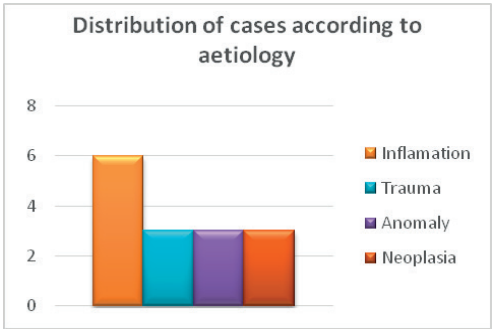


Chart 2. Distribution of cases according to aetiology

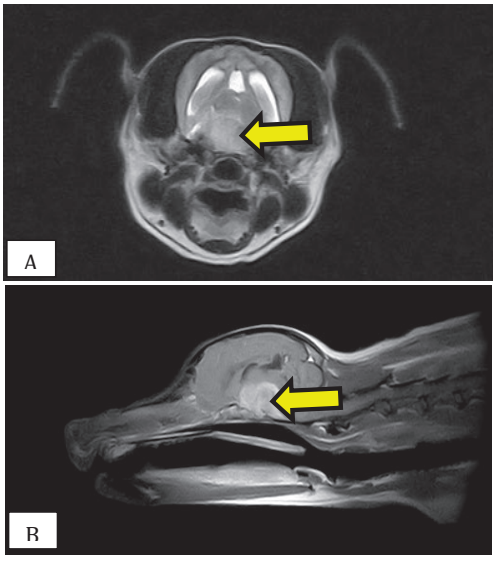


Figure 5. French Bulldog, M, 7 years old. [A] T2 and [B] T1 contrast enhancement transversal and sagittal MRI sections. Delimitated mass (arrows) with soft tissue density and signal, approximately 25 x 27 x 15 mm, with T2/FLAIR hypersignal and T1 contrast enhancement, having an invasive pituitary localization at the level of the right hemisphere, with compression on the adjacent structures, including the brainstem and cerebellum

CONCLUSIONS

Brain stem disorders were diagnosed with an equal share in both studied populations, the differences being related to breed - in the canine population, purebred animals predominated, and in the feline population, European cats predominated.

In both populations, young animals were diagnosed with brainstem anomalies and old animals with neoplastic diseases.

Recognition of the specific deficits (by a proper approach of the patient) and the corroboration of anamnesis, clinical and neurological examination findings (breathing abnormalities, stupor, decerebrate rigidity, multiple cranial nerves deficits) were essential stages that lead to a correct localisation of brainstem lesions.
The imaging technique remains a valuable tool in confirming the etiological diagnosis when structural changes in the brain are suspected.
Complications of brainstem pathologies can occur in domestic carnivores, resulting in life-threatening conditions.

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