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VESTIBULAR SYNDROME IN DOGS AND CATS - CLINICAL APPROACH TO DIAGNOSIS AND A RETROSPECTIVE CASE SERIES REPORT

Raluca Mihaela TURBATU, Cristina FERNOAGĂ, Niculae TUDOR, Constantin VLĂGIOIU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Veterinary Medicine, 105 Spl. Independentei, District 5, Bucharest, Romania

Corresponding author email: raluca.tbt@gmail.com

Abstract

The vestibular system is a sensory system comprised of several structures and tracts that is responsible for providing the brain information about spatial orientation and balance. Clinical signs like head tilt, nystagmus, positional strabismus or leaning are cardinal symptoms of a vestibular syndrome in small animal neurology. To establish an appropriate therapeutic plan and to provide owners accurate information regarding the prognosis, a differential diagnosis between a central or a peripheral vestibular disease is essential. In 2019, more than 310 cases of dogs and cats with neurological symptomatology were diagnosed in the Clinic of the Faculty of Veterinary Medicine in Bucharest, in agreement with the protocol already implemented in our practice. Full history, physical examination followed by a complete neurological examination were mandatory steps required to localise the lesion within the four main regions of the brain: forebrain, brain stem, cerebellum or vestibular apparatus. Among the total number of cases, approximately 15% showed clinical signs consistent with a vestibular syndrome. This article aims to present the predisposition factors, clinical features and neurological findings of the 32 dogs and 16 cats diagnosed with vestibular pathology.

Key words*: central vestibular syndrome, peripheral vestibular syndrome, head tilt, nystagmus, neurology.*

INTRODUCTION

In human medicine, vestibular syndrome has been studied for more than a century, attracting the interest of several researchers. In 1914, Barany Robert won the Nobel Prize in Medicine and Physiology for his study of vestibular mechanisms. He managed to differentiate the central vestibular syndrome from peripheral vestibular syndrome and he also studied the interdependence between vertigo and nystagmus in affected patients. (Lopez & Blanke, 2014).

The vestibular syndrome is quite common in dogs and cats and it represents a real challenge for the veterinarian in terms of diagnosis and treatment (Fluehmann et al., 2006; Rădulescu et al., 2020).

Neurological examination is essential for differentiation between central and peripheral vestibular syndrome and requires knowledge of the anatomy and physiology of the central nervous system. Clinical signs like imbalance and postural disturbance along with vestibular ataxia may be a result of dysfunction of both peripheral and central components of the vestibular apparatus, as shown in Table 1. (Rossmeisl, 2010).

The peripheral vestibular disease does not affect the strength or general proprioception. Spontaneous or positional horizontal or rotatory nystagmus can occur, and the fast phase will be away from the side of the lesion. Peripheral vestibular lesions can also affect the facial nerve and postganglionic sympathetic innervation to the head (Horner syndrome). Vestibular signs associated with a depressed level of consciousness, spastic hemiparesis, cranial nerve V-XII deficits, or general proprioceptive deficits on the same side as the vestibular deficits should be considered to indicate a central vestibular disorder (de Lahunta & Glass, 2010; Rossmeisl, 2010).

For a correct diagnosis and an accurate prognosis, the interaction between doctor, patient and owner is particularly important in terms of evolution and prognosis of the disease (Lorenz et al., 2011).

In current veterinary practice in our country, the number of patients with vestibular disorders represents a significant percentage of the total number of animals that are presenting for

consultation with neurological deficits. According to a study conducted in 2018 in the Clinic of the Faculty of Veterinary Medicine in Bucharest, out of 209 cases, 22 cases showed a lesion localised in the vestibular apparatus (13%), a higher number compared to the number of cases with cerebellar disease (n = 8), or brainstem lesions (n = 3) (Turbatu et al., 2019).

Table 1. Differentiating clinical features of the peripheral and central vestibular disease (Rossmeisl, 2010)

Clinical sign	Peripheral vestibular lesion	Central vestibular lesion
Head tilt	Towards lesion	To either side
Pathologic nystagmus	Direction unaltered by head position Horizontal or rotatory Fast phase away from the lesion	Direction may change with head position Horizontal, rotatory or vertical
Postural reactions	Normal	Deficits ipsilateral to the lesion
Conscious proprioception	Normal	Deficits ipsilateral to the lesion
Cranial nerve deficits	±ipsilateral cranial nerve (CN) VII	± CNN V-XII ipsilateral to the lesion
Horner syndrome	±postganglionic	± preganglionic (rare)
Consciousness	Normal Disoriented if acute	Normal to comatose

Given the increased frequency of vestibular syndrome in veterinary practice, the current study presents a detailed analysis of the cases diagnosed with the vestibular syndrome (both central and peripheral) during 2019, emphasising important information such as incidence, risk factors, clinical signs or neurological deficits of these patients.

MATERIALS AND METHODS

The analysis of cases (dogs and cats) diagnosed with vestibular syndrome during 2019 implied a mandatory follow-up of the consultation protocol already implemented in the Internal Medicine Department of the Faculty of Veterinary Medicine in Bucharest. Consequently, before establishing an etiological diagnosis, a series of preliminary stages were followed for each patient. Elements like signalment, anamnesis, complete physical and neurological examination, localisation of the lesion within the central nervous system, a list of differential diagnosis and recommendations of paraclinical investigations were part of the consultation sheet of each case. The study was conducted during the year 2019 (1/01-31/12/2019) and the collected data from the Consultation Register have been statistically analysed in order to emphasize the most important factors that were corelated with the vestibular syndrome for the 48 animals (dogs and cats) discussed in this article.
Case inclusion criteria required a final diagnosis of vestibular syndrome. The entire database was manually revised to extract relevant information regarding symptomatology, clinical and neurological examination findings of each case.

RESULTS AND DISCUSSIONS

During the year 2019, more than 2200 small animals were examined in the Clinic of the Faculty of Veterinary Medicine in Bucharest, at Internal Medicine Department. Of the total number of cases, 310 domestic carnivores showed neurological signs specific to one region of the brain - forebrain, brain stem, cerebellum or vestibular apparatus - 14.09 % from the total number of cases.
In total, 32 dogs and 16 cats (15.48% out of the 310 neurological patients) were presented for further investigation due to signs compatible with a vestibular syndrome, during the investigated period.
For a proper analysis of the results, every stage of the diagnosis protocol will be outlined, starting with signalment, who included elements like species, breed, age and gender of the patient (as it is shown in Table 2).
Regarding the species, an important difference between dogs and cats was observed. The number of canine patients with vestibular lesions was almost double compared to the number of feline patients (66.66% dogs and 33.33% cats). Previous studies have also stated that vestibular syndrome is less reported in feline pathology than in canine pathology (Grapes et al., 2020).

Table 2. The distribution of cases by species, breed, age and gender

CRITERIA	NUMBER OF ANIMALS		
SPECIES	Canine 32		Feline 16
DOG BREEDS	Purebred dogs 23		Crossbred 9
AGE	Under 1 year 8	2 to 7 years 12	8 to 18 years 28
GENDER	Male 23		Female 25

The number of affected purebred dogs (n = 23) was higher than the number of crossbred dogs (n = 9). The breeds included in purebred dogs were Beagle (n = 5), Bichon (n = 5), French Bulldog (n = 4), English Bulldog (n = 4), Yorkshire Terrier (n = 2), German Shephard (n = 1), Mops (n = 1), Labrador (n = 1). According to these results, brachycephalic-type breeds are more likely to develop vestibular syndrome compared to crossbreed dogs (39% of the total number of purebred dogs were brachycephalic). Other studies that were following breed predisposition have also shown that the incidence of vestibular syndrome in bulldogs is higher than in other dog breeds, due to the predisposition of this breed in developing brain disorders (Hayes et al., 2010; Mayousse et al., 2017).

According to the age, older patients were more likely to develop a vestibular syndrome compared to juvenile patients (58.33% of patients were within the limit of 8 to 18-year-olds), as shown in Figure 1.

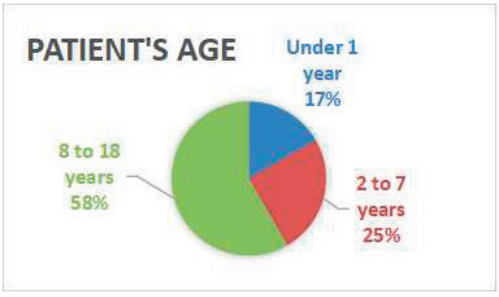

Figure 1. Distribution of patients according to their age

Regarding gender, the number of cases was almost equal - 52% of the investigated carnivores were females and 48% were males.

Another important stage of the diagnosis protocol was anamnesis. Every owner was kindly asked to fill out a template. Important details were obtained, using a series of essential questions concerning:

Patient's signalment - age, bred, sex and hormonal status of the animal;

The reason for the visit: What is the reason for the visit? When did the problem start? (peracute, acute and chronic); The duration and/or frequency of the current problem? Are there any factors that could have triggered the problem? How did the problem evolve?

The owner's perspective: What did the owner notice? What does the owner think is the problem? What worries him the worst and why?

The patient's behavioural history: Did the patient had pre-existing behavioural problems?

The patient's medical and surgical history: Has the patient been diagnosed with one or more medical conditions? If so, what are these conditions, how they were diagnosed and what treatment did he follow? Has he ever been anaesthetized? Has he undergone any surgery? Did he experience side effects from medications, including anaesthetics?

The patient's environment: Does the animal live alone inside or outside? Does he live in the house and outside? What other animals live in the same house?

Physical activity of the patient;

Travel history;

Diet: How often is the animal fed? What does it eat? What rewards does he receive? Does it have the appropriate weight for its size and breed?

Vaccine history: Is he vaccinated? Is the vaccination schedule complete and correct? Did he experience side effects from vaccines?

Pharmacological history – Is he currently receiving any treatment? Is he currently taking vitamins or supplements? Is it internally dewormed? Is it externally dewormed?

Anamnesis revealed a series of common points for the patients with vestibular lesions, like a sudden onset of disease, progressive clinical signs (from days to weeks), including head tilt, circling, nystagmus, asymmetrical ataxia and multiple episodes of vomiting. Also, for 10 cases a history of recurrent otitis was registered. Previous studies have shown that in

cats, a history of otitis externa was significantly associated with otitis media/interna and a diagnosis of a peripheral vestibular syndrome (Grapes et al., 2020).
After recording the data from the anamnesis, a complete physical assessment using inspection, palpation, percussion, and auscultation was performed for each case.
In order to rule out a systemic or a metabolic disorder, physical examination was always used before neurological examination.
Stages of the neurological evaluation included assessment of the mental status and behaviour, posture, cranial nerves, proprioception, gait and other abnormal movements, spinal reflexes, panniculus and perianal reflex (Dewey & da Costa, 2016). As a result, the lesion was localised within the central or peripheral vestibular system.

Figure 2. Dog with a right head tilt (A) and dog with a left head tilt (B)

Clinical signs like a depressed level of consciousness, spastic hemiparesis, cranial nerve V-XII deficits, or general proprioceptive deficits on the same side as the vestibular deficits were compatible with the diagnosis of the central vestibular syndrome. A head tilt and balance loss will occasionally be appreciated in a patient who simultaneously has postural reaction deficits contralateral to the direction of the head tilt. When these specific clinical signs are noticed, the lesion must involve the caudal cerebellar peduncle or the flocculonodular lobe of the cerebellum on the side of the body opposite that of the head tilt. This condition is called paradoxical vestibular disease, and it is always indicative of central vestibular dysfunction (de Lahunta & Glass, 2010).

However, patients with ataxia, head tilt, normal proprioception and absence of cranial nerve deficits other than facial or vestibulocochlear nerve were suggestive of a diagnosis of a peripheral vestibular syndrome (Figure 2). Pathologic nystagmus is present in both types of vestibular syndrome, but vertical nystagmus whose direction changes depending on the position of the head is specific for a lesion localised within the central vestibular apparatus.
In some patients, the lesions were diffuse, so clinical signs of vestibular dysfunction were associated with other clinical manifestations. Consequently, seizures, hypermetria or tremor were recorded in patients in whom lesions were extended within the forebrain or cerebellum.
From the total number of investigated patients, 64% of the patients were diagnosed with central vestibular syndrome (n = 32) and 36% with peripheral vestibular syndrome (n = 18), as it is shown in Figure 3. Other recent reports showed similar results (Boudreanu et al., 2018; Bongartz et al., 2020)
For each patient, after the localisation of the lesion, a list of differential diagnoses has been established using the acronym VITAMIND (Vascular, Inflammatory, Trauma, Anomaly, Metabolic, Idiopathic, Neoplasia, and Degenerative) (Dewey & da Costa, 2015).

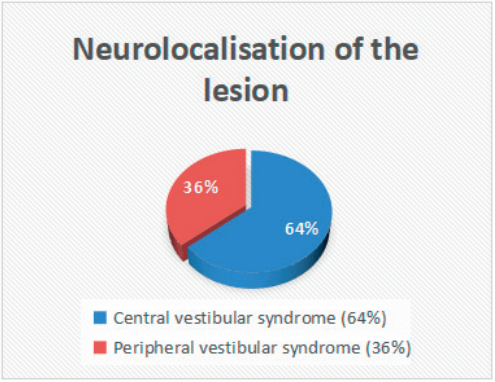

Figure 3. Distribution of patients according to the neurolocalisation of the lesion

For vascular pathology, ischemic infarctions or transient ischemic attacks were taken into consideration for patients who showed acute, focal and nonprogressive signs. From the total number of patients, 8 cases manifested signs

compatible with a stroke. All of them were aged above 10 years old. Additionally, for these patients, the cardiologic examination showed major dysfunctions that could be related to the neurological signs. This result is in concordance with previous studies that have shown that neoplasia and vascular disease were among the common causes of a central vestibular syndrome (Negrin et al., 2010; Bongartz et al., 2020).

The inflammatory pathology was associated with cases with subacute-chronic and progressive onset, asymmetric or multifocal signs and often pain (vocalisations). Meningoencephalitis was one of the causes for central vestibular dysfunction, being in general associated with small breeds of dogs (Schrauwen et al., 2014). In our study, 5 dogs (2 Bichon Frise, 2 French Bulldogs and 1 Yorkshire terrier) showed signs compatible with encephalitis. However, otitis media/interna was incriminated for producing a considerable number of cases of a peripheral vestibular syndrome (n = 10). The diagnostic of otitis was based on a complete otoscopic examination.

For all 48 patients, traumatic lesions were excluded, as owners stated that they did not witness any episodes of trauma involving their pets.

As an anomaly, during the study, one case of hydrocephalus was confirmed by MRI investigation in a 7-month-old crossbreed dog, in which clinical signs were compatible with a diffuse lesion (forebrain and central vestibular system).

For metabolic aetiology, differential diagnosis implied hypothyroid associated neurologic dysfunction and metronidazole toxicity. In this study, 1 case (Labrador, 1-year old) showed clinical signs compatible with a central vestibular syndrome (right head tilt, leaning on the right side, ataxia and loss of balance on thoracic limbs, horizontal nystagmus and modified proprioception on the specific tests) after receiving continuous high doses of Metronidazole.

The idiopathic vestibular syndrome is well known in cats and dogs and is responsible for many cases of peripheral vestibular syndrome (Bongartz, 2020). Considering the unknown pathology, diagnosis is always performed by the exclusion of other causes of peripheral vestibular disease. In this study, 8 cases were showing signs compatible with the idiopathic vestibular syndrome.

The neoplasia was always on the differential list for patients with asymmetric and progressive evolution of neurological sign. For confirmation, an advanced imagining technique is required. During the study period, we confirmed 5 cases of intracranial tumours associated with signs specific for a central vestibular syndrome.

Degenerative processes rarely affect the central vestibular system and their confirmation is difficult. Therefore, no case was diagnosed with a degenerative disease.

For all patients included in the study, after establishing the lesion localisation and the list of differential diagnoses, the next step was to perform a series of paraclinical tests to confirm the initial suspicion.

Depending on the situation, the recommended investigations were blood tests that included haematology, serum biochemistry and thyroid hormone dosage, cardiologic, ophthalmologic and otoscopic examination, radiographs, MRI, or cerebrospinal fluid analysis.

For each patient, additional investigations were performed in correlation with the owners' financial resources.

CONCLUSIONS

To establish the diagnosis of vestibular syndrome, all stages of the examination protocol, including the signalment, anamnesis, clinical and neurological evaluation, must be analysed.

The results of neurological examination will be correlated to differentiate between central and peripheral vestibular syndrome.

The brachycephalic-type breeds showed a predisposition for developing vestibular syndrome compared to other breeds dogs - 39% (n = 9) of the total number of purebred dogs were brachycephalic.

Regarding the age, older patients were more likely to develop a vestibular pathology than young patients - 58.33% (n = 28) were within the limit of 8 to 18-years-old.

The distribution of cases according to gender was almost equal: 52% females (n = 23) and 48% males (n = 25).

The acronym "VITAMIND" was always used to establish a list of differential diagnoses for each case of symptomatology compatible with a central or a peripheral vestibular syndrome.

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