

Vestibular Disorders of Dogs and Cats

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The vestibular system has two main functions

1. To maintain the visual image by stabilizing the eyes in space during head movement
2. To stabilize the position of the head in space - thus ensuring that the position of the body is stable.

Clinical signs

Vestibular dysfunction causes varying degrees of loss of equilibrium causing imbalance and ataxia. Strength is not affected, and therefore paresis is not observed unless nervous system structures beyond the vestibular system are affected. As a rule, vestibular disturbance is unilateral or asymmetrical, and the signs are those of an asymmetrical ataxia with preservation of strength.

Unilateral vestibular signs may result from either central (brain stem) or peripheral (labyrinth) disease. Signs of vestibular disease include: nystagmus, falling, rolling, tilting of the head, circling, positional strabismus (deviation of one eye in some head positions), and an asymmetrical ataxia.

Peripheral vestibular disease

Peripheral lesions involve the middle and inner ear. Middle ear (bulla tympanica) lesions usually produce head tilt (ipsilateral to the lesion) only, in the absence of other signs. Horizontal or rotatory nystagmus also may be seen. Inner ear disease, which actually involves the receptors and vestibular nerve within the petrosal bone, usually produces other signs in addition to the ipsilateral head tilt - falling, rolling, circling, nystagmus, positional strabismus, asymmetrical ataxia.

Horner's syndrome (miosis, ptosis, enophthalmos) of the ipsilateral eye may be present with either middle or inner ear disease in dogs and cats, because the sympathetic trunk passes through the middle ear in close proximity to the petrosal bone.

The facial nerve may be affected in inner ear disease, as it courses through the petrosal bone in contact with the vestibulocochlear nerve.

The primary characteristics of unilateral peripheral vestibular disease are: asymmetrical ataxia without deficits in postural reactions, and a horizontal or rotatory nystagmus that does not change in direction with different head positions. The fast phase of the nystagmus is directed away from the affected side.

Central vestibular disease

Any signs of brain stem disease in association with vestibular signs indicate that central involvement is present. The most frequent differentiating feature is a deficit in postural reactions, as central vestibular lesions most often result in paresis or loss of proprioceptive positioning reactions. Alterations in mental status, or deficits in Vth or VIIIth cranial nerves, also may be indicative of central disease. Nystagmus may be a key to differentiating central from peripheral disease. Nystagmus occurs in most central vestibular syndromes, and appears to be a permanent deficit. It is a positional nystagmus; therefore it may be present in some head positions (with respect to gravity), but not in others. Also the nystagmus may vary in direction with change in head position. Vertical nystagmus in any head position is most consistent with central vestibular disease.

Paradoxical central vestibular syndrome

Unilateral lesions of the peripheral vestibular system produce a head tilt towards the side of the lesion. With few exceptions, the same occurs with lesions of the central components of the vestibular system. Exceptions to this rule are therefore termed "paradoxical". Some unilateral lesions of the central vestibular pathways, especially unilateral involvement of the flocculonodular lobe of the cerebellum or the supramedullary part of the caudal cerebellar peduncle, produce a head tilt and ataxia directed toward the side opposite to the lesion, and a nystagmus with the fast component towards the side of the lesion. Such lesions usually are space-occupying lesions. Usually these lesions will produce postural reaction deficits or additional cranial nerve abnormalities on the side of the lesion.

Bilateral vestibular disease

Bilateral peripheral vestibular disease with complete loss of function is characterized by symmetrical ataxia and loss of balance of either side, with strength preserved. Postural asymmetry is not present. A characteristic "side-to-side" head movement often accompanies these signs. Abnormal nystagmus is not observed, and with bilateral destruction of the receptor organs, normal (physiological) vestibular nystagmus cannot be elicited by head movement or caloric testing.

Diseases causing peripheral vestibular dysfunction

Anomalies

Congenital vestibular disease is reported in both purebred dogs and cats (GSD, Doberman, English Cocker, Siamese and Burmese, etc.). Signs usually are unilateral (bilateral in Beagle and Akita). Onset is usually from birth to 3 months of age. Clinical signs include head tilt, ataxia, usually no nystagmus, +/- deafness. Prognosis can be favorable with some animals improving with time due to compensation.

Metabolic disorders

Hypothyroidism has been associated with polyneuropathy involving CN VII and CN VIII in adult dogs. It usually presents as unilateral disease and often progresses to bilateral involvement. Diagnosis is based on physical and neurological examination, thyroid panel and therapeutic trials (although no proven benefit of supplementation has been demonstrated). This presentation also has been associated with pituitary adenomas. Prognosis can be favorable with some animals improving with time, however residual deficits of CN VII are common.

Neoplasia

Neurofibroma/acoustic neuroma of CN VIII may occur. Usually unilateral signs, often involving CN VII. May affect central structures with time/growth. Neoplasia may involve the petrous temporal bone; osteosarcoma, fibrosarcoma, chondrosarcoma, squamous cell carcinoma.

Infectious/Inflammatory disorders

Otitis-media and otitis-interna: The most common cause of peripheral vestibular disease. Vestibular signs occur when the middle ear inflammation/infection directly or indirectly affects the function of the membranous labyrinth. Most cases are due to extension from the external ear, but this is not always the case. Aural cholesteatoma: A form of epidermoid cyst that may be associated with otitis-media. Inflammatory polyps of the middle ear in cats.

Idiopathic diseases

Canine idiopathic vestibular disease ("Old dog vestibular disease"). Feline idiopathic vestibular disease.

Trauma

Head trauma may involve the petrous temporal bone.

Toxic disorders

Ototoxicity may cause hearing loss, vestibular dysfunction or both. Topical therapy is the most common cause, however oral and parenteral toxicity is possible. Many drugs/agents are potentially toxic; the most common ones include the aminoglycoside antibiotics that can affect the hair cells, flocculonodular lobe and fastigial nucleus. Streptomycin tends to have vestibular effects, whereas neomycin, gentamycin, kanamycin, vancomycin tend to have more effect on the auditory system. Loop diuretics, cisplatin, propylene glycol and chlorhexidine have also been implicated in ototoxic disease.

Vascular disorders

Diseases causing central vestibular dysfunction

Degenerative diseases

Storage diseases. Inherited diseases of dogs and cats due to deficiency of a lysosomal enzyme. Slowly progressive onset usually before 1 year of age. Progressive disease with no treatment.

Neoplasia

Tumors usually are found within the brainstem (gliomas, ependymomas, metastatic tumors) or involving the cerebellomedullary angle or surface of the brainstem (meningiomas, neurofibromas, choroid plexus tumors, lymphosarcoma).

Nutritional disorders

Thiamine deficiency. Generally seen in cats fed all fish diets (fish contains thiaminase). Thiamine deficiency causes spongy necrosis and hemorrhage of grey matter. Vestibular signs may be present early in the disease with progression to seizures, dilated pupils, cervical ventroflexion and death. Diagnosis is based on history, clinical signs, decreased blood thiamine and transketolase activity and response to therapy. Treatment is supportive with thiamine supplementation and diet management. Successful treatment is possible in the early stages.

Infectious/inflammatory diseases

Bacterial infections

Uncommon. Extension of otitis media-interna. Treat with surgery and long term antibiotics, ideally based on culture and sensitivity results.

Viral infections

a. Canine distemper virus: Dogs, sealions, lions, tigers affected. May or may not exhibit systemic signs. Diagnosis antemortem is difficult and is based on history, clinical signs, CSF analysis, serology and PCR. Treatment is supportive. Prognosis is guarded. b. Feline infectious peritonitis: Nervous system lesions often affecting ependymal surfaces and meninges. May be associated with uveitis. Usually chronic progressive illness. A variety of CNS signs may be seen including vestibular disease. Diagnosis antemortem is difficult. History, coronavirus titers, MRI, increased serum globulin and often markedly abnormal CSF (Markedly raised protein with monocytic pleocytosis). Treatment supportive, may be transient response to corticosteroids. Prognosis poor. c. Rabies: Can manifest with almost any neurological syndrome, however behavioral signs and ataxia are most common. Diagnosis is post mortem. There is no treatment. Suspect animals must be quarantined. Death normally occurs within 10-15 days. d. West Nile Virus?

Protozoal infections: a. Neospora/Toxoplasmosis: Relatively uncommon infection causing vestibular signs in cats (toxoplasmosis) and dogs (neosporea and toxoplasmosis). Respiratory and ocular signs may be more common. Myopathy may be seen in young dogs. Diagnosis

antemortem may be difficult as serology can be difficult to interpret. PCR may be helpful in diagnosis. Treatment is with potentiated sulphonamides or clindamycin. Prognosis guarded once neurological signs are apparent.

Mycotic Infections: a. Several mycotic agents cause granulomatous disease of the CNS in cats and dogs. b. The more common agents include: i. *Cryptococcus neoformans*; ii. *Coccidiomycosis immitis*; iii. *Blastomycosis*; iv. *Histoplasmosis*

Parasitic diseases

Aberrant migration and growth of parasites within the CNS is rare in dogs and cats.

Rickettsia

Rarely involves the CNS.

Inflammatory disorders

Pathogen free inflammatory brain disease is common in the dog, and rare in the cat. Several distinct diseases are recognized, some of which appear to preferentially affect the brainstem +/- cerebellum.

Trauma

Vestibular signs may be due to primary damage, or secondary to raised intracranial pressure, herniation or progression of hemorrhage etc. Serial neurological examinations are essential to monitor progress. CT is the imaging modality of choice in the 1st 24 hours (for acute hemorrhage and bony involvement). MRI is preferential for imaging the brain after this period. Treatment depends on the injuries sustained and may include the use of hyperosmolar agents such as mannitol to decrease intracranial pressure, supportive intensive care and surgery to repair fractures and provide decompression. Prognosis depends on the extent of brainstem involvement and the underlying cause.

Toxic disorders

Metronidazole Toxicity. Doses of metronidazole over 60 mg/kg daily have been associated with acute onset of vestibular signs, often with a marked vertical nystagmus and ataxia. Other CNS signs such as seizures may be apparent. Diagnosis is based on history and clinical signs and prognosis is good if the diagnosis is made early and the administration stopped.

Vascular disorders

Hemorrhage and/or infarction are common in domestic species but can occur secondary to hypothyroidism, coagulopathies, hyperviscosity syndromes, amyloidosis, septicemia and cardiac disease.