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What Is Your Neurologic Diagnosis?

A 17-month-old 35.4-kg (77.9-lb) sexually intact male Doberman Pinscher was evaluated because of a 3-week history of progressive neurologic deficits. Two weeks prior, the dog developed dysphagia and vomiting; at that time, physical examination and diagnostic test findings had been unremarkable, although facial asymmetry was evident when the dog was panting. A few days later, the dog was noted to have a left head tilt, ataxia, and dysphagia. The dog's free thyroxine (assessed by dialysis), thyrotropin, and thyroglobulin autoantibody concentrations were all considered normal. The result of Lyme disease testing was consistent with previous vaccination or natural exposure to *Borrelia burgdorferi*. There were no radiographic abnormalities of the vertebral column. Despite treatment with meloxicam (initiated 2 weeks prior to referral), the neurologic signs progressed. At the referral evaluation, mild petechiation along the labial mucosa was the only physically detectable abnormality.

Neurologic examination

Observation

Mental	Alert		Depressed	X	Disoriented		Stupor		Coma		
Posture	Normal		Head tilt	L	Tremor		Falling	R			
Gait	Normal		Ataxia	X	Pelvic limbs		All 4	X	Circling		
Paresis	Para		Tetra		Hemi	R	Mono				
Other	The dog was nonambulatory with right lateralizing tetraparesis and proprioceptive ataxia as well as marked left vestibular ataxia. When supported, the dog rolled to the left side.										

Postural reactions

Key: 4 = exaggerated, clonus; 3 = exaggerated; 2 = normal; 1 = diminished; 0 = none; NE = not evaluated

	LF	RF	LR	RR
Wheelbarrow	0	0		
Hopping	1	0	1	0
Ext postural thrust			NE	NE
Proprioceptive pos	1	0	1	0
Hemistand/walk	1	0	1	0
Placing–tactile	NE	NE		
Placing–visual	NE	NE		

Spinal reflexes

	LF	RF	LR	RR
Quadriceps			2	2
Extensor carpi	NE	NE		
Flexion	2	2	2	2
Crossed extensor	0	0	0	0
Perineal			2	2

Cranial nerves

	L	R
II, VII–Vision menace	2	2
II, III–Pupils resting	2	2
Stim L	2	2
Stim R	2	2
II–Fundus	2	2
III, IV, VI–Strabismus, resting	2	2
III, IV, VI, VIII–Strabismus, position	2	3

	L	R
VIII–Nystagmus, resting	3	3
VIII–Nystagmus, change	3	3
V–Sensation	2	2
VII–Facial mm	2	2
V, VII–Palpebral flex	2	2
IX, X–Gag	1	1
XII–Tongue	2	2

Comments CN

Resting vertical nystagmus was present. Neurogenic atrophy of the right masticatory muscles developed during hospitalization.

Sensation (Locate and describe abnormal)

Hyperesthesia	0	
Superficial pain	2	
Cutaneous reflex	2	
Deep pain	0	

What is the problem? Where is the lesion? What are the most probable causes of this problem? What is your plan to establish a diagnosis? Please turn the page.

Assessment

Anatomic diagnosis

Problem	Rule out location
Right lateralizing tetraparesis and proprioceptive ataxia with apparently normal spinal reflexes	Right-sided C1-C5 region of the vertebral column or right-sided aspect of the brainstem
Left head tilt with positional change in direction of nystagmus and vertical nystagmus	Central vestibular system—left rostral portion of the medulla or right side of the cerebellum (caudal cerebellar peduncle or flocculonodular lobe)
Right hemiparesis and proprioceptive ataxia with left vestibular dysfunction	Central vestibular system (including vestibular nuclei in the medulla oblongata and neurons in the flocculonodular lobe of the cerebellum) or spinal cord segment (C1-C2) lesions that interrupt the spinovestibular tracts
Dull mentation	Brainstem or cerebrum
Neurogenic atrophy of the right masticatory muscles	Right trigeminal motor nucleus located in the pons or mandibular branch of the trigeminal nerve
Right lateralizing tetraparesis and proprioceptive ataxia, atrophy of the right muscles of mastication, and left vestibular ataxia with vertical positional nystagmus	Right cerebellopontomedullary angle

Likely location of one lesion

Right cerebellopontomedullary angle

Etiologic diagnosis—Differential diagnoses for this dog included inflammatory disease (meningoencephalitis), progressive compressive lesions, and developmental disorders. Many infectious causes of CNS inflammation are associated with infections in tissues outside of the CNS. In those cases, the most direct route to diagnosis may be evaluation and assessment of samples obtained from extracranial sites. Noninfectious inflammatory disease (meningoencephalitis of unknown etiology) was also considered. Space-occupying lesions resulting from neoplasia, and epidermoid or dermoid cysts were considered. Cerebrovascular accident was not considered likely because of progression of the clinical signs. Because results of comprehensive blood analyses were unremarkable, the diagnostic plan included MRI of the brain and collection of a CSF sample from the cerebellomedullary cistern.

Diagnostic test results, supportive care, and outcome—The dog was admitted to the hospital for supportive care and further diagnostic testing. Magnetic resonance imaging was performed with a 0.2-T MRI unit. Multiplanar T2-weighted, T1-weighted, and fluid-attenuated inversion recovery images were obtained before and after IV administration of gadodiamide (0.2 mL/kg [0.09 mL/lb]). Imaging revealed a well-defined 1.5-cm-diameter spherical intra-axial mass at the right cerebellopontomedullary angle (**Figure 1**). The mass was hyperintense on T2-weighted images and isointense on fluid-attenuated inversion recovery and T1-weighted images; contrast enhancement of the mass was not evident. There was moderate mass effect and compression of the cerebral aqueduct but minimal ventricular enlargement.

Analysis of a CSF sample obtained from the cerebellomedullary cistern revealed a WBC count of 0 WBCs/µL (reference range, < 4 WBCs/µL), RBC count of 3 RBCs/µL (reference range, 0 RBCs/µL), and protein concentration of 15 mg/dL (reference range, < 25 mg/dL). Cytologic examination findings for the CSF sample were unremarkable. On the basis of the diagnostic test results, neoplasia was considered the most likely diagnosis and options for treatment were discussed. The owners elected for palliative treatment.

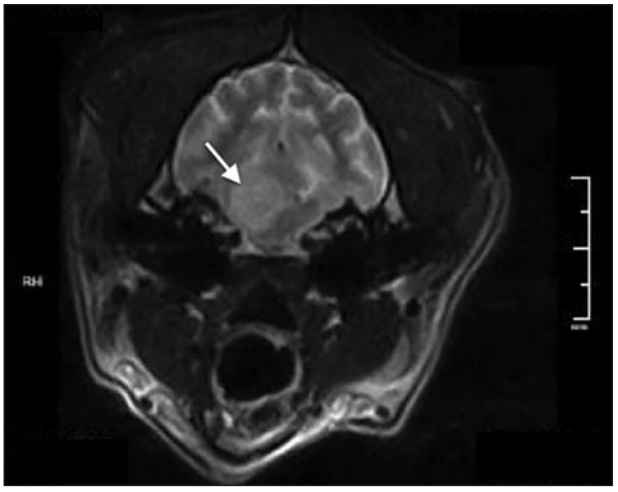

Figure 1—Transverse T2-weighted image of the brain (at the level of the rostral medulla) of a young dog that was evaluated because of a 3-week history of progressive neurologic deficits. A hyperintense intra-axial spherical mass is visible in the right cerebellomedullary pontine angle (arrow). There is a moderate mass effect and compression of the cerebellum and brainstem. Scale on the right is in millimeters.

During hospitalization, the dog's condition improved slightly but not sufficiently to provide a good quality of life. Progressive neurogenic atrophy of the right masticatory muscles developed as a result of trigeminal nerve involvement. The dog was unable to stand or walk without assistance and continued to have intermittent vertical nystagmus. Given the dog's poor prognosis, the owners requested euthanasia on day 7 of hospitalization. The brain was removed and

submitted for histopathologic examination at the owner's request.

Grossly, the anterior to central right brainstem was expanded by a 2 × 1.5-cm gray-tan, mildly granular firm mass, which was fairly well demarcated from the surrounding brain. There was compression of the anterior lobes of the cerebellar cortex, being more severe on the right. On the basis of histopathologic findings and the fact that some tumor cells were positive for glial fibrillar acidic protein and tumor cells were negative for cyclic nucleotide phosphodiesterase, the final diagnosis was a poorly differentiated high-grade astrocytoma (glioblastoma).

Comments

For the dog of the present report, the right hemiparesis could be explained by right-sided brainstem dysfunction; however, the left-sided head tilt, loss of balance, and falling to the left indicated left vestibular system dysfunction. The combination of signs could be indicative of either multifocal disease or paradoxical vestibular disease. The latter is caused by lesions in the caudal cerebellar peduncle or flocculonodular lobe of the cerebellum.[1] Normally, peripheral and central vestibular disease can be easily localized because head tilt, loss of balance, and falling are directed toward the side with the least vestibular activity (in other words, the side bearing the lesion).[2] Paradoxical disease results from a lesion causing a lack of inhibition of the vestibular cell bodies. The result is excessive discharge of their neurons effectively overriding normal vestibular function on the side without the lesion. Clinically, this gives the appearance of decreased vestibular function on the otherwise normal side.[2] Right-sided proprioceptive ataxia and postural deficits are indicative of involvement of the right side of the brainstem. The tumor in the dog of this report was growing in the brainstem and secondarily causing compression of the cerebellum, which resulted in the paradoxical vestibular signs. The masticatory muscle atrophy, which developed during hospitalization, was due to compression of the motor nucleus of the trigeminal nerve located in the pons and at the level of the middle and rostral cerebellar peduncles.[2]

The primary lesion in the dog of this report was a poorly differentiated astrocytoma affecting the pontine region of the brainstem. Astrocytes are a type of glial cell, the supporting cells of the nervous system that are derived from spongioblasts.[2] Phenotypically, astrocytic tumors are made of neoplastic cells that resemble astrocytes; however, the origin of the tumor is still considered controversial because of the lack of a recognized premalignant state.[3] Although older dogs are more commonly affected, results of studies[1,4] have indicated the importance of considering neoplasia in the differential diagnosis list for CNS disease in young dogs, such as the dog of the present report.

The current World Health Organization grading system for dogs differentiates tumors into low (well-differentiated), medium (anaplastic), and high (glioblastoma) grades of malignancy.[5] Prognostic information is scarce in the veterinary medical literature, and survival times have been shown to vary among dogs pending treatment and with different glial cell tumors. A survival time of 3 months has been reported for a dog with an astrocytoma after surgery, chemotherapy, and radiation therapy and for a dog with glioblastoma multiforme after chemotherapy.[6] In those 2 dogs, clinical signs had been present for 12 months in 1 dog and 6 weeks in the other.[6] Another dog with astrocytoma survived 6 months following radiation therapy, and another dog with undifferentiated glioma survived 8 months following surgery and chemotherapy.[6]

For dogs with astrocytomas, treatment options include palliation with corticosteroid administration, chemotherapy, surgery, radiation therapy, or a combination thereof.[7] More recently in veterinary medicine, the combination of surgery, vaccination, and gene therapy has had success.

For the dog of the present report, the key features that helped localize this lesion were right hemiparesis and left vestibular dysfunction, as explained by paradoxical vestibular disease. The normal CSF protein content and WBC count were inconsistent with an inflammatory process, yielding a tentative diagnosis of neoplasia. Radiation and chemotherapy were possible treatments; however, given the intra-axial nature of the mass, surgical removal was not possible.

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