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What Is Your Neurologic Diagnosis?

A 5-year-old 52-kg (114.4-lb) neutered male mixed-breed dog was evaluated because of a 1-month history of difficulty eating, atrophy of the temporal and masseter muscles, and 1 episode of right-sided epistaxis. Two weeks prior to evaluation, the dog was treated with prednisone by the referring veterinarian but had no signs of improvement. Physical and neurologic examinations revealed bilateral and asymmetric masticatory muscle atrophy (left side worse than right side), right-sided ocular discharge, elevation of the third eyelid of the left eye, left exophthalmia, and mydriasis of the left pupil that was not responsive to light (absent pupillary light reflex). The remainder of the neurologic examination findings, including jaw tone, were considered unremarkable.

Neurologic examination

Observation

Mental	Alert	X	Depressed		Disoriented		Stupor		Coma		
Posture	Normal	X	Head tilt		Tremor		Falling				
Gait	Normal	X	Ataxia		Pelvic limbs		All 4		Circling		
Paresis	Pelvic limbs		Tetra		Hemi		Mono				
Other											

Postural reactions

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

	LF	RF	LR	RR
Wheelbarrow	NE	NE		
Hopping	2	2	2	2
Ext postural thrust			NE	NE
Proprioceptive pos	2	2	2	2
Hemistand/walk	NE	NE	NE	NE
Placing–tactile	NE	NE		
Placing–visual	NE	NE		

Spinal reflexes

	LF	RF	LR	RR
Quadriceps			2	2
Extensor carpi	2	2		
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	4	2
Stim L	0	2
Stim R	0	2
II–Fundus	2	2
III, IV, VI–Strabismus, resting	0	0
III, IV, VI, VIII–Strabismus, position	0	0

	L	R
VIII–Nystagmus, resting	0	0
VIII–Nystagmus, change	0	0
V–Sensation	2	2
VII–Facial mm	0	1
V, VII–Palpebral flex	2	2
IX, X–Gag	2	2
XII–Tongue	2	2

Comments CN

The third eyelid of the left eye was elevated and the left pupil was mydriatic and not responsive to light (absent pupillary light reflex).

Sensation (Locate and describe abnormal)

Hyperesthesia	0	
Superficial pain	NE	
Cutaneous reflex	2	
Deep pain	NE	

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
Asymmetric masticatory muscle atrophy (left side worse than right side)	Trigeminal nerve (mandibular branch)
Elevation of the third eyelid of the left eye	Sympathetic nerve to left eye; more likely secondary to muscle atrophy
Left mydriatic pupil (nonresponsive to light)	Efferent pathway of the left oculomotor nerve

Likely location of 1 lesion

These signs are best described by a neuropathy involving cranial nerve V (trigeminal nerve) and left cranial nerve III (oculomotor nerve).

Etiologic diagnosis—Differential diagnoses considered for a lesion causing signs of peripheral cranial neuropathy in a dog included several neoplasms (ie, squamous cell carcinoma [SCC], adenocarcinoma, lymphoma, and myxosarcoma).[1] An abscess or granulomatous inflammation was considered less likely. The initial diagnostic plan included a CBC, serum biochemical analysis, a vector-borne disease panel,[a] and assessment of anti-*Toxoplasma gondii* and anti-*Neospora caninum* antibody titers (determined by immunofluorescence assays). Planned diagnostic imaging included MRI of the head, including the oral and nasal cavities.

Diagnostic test findings—Results of testing for circulating *Dirofilaria immitis* antigen and antibodies against *Ehrlichia canis*, *Ehrlichia ewingii*, *Borrelia burgdorferi*, *Anaplasma phagocytophilum*, and *Anaplasma platys* were negative. Similarly, the dog was negative for anti-*T gondii* IgG and anti-*N caninum* antibodies. A CBC revealed no important abnormalities. Serum biochemical analysis revealed high activities of alkaline phosphatase, alanine aminotransferase, and γ-glutamyltransferase, which were attributed to corticosteroid administration.

The dog was anesthetized and MRI of the head, including the oral and nasal cavities, was performed with a 0.25-T scanner[b]; T1-weighted sequences used a repetition time of 710 milliseconds and an echo time of 16 milliseconds, whereas T2-weighted sequences used a repetition time of 5,670 milliseconds and an echo time of 120 milliseconds. A fluid attenuated inversion recovery (FLAIR) sequence was not available owing to suboptimal image quality at the time of scanning.

A large heterogeneous and regionally infiltrative soft tissue mass was identified medial to the left mandibular coronoid process; the mass had invaded the left caudal nasal cavity and left orbit. The mass had a mixed hyperintense signal on the T2-weighted images, with areas of iso- to hypointensity on T1-weighted images **(Figure 1)**. Following IV administration of paramagnetic contrast agent,[c] the mass had strong uniform enhancement except for the suspected cystic central portions **(Figure 2)**. The rostral to caudal measurement of the mass between the left ramus and maxilla was 6.6 cm. There was bony lysis at the peripheral aspect of the mass affecting the left maxilla, left pterygoid process, left caudal maxillary turbinates, and left cribriform plate leading to intracal-

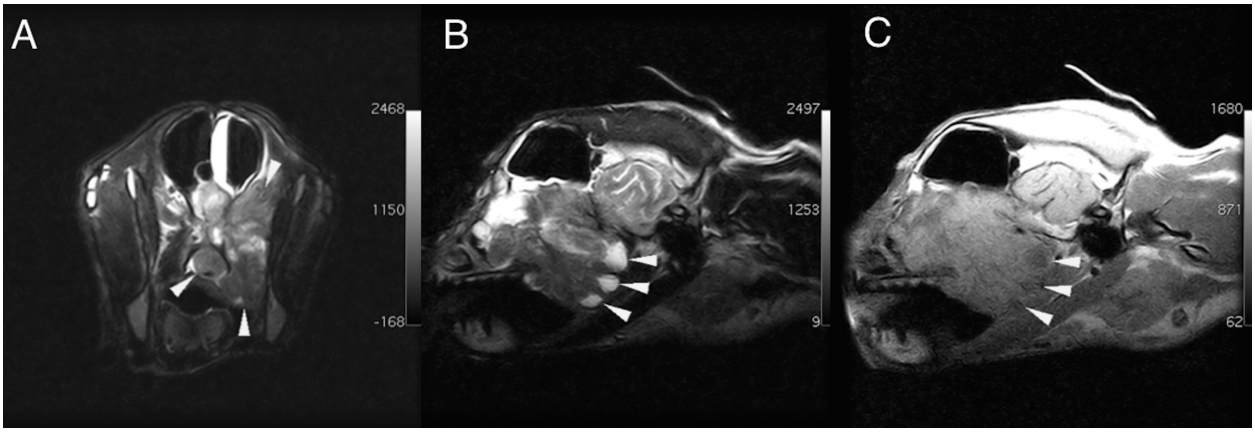

Figure 1—Magnetic resonance images of the head of a dog that was evaluated because of a 1-month history of difficulty eating, atrophy of the temporal and masseter muscles, and 1 episode of right-sided epistaxis. A—Transverse T2-weighted image. Notice the extent of a mass in the region surrounding the left pterygoid process (arrowheads). B—Sagittal T2-weighted image. Notice the extent of the mass surrounding the left pterygoid process (arrowheads). C—Sagittal T1-weighted image. Notice the cystic appearance of the mass (arrowheads). Numbers to the right of the images represent repetition time in milliseconds.

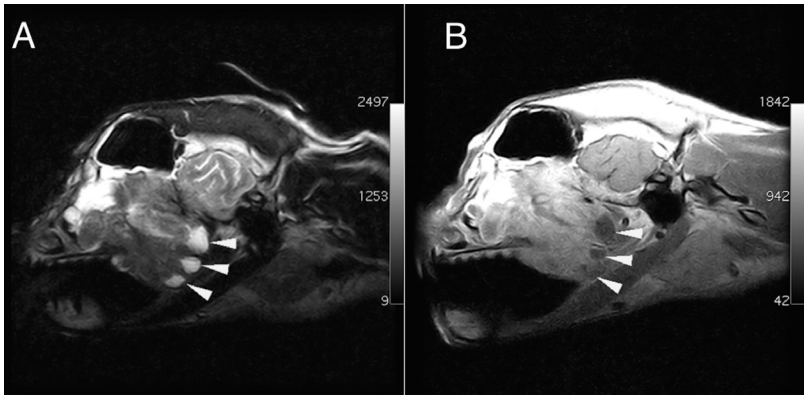

Figure 2—Sagittal T2-weighted (A) and T1-weighted (B) MRI images of the head of the dog in Figure 1 obtained after administration of contrast agent. Notice the strong contrast enhancement, compared with precontrast administration findings, and the noncontrast-enhancing cystic appearance of the mass (arrowheads). **See** Figure 1 for key.

varial extension. Further extension was seen within the soft tissues surrounding the nasopharynx. Both the right optic canal and orbital fissure were widened, compared with the corresponding features on the left side. There were resulting mass effects on the left orbit (causing exophthalmia) and left olfactory bulb of the cerebral cortex at the point of cribriform plate destruction. There was mild asymmetry of masticatory muscle mass with the left side having markedly greater atrophy than the right. Atrophy involved the temporal muscle, masseter muscle, and rostral and caudal digastricus muscles. The bulk of the mass lesion was in the region of the left medial and lateral pterygoid muscle resulting in complete obliteration of the muscle. The distal extents of the left oculomotor and trigeminal nerves were not identified because of the locally extensive nature of the mass. Lymphadenomegaly was not identified.

Under anesthesia, fine-needle aspirate and punch biopsy specimens of the mass were obtained via the oral cavity through the soft palate. Cytologic examination of the aspirate specimen revealed SCC, which was also confirmed by histologic examination of the biopsy specimen.

Comments

For the dog of the present report, palliative radiation therapy was instituted with the intent of slowing tumor progression and providing pain relief. Given the extent of bone destruction despite the lack of an obvious external mass, the prognosis was guarded to grave. Two days following the initial palliative radiation treatment, the dog's condition rapidly deteriorated. The dog began expelling a thick green mucoid discharge from the left nostril and its left eyelid became edematous. Owing to the continued decline of the dog's condition, the owners elected euthanasia.

Squamous cell carcinomas are commonly found in dogs and are the second most common oral tumors in this species.[2–4] In dogs, SCCs are most common in the frontal sinus, nasal planum, and cutaneous, oral, and sublingual locations.[5] Squamous cell carcinomas may also develop from the epithelial lining of other nearby structures (eg, ear, pharynx, or oral cavity) and invade or infiltrate the nasal cavity.[2,5] Most SCCs are associated with aggressive local soft tissue or bone invasion with extension to regional lymph nodes.[6] In the case described in the present report, the authors strongly suspected that the SCC originated from the soft palate, but no regional lymphadenopathy was detected via advanced imaging. The authors recognize that metastasis to lymph nodes may have occurred at the time of the examination (with changes in node size yet to develop) and because samples of the nodes did not undergo cytologic examination, this possibility cannot be ruled out. As described by Nemec et al,[3] canine oral SCCs may have 2 appearances on imaging; one involves bone loss in a cystic pattern or an expansive mass (cavitary form) and the other involves an infiltrative pattern of bone destruction (noncavitary form).[3] The mass in the dog of the present report involved the same oral region as some of the dogs in the reported study[3] and had both a cavitated and a noncavitated appearance, with a cystic infiltrative pattern of both bone and muscle evident on MRI images.

Magnetic resonance imaging is the imaging technique of choice for evaluating brain and cranial neuropathies because it provides visualization of structures without superimposition and superior soft tissue contrast, compared with CT.[7] With perineural tumor infiltration, as suspected in the dog of the present report, MRI can detect nerve enlargement and enhancement or obliteration of the normal fat signal surrounding a nerve.[8] In this case, MRI aided in the visualization of a mass extending from the coronoid process of the mandible to the nasal cavity and orbit. The MRI examination revealed diffuse enlargement of the affected nerves with hyperintensity on T2-weighted images and contrast agent enhancement on T1-weighted images, findings that are consistent with those of documented cranial neuropathies.[9,10] Although the lesion could not be confirmed as cystic without FLAIR, the TI- and T2-weighted images of the mass had homogeneous areas of hyperintensity and hypointensity respectively, suggesting that the mass was highly likely to be cystic and less likely hemorrhagic or edematous tissue.

The trigeminal nerve is the largest cranial nerve in dogs and has both a motor and a sensory component.[10,12] Loss of facial sensation, difficulty in closing the mouth or chewing, and masticatory muscle atro-

phy are all indicative of a trigeminal nerve problem.[10,12] The dog of the present report had left masticatory muscle atrophy and normal jaw closure as assessed by external manipulation. The difficulty closing the mouth during eating was likely due to pain, rather than a functional deficit associated with bilateral trigeminal neuropathy. Additionally, the third eyelid of the left eye was elevated, which was most likely secondary to the masticatory muscle atrophy. Lastly, the left pupil was mydriatic, indicative of an oculomotor neuropathy. Parasympathetic function of the oculomotor nerve can be evaluated by assessment of pupil sizes and the pupillary light reflexes.[13] For the dog of this report, the pupillary light reflex in the left eye was absent. Flaccid paralysis of the masticatory muscles with an inability to close the mouth has previously been associated with a diagnosis of trigeminal neuropathy, lymphoma, myelomonocytic leukemia, and rabies.[13] In the case described in the present report, these neurologic deficits confirmed the locally selective and invasive nature of the mass.

Multiple cranial neuropathy attributable to SCC has only previously been described in a cat with SCC causing blindness and ophthalmoplegia.[14] The cat had signs of multiple cranial neuropathy, and CT revealed focal bony destruction of the right tympanic bulla and proliferative bone reaction along the right mandible. The definitive diagnosis of SCC was made after necropsy.[14]

The dog of the present report had an oral mass with an MRI pattern that was both cavitated and infiltrative, which may suggest the addition of an imaging pattern class of oral SCCs to those proposed by Nemec et al.[3] Unfortunately, because of the lack of specific necropsy data, the authors cannot confirm the histopathologic characteristics of the mass. However, to the authors' knowledge, this is the first report of multiple cranial neuropathy caused by SCC (determined on the basis of cytologic and histologic examination findings for antemortem tissue samples) in a dog.

Footnotes

a. Canine SNAP 4Dx, Idexx Laboratories Inc, Westbrook, Me.
b. Vet MR Grande, Esaote, Florence, Italy.
c. Gadodiamide (100 mg/kg), Omniscan, GE Healthcare, Little Chalfont, Buckinghamshire, England.

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