# UC Davis
## UC Davis Previously Published Works

**Title**

Choroidal neuroendocrine neoplasia in a dog

**Permalink**

**Journal**

Veterinary Ophthalmology, 24(3)

**ISSN**

**Authors**

Lucyshyn, Danica R
Knickelbein, Kelly E
Hollingsworth, Steven R
et al.

**Publication Date**

2021-05-01

**DOI**

Peer reviewed

# Choroidal neuroendocrine neoplasia in a dog

Danica R. Lucyshyn[1] | Kelly E. Knickelbein[2] | Steven R. Hollingsworth[1] |
Christopher M. Reilly[3] | Kelsey D. Brust[1] | Lance C. Visser[4] | Rhonda Burge[2] |
Jennifer L. Willcox[1] | David J. Maggs[1]

[1]Department of Veterinary Surgical and Radiological Sciences, School of Veterinary Medicine, University of California, Davis, CA, USA

[2]Veterinary Medical Teaching Hospital, School of Veterinary Medicine, University of California, Davis, CA, USA

[3]Insight Veterinary Specialty Pathology, Davis, CA, USA

[4]Department of Veterinary Medicine and Epidemiology, School of Veterinary Medicine, University of California, Davis, CA, USA

**Correspondence**
David J. Maggs, Department of Surgical and Radiological Sciences, School of Veterinary Medicine, University of California, 2112 Tupper Hall, Davis, CA 95616, USA.
Email: djmaggs@ucdavis.edu

**Present address**
Danica R. Lucyshyn, Department of Small Animal Clinical Sciences, Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, SK, Canada
Rhonda Burge, Department of Veterinary Clinical Sciences, College of Veterinary Medicine, Ohio State University, Columbus, OH, USA

**Abstract**

**Objective:** To report onset and progression of clinical signs of a neuroendocrine neoplasm (NEN) presumed metastatic to the choroid in a dog.

**Animals Studied:** A 7.5-year-old female spayed German shepherd dog mix referred for advanced imaging and evaluation of a subretinal mass in the right eye.

**Procedures:** Procedures performed included general physical and ophthalmic examinations; ocular, orbital, and abdominal ultrasonography; thoracic radiographs; cranial magnetic resonance imaging; serologic testing for infectious agents; analysis of hematologic as well as serum and urine biochemical parameters; echocardiography; electrocardiography; cytologic assessment of lymph nodes; and histopathology and immunohistochemistry of the enucleated globe.

**Results:** Examination and imaging identified a pigmented mass within and expanding the superior choroid. Following enucleation, a choroidal NEN with tumor emboli in scleral blood vessels was diagnosed by histopathologic assessment and confirmed by immunohistochemical labelling. Despite extensive and repeated diagnostic testing over many months, a putative primary site was not identified until 19 months after the initial ocular signs were noted. At that time, a heart-base mass and congestive heart failure were highly suggestive of a chemodectoma.

**Conclusion:** This comprehensive report of a NEN presumed metastatic to the choroid in a dog suggests that ocular disease can be a very early and solitary sign of NEN in the dog.

**KEYWORDS**

carcinoid, chemodectoma, congestive heart failure, immunohistochemistry, metastasis, retinal detachment

## 1 | INTRODUCTION

Neoplasms metastatic to the eye are infrequently reported in dogs.[1,2] For example, ocular metastases were identified in only 11.6% of dogs with metastatic or multicentric neoplasms diagnosed on necropsy, with the uveal tract being the most commonly affected ocular site.[3] Metastasis to or multicentric neoplasia affecting the uveal tract has been reported in dogs with lymphoma,[1–4] hemangiosarcoma,[1,3] histiocytic sarcoma,[2] malignant oral melanoma,[1] transmissible
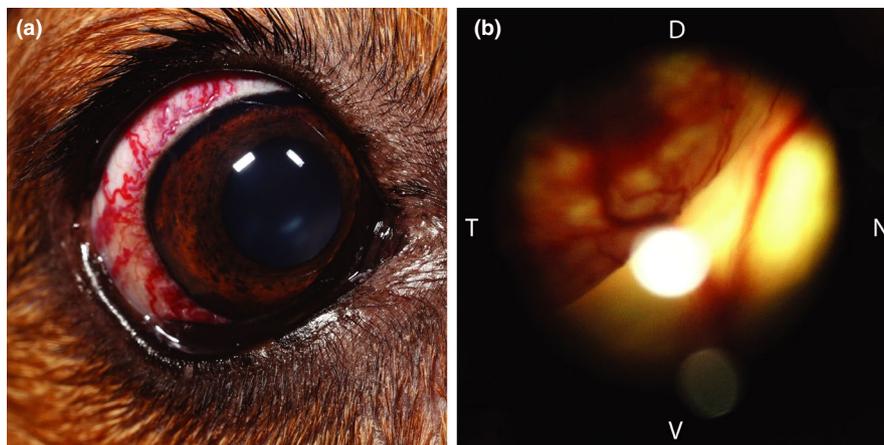
**FIGURE 1** External (A) and fundic (B) photographs of the right eye of a 7.5-year-old female spayed German shepherd dog mix with a subretinal mass subsequently diagnosed as a choroidal neuroendocrine neoplasm. Abnormalities apparent on ophthalmic examination included severe episcleral hyperemia (A), extensive serous retinal separation, and intraretinal hemorrhage (B). Image (B) was collected at initial presentation using a direct fundic camera (ClearView™ Optical Imaging System, Optibrand, Fort Collins CO, USA). Image (A) was collected 1 week later. D, dorsal; N, nasal; T, temporal; V, ventral

venereal tumors,[4] carcinomas of mammary,[1–3] bile duct,[3] or endometrial origin,[1] malignant chemodectoma,[3] and various adenocarcinomas.[4,5] Though ocular signs may be the first indications of disease in animals affected by neoplasms metastatic to the eye,[4] typically clinical signs, or hematologic, cytologic or imaging changes attributable to the primary tumor, are additionally or primarily evident.[3,4,6] The purpose of this case report is to describe a neuroendocrine neoplasm (NEN) presumed metastatic to the choroid for which a putative primary site was not evident despite extensive diagnostic testing for 19 months after the first ocular signs were noted.

## 2 | CASE PRESENTATION

### 2.1 | History and clinical assessment

A 7.5-year-old female spayed German shepherd dog mix was referred to the University of California-Davis Veterinary Medical Teaching Hospital (UCD-VMTH) for evaluation of a subretinal mass in the right eye (OD). Approximately 2 months prior to referral, the dog was evaluated by a veterinarian for a 10-day history of redness OD. There was no improvement following 2 weeks of treatment with neomycin-polymyxin B-dexamethasone ophthalmic suspension (2 drops OD q12 h). Examination by a veterinary ophthalmologist approximately 1 month prior to referral to the UCD-VMTH confirmed moderate episcleral hyperemia OD with mild chemosis, epiphora, and a pigmented subretinal mass approximately five optic nerve heads (ONHs) in diameter and located approximately 3 ONHs superotemporally to the optic disk. The left eye (OS) was unremarkable. Intraocular pressure (IOP) estimated by rebound tonometry was 21 mmHg OD and 12 mmHg OS. Dorzolamide 2% ophthalmic solution (1 drop OD q8 h) and

neomycin-polymyxin B-dexamethasone ophthalmic suspension (1 drop OD q8 h) were prescribed. Results of a complete blood count and serum biochemistry profile were clinically unremarkable. Three-view thoracic radiographs were unremarkable, and systolic blood pressure was 160 mmHg. Referral to the UCD-VMTH for advanced imaging was recommended.

At the UCD-VMTH, the owners reported frequent hiking with tick exposure in Northern California but no other travel history significant for infectious agents. General physical examination indicated no signs of systemic illness. Body weight was 25.0 kg. Periorbital palpation and globe retropulsion were normal in both eyes (OU). The menace response and dazzle and palpebral reflexes were intact OU. Pupils were symmetrical. Direct pupillary light reflex (PLR) was incomplete OD and normal OS. Consensual PLR was absent OD to OS but normal OS to OD. Examination OD revealed normal eyelids, third eyelid, and conjunctiva, severe episcleral hyperemia (Figure 1A), clear cornea, a formed anterior chamber free of aqueous flare or cells, mild iris atrophy, and nuclear sclerosis. The vitreous was normal. There was extensive serous retinal separation sparing only a narrow (~1 x 5 ONHs), vertically oriented region superiorly. Superotemporally, there was an approximately 1 ONH diameter intraretinal hemorrhage (Figure 1B). Examination findings OS were unremarkable. Schirmer tear test type 1 results were 20 mm/min OU, and IOP assessed using rebound tonometry was 20 mmHg OD and 12 mmHg OS. Fluorescein stain was not retained by either cornea.

### 2.2 | Diagnostic testing and treatment

Given the reported tick exposure and breed susceptibility to systemic mycoses,[7] serologic testing for antibodies to *Anaplasma phagocytophilum*, *Anaplasma platys*, *Ehrlichia canis*,
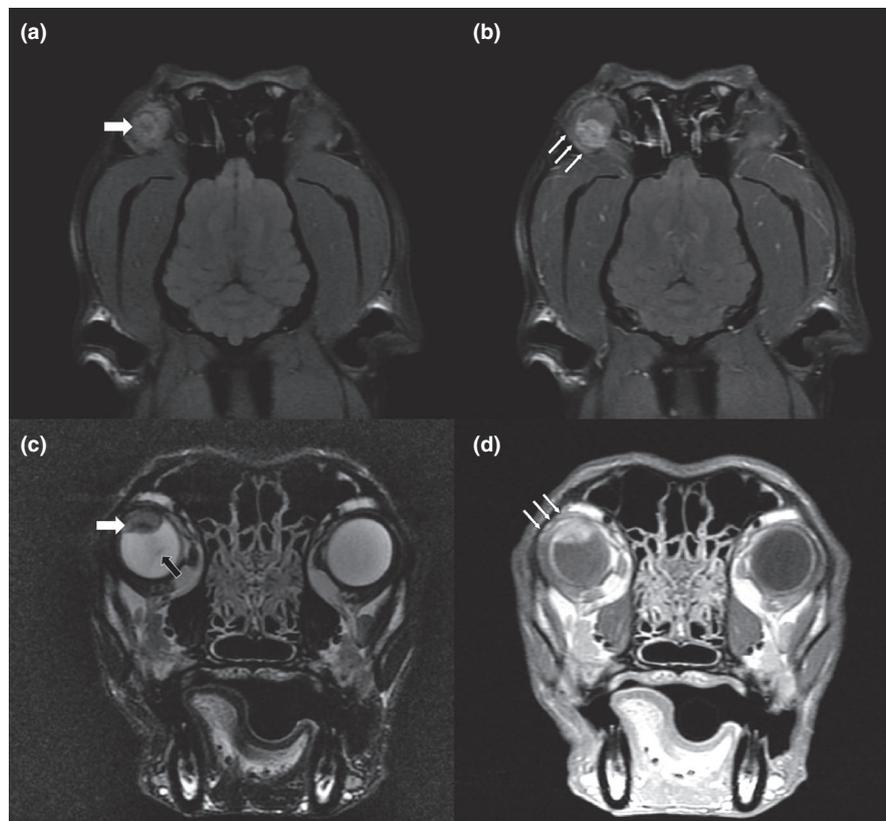
**FIGURE 2** Magnetic resonance images of the head of a 7.5-year-old female spayed German shepherd dog mix with a mass in the right eye subsequently diagnosed as a choroidal neuroendocrine neoplasm. (A) Dorsal plane fat-saturated T1 W image at the level of the mass (large white arrow). (B) Dorsal plane fat-saturated T1 W image with intravenous contrast enhancement of the mass; note also the rim of thickened contrast-enhancing tissue (3 white arrows). (C) Transverse T2 W image at the level of the mass; note the retinal detachment (black arrow) immediately ventral to the mass (large white arrow). (D) Transverse T1 W image with intravenous contrast enhancement of the mass; note also the rim of thickened contrast-enhancing tissue (3 white arrows) and the mild hyperintensity of the right vitreous body compared to the left. All images are oriented with the right side of the skull to the left of the image

*Ehrlichia ewingii*, *Borrelia burgdorferi* (SNAP® 4Dx® Plus Test; IDEXX Laboratories, Inc.) and *Coccidioides* spp. (UCD Coccidioidomycosis Serology Laboratory); as well as urine testing for *Aspergillus*, *Histoplasma*, and *Blastomyces* spp. antigens (MiraVista Diagnostics) were performed. *Dirofilaria immitis* antigen testing was also included in the commercial SNAP test. All serologic assays were negative. Urinalysis was unremarkable. Dorzolamide was continued (1 drop OD q8 h), and prednisolone acetate 1% ophthalmic suspension was prescribed (1 drop OD q8 h).

At the time of imaging 1 week later, clinical examination revealed progression to complete retinal separation OD, absent dazzle reflex and direct PLR OD, and absent consensual PLR from OD to OS. Other findings OD and OS were unchanged from the previous visit. Thoracic radiographs, previously obtained by the primary care veterinarian, were reviewed by the UCD-VMTH Diagnostic Imaging Service. These radiographs revealed mild dorsal deviation of the trachea within the cranial thorax and age-related changes in the pulmonary parenchyma. Abdominal ultrasonography performed at the UCD-VMTH was unremarkable. Ocular and

orbital ultrasonography confirmed diffuse retinal detachment with subretinal anechoic fluid and an echogenic, slightly heterogeneous, 1.0-cm-diameter subretinal mass in the superotemporal fundus OD. No orbital abnormalities were detected.

To better determine optic nerve involvement prior to surgery, magnetic resonance imaging (MRI) of the head was performed with a Signa 1.5 Tesla MR unit (General Electric Medical System), which included transverse and dorsal plane T1-weighted and T2-weighted, transverse proton density (PD), and dorsal short tau inversion recovery sequences (STIR), followed by fat-saturated T1-weighted sequences in similar planes and a fast spoiled gradient echo (FSPGR) sequence after intravenous injection of 0.2 mL/kg gadopentetate dimeglumine (Magnevist). MRI confirmed a broad-based intraocular mass extending along the superior and posterior internal margin of the globe (Figure 2). The mass was ovoid (measuring 1 x 1.2 x 0.58 cm), well-defined, mildly T1 hyperintense, and mildly heterogeneous. It was associated with a slightly deformed globe margin (not shown), a diffusely, mildly homogenous and T1-hyperintense vitreous body, and retinal detachment. Following intravenous injection of contrast, the

intraocular mass was moderately enhanced. A rim of thickened contrast-enhancing tissue was also identified along the globe superior to the mass. Mild right mandibular lymph node enlargement was also noted. No orbital, optic nerve, or brain involvement was apparent. A lateral approach enucleation[8] was performed OD under the same anesthetic episode. The globe was trimmed and placed in 10% neutral-buffered formalin. No gross abnormalities of the optic nerve or remaining orbital contents were noted intraoperatively. Physiologic parameters under general anesthesia were normal, and the post-operative recovery was routine. The patient received carprofen (2.2 mg/kg PO q12 h for 7 days) and tramadol (4 mg/kg PO q8 h as needed for pain). Wound healing was routine.

## 2.3 | Histopathology and immunohistochemistry

The formalin-fixed globe was parasagittally sectioned. Gross examination confirmed diffuse retinal separation and a 1.2 x 0.8 x 0.5-cm soft, brown-to-black-to-red mass expanding the superior choroid. Sections from the hemisected globe were stained with hematoxylin and eosin (Figure 3A-C). The mass was comprised of sheets and variably sized packets of polygonal cells separated by fine fibrous septa or anastomosing blood-filled cavities (Figure 3C). Cells contained a moderate amount of faintly amphophilic, frequently vacuolated cytoplasm, and cell borders were indistinct. Nuclei were relatively large and generally round, with coarse to vesicular chromatin and prominent nucleoli. Anisocytosis and anisokaryosis were moderate, with scattered karyomegalic cells and irregularly shaped nuclei with folded membranes. There were 6 mitotic figures per 10400x fields. Clusters of intravascular neoplastic cells (emboli) were scattered throughout the choroid distant from the mass and expanded equatorial scleral blood vessels (Figure 3B). The neural retina, largely absent due to processing artifact, was diffusely separated from swollen retinal pigment epithelium, with attenuated photoreceptor segments in evaluable portions, indicating true separation. Secondary/incidental lesions included regional lens fiber disorganization and swelling, and minimal neutrophilic keratitis.

Immunohistochemical labeling was performed using commercially available antibodies validated for canine use
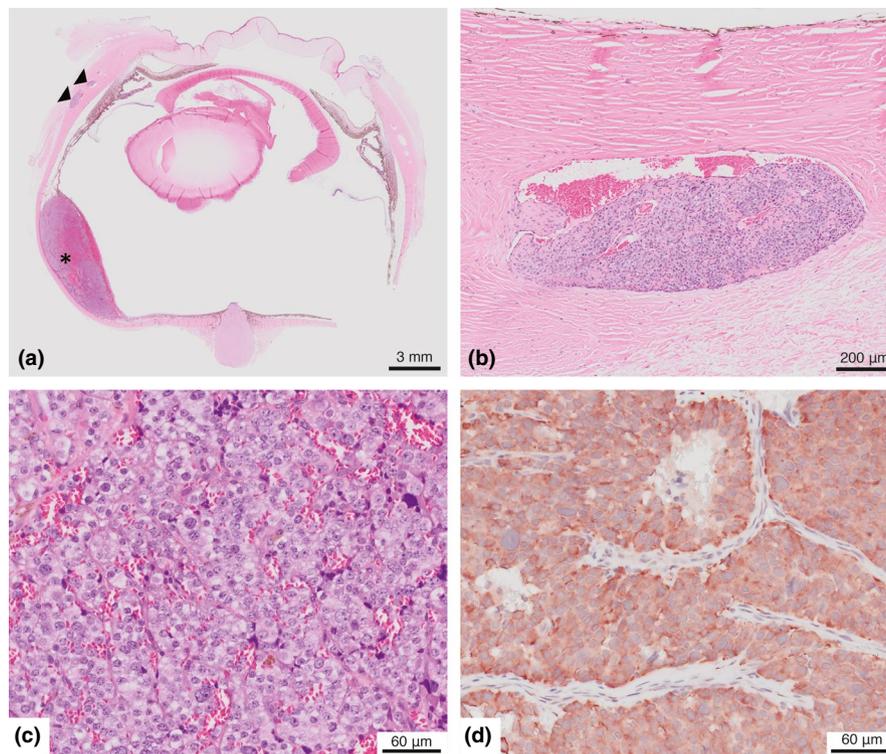


**FIGURE 3** Photomicrographs of hematoxylin- and eosin-stained (A, B, & C) and immunohistochemically labeled (D) sections of a choroidal mass from the right eye of a 7.5-year-old female spayed German shepherd dog mix. (A) Subgross photomicrograph of the enucleated globe. A congested and cellular mass expands the superior, peripheral choroid (asterisk) and has embolized into anterior scleral blood vessels (arrowheads). Disruptions of the inferior sclera (lower right) and lens (upper center) are artifactual. (B) Medium magnification image of an intravascular embolus of neuroendocrine cells in the anterior sclera. Note packeting arrangement of cells. (C) High magnification image of the neuroendocrine cells. Note their arrangement into small packets with thin fibrovascular septa. Golden brown pigment is hemosiderin (blood breakdown). (D) Photomicrograph of chromogranin A (CGA) immunohistochemistry. The cells diffusely express membranous to cytoplasmic CGA. Vector red chromogen, Meyer's hematoxylin counter stain

and protocols validated by the UCD-VMTH. The neoplastic cells were nonreactive to SOX10, PNL2, and pancytokeratin, indicating they were not melanocytes (cells of neural crest origin) or epithelial cells. The cells expressed strong granular cytoplasmic immunoreactivity to chromogranin A (Figure 3D), as well as membranous reactivity to synaptophysin (not shown), consistent with a NEN. Therefore, this tumor was presumed to be metastatic and the patient was referred to the UCD-VMTH Medical Oncology Service.

## 2.4 | Clinical outcome

When seen by the Medical Oncology Service 6 weeks following enucleation, physical examination was unremarkable aside from a grade II/VI left basilar systolic murmur. Body condition score (BCS) was 5/9 and body weight was 25.5 kg. Fine needle aspirates from both mandibular lymph nodes revealed mild reactive lymphoid hyperplasia. Given the murmur, consultation with a cardiologist was requested. Echocardiographic examination revealed mild myxomatous mitral valve disease with trivial mitral valve regurgitation and a left ventricular outflow tract velocity of 1.9 m/s suggestive of a physiologic murmur. A heart base mass was not visualized at this time, and no other echocardiographic abnormalities were identified aside from atypical QRS complex morphology noted on the echocardiographic electrocardiogram (ECG) lead. A diagnostic 6-lead ECG revealed a sinus rhythm with low-voltage QRS complexes (R wave voltage = 0.3 mV) and ST segment elevation. No cause for the ECG abnormalities was identified. Repeat abdominal ultrasound and thoracic radiographs performed 12 weeks after enucleation also revealed no evidence of neoplasia. The previously noted mild dorsal tracheal deviation within the cranial thorax was still present and again believed to be likely incidental or secondary to head positioning. Follow-up evaluation and imaging in 6 months were recommended, but not pursued by the owners.

Seventeen months following enucleation (19 months following the onset of ocular signs), the patient was diagnosed with congestive heart failure at an emergency clinic. When seen 1 week later at the UCD-VMTH Cardiology Service, the owners reported that the dog had an intermittent, nonprogressive, dry cough for 1 year, and nonprogressive hyporexia for 6 months. Body weight was 22.9 kg (representing approximately 10% weight loss since last visit), and the BCS was 3/9. Abnormalities detected included mild bilateral truncal muscle atrophy and a grade III/VI left and right apical systolic murmur. Systolic blood pressure was 151 mmHg. To attempt to determine the cause of the chronic cough, a heartworm antigen test was submitted and was negative. Thoracic radiographs revealed a heart-base mass with cranial thoracic tracheal deviation, as well as pulmonary venous and arterial distention (Figure 4A). Echocardiographic examination confirmed an approximately 5-cm diameter circular, circumscribed, heterogeneous mass adjacent to the aortic root, near the pulmonary artery bifurcation, and just dorsal to the left atrium (Figure 4B,C). Some extraluminal compression of the pulmonary artery was suspected, and severe myxomatous mitral valve disease was identified. Given the previously diagnosed choroidal NEN and the location of the mass at the heart base, a chemodectoma was considered most likely. Additional testing and treatment were declined, and the patient was lost to follow-up. Communication with the primary care veterinarian 19 months later revealed that the patient was deceased, but no further details were available.

## 3 | DISCUSSION

Choroidal NEN is rarely reported in dogs, and to the authors' knowledge, this is the first report describing the onset and progression of clinical signs, detailed diagnostic workup, and histopathologic and immunohistochemical features of a NEN metastatic to the choroid. However, NEN is a broad and variably defined umbrella term for a large variety of neoplasms of cells containing dense core granules that produce monoamines and peptides,[9] including carcinoids,[9–11] neuroendocrine carcinomas,[11] paragangliomas,[10] and chemodectomas.[12] Comparison with previous reports is, therefore, problematic. For example, some authors suggest thyroid adenocarcinoma and pheochromocytoma meet the definition of a NEN, and there are reports of the clinical signs associated with, and the histologic appearance but not immunohistochemical labeling of, a thyroid adenocarcinoma metastatic to the choroid in a dog.[5] Similarly, potential choroidal metastasis of neoplastic emboli from a pheochromocytoma which was immunoreactive to calcitonin, neuron specific enolase, and keratins, but not to chromogranins was reported in a dog euthanized shortly after presenting to a veterinary hospital for epistaxis and weakness.[13] Finally, a retrospective review of necropsy records describes choroidal metastasis of NEN in a dog, but onset and progression of clinical signs were not described, and the primary site was not reported.[3] Additionally, in that report,[3] the NEN was broadly disseminated throughout the eye with neoplastic cells seen in the sclera, iris, ciliary body, optic nerve, and choroid. By contrast, in the present case, neoplastic cells were detected only within the choroid and scleral blood vessels and clinical signs were limited to episcleral injection, retinal detachment, mild ocular hypertension, and reduced PLRs.

Given that neuroendocrine cells are not described within normal choroid, and because primary choroidal NENs have not, to the authors' knowledge, been reported in any species, we propose that the tumor of the current report was metastatic to the choroid. Choroidal metastasis of NENs is very rarely reported in humans with primary tumors detected in
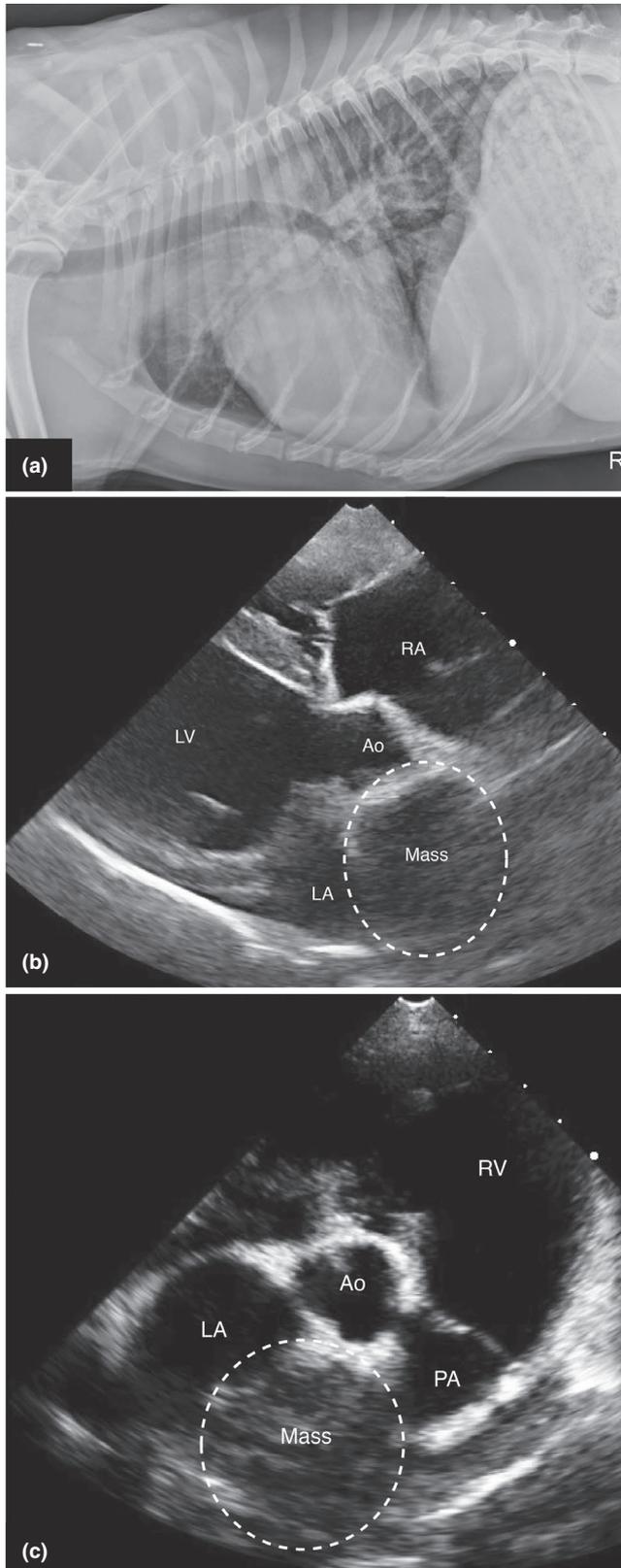
chemoreceptor cells.[15] In dogs, chemodectomas most commonly originate from the aortic or carotid body and are diagnosed at an average age of 10 years.[12] Metastasis has been reported in up to 22% of canine chemodectomas overall[10] and in 12% and 16% of canine aortic and carotid body chemodectomas, respectively. The lungs, liver,[12] and myocardium[10] are the most commonly reported sites of metastasis. Chemodectomas in dogs are most frequently associated with congestive heart failure,[10] as was the case in the current report.

In the present case, immunoreactivity to the neuroendocrine markers chromogranin A and synaptophysin, and lack of reactivity to PNL2 and SOX10 strongly support that the neoplasm was a NEN; however, rare neuroendocrine differentiation of malignant melanomas arising from primary sites including cutaneous, nasal mucosal,[16] and uveal[17] tissue is reported in humans. Therefore, a primary choroidal melanoma with focal neuroendocrine differentiation cannot be definitively ruled out in the present case. However, this would require that this neoplasm gained immunoreactivity for chromogranin A and synaptophysin while also losing immunoreactivity to SOX10, PNL2, and pancytokeratin, which seems unlikely. Assuming this was a tumor metastatic to the choroid, it is striking that the first clinical signs were ocular, were limited to episcleral injection, and that overt evidence of the putative primary neoplasm was not detected until 19 months later. This was despite extensive blood testing, cytologic assessment of lymph nodes, and repeated clinical examinations and imaging. Vision loss was the first symptom of a choroidal NEN in a human[11]; however, that patient also had nodular increases in lung density and an equivocal breast mass evident on computed tomography, and a family history of breast carcinoma. In that patient, time from detection of the choroidal mass until development of systemic clinical signs (cough) and subsequent ultrasonographic detection of the putative primary tumor in the thyroid, was approximately 6 months. Similarly, the dog described here developed a cough approximately 5 months after onset of ocular signs. In humans with carcinoid tumors (a well-differentiated type of NEN), 20% have metastatic disease at the time of diagnosis

the lungs[11] or pancreas.[14] The primary tumor site for the dog of the present report was not proven; however, the heart base mass diagnosed 19 months after initial ocular signs was considered echocardiographically most consistent with a chemodectoma—a NEN originating from neuroectoderm-derived[12]

but the primary tumor is unidentifiable on initial imaging in about half of these patients.[18] In the present case, thoracic radiographs performed 1, 5, and 8 months after initial ocular signs revealed mild dorsal elevation of the trachea. Upon retrospective assessment of this series of thoracic radiographs, there was a poorly defined, but repeatable convex soft tissue margin near the heart base that appeared to slowly increase in size over 19 months until it was evident as the 5-cm diameter heart base lesion seen in the final thoracic radiograph (Figure 4A). This suggests that the dorsal elevation of the trachea in initial radiographs may have been a harbinger of the mass rather than solely a positional artifact, and emphasizes the challenge in radiographic assessment of heart base lesions and potential under-interpretation of mild tracheal deviation. In veterinary patients presented with intraocular NEN, advanced imaging such as MRI, computed tomography, and echocardiography may be of greater diagnostic value than the more typically conducted modalities such as abdominal ultrasound and thoracic radiographs.

## CONFLICT OF INTERESTS
The authors have no conflicts of interest to disclose.

## ORCID
*Danica R. Lucyshyn* https://orcid.org/0000-0001-7054-3869
*Kelsey D. Brust* https://orcid.org/0000-0001-9726-8879
*David J. Maggs* https://orcid.org/0000-0001-6537-4335

## REFERENCES
1. Dubielzig RR. Ocular neoplasia in small animals. *Vet Clin North Am Small Anim Pract*. 1990;20(3):837-848.
2. Labelle AL, Labelle P. Canine ocular neoplasia: a review. *Vet Ophthalmol*. 2013;16(Suppl 1):3-14.
3. Bandinelli MB, Viezzer Bianchi M, Wronski JG, et al. Ophthalmopathologic characterization of multicentric or metastatic neoplasms with an extraocular origin in dogs and cats. *Vet Ophthalmol*. 2020;23(5):814-827.
4. Willis AM, Wilkie DA. Ocular oncology. *Clin Tech Small Anim Pract*. 2001;16(1):77-85.
5. Bellhorn RW. Secondary ocular adenocarcinoma in three dogs and a cat. *J Am Vet Med Assoc*. 1972;160(3):302-307.
6. Dubielzig RR, Ketring K, McLellan GJ, Albert DM. Pathologic mechanisms in ocular disease. In: Dubielzig RR, Ketring K, McLellan GJ, Albert DM, eds. *Veterinary Oular Pathology: A Comparative Review*. 1st ed. Edinburgh: W.B. Saunders; 2010. p. 14.
7. Schultz RM, Johnson EG, Wisner ER, Brown NA, Byrne BA, Sykes JE. Clinicopathologic and diagnostic imaging characteristics of systemic aspergillosis in 30 dogs. *J Vet Intern Med*. 2008;22(4):851-859.
8. Bellhorn RW. Enucleation technique: a lateral approach. *Anim Hosp*. 1972;8:59-60.
9. Oronsky B, Ma PC, Morgensztern D, Carter CA. Nothing but NET: a review of neuroendocrine tumors and carcinomas. *Neoplasia*. 2017;19(12):991-1002.
10. Patnaik AK, Liu SK, Hurvitz AI, McClelland AJ. Canine chemodectoma (extra-adrenal paragangliomas)-a comparative study. *J Small Anim Pract*. 1975;16(1–12):785-801.
11. Eagle RC Jr, Ehya H, Shields JA, Shields CL. Choroidal metastasis as the initial manifestation of a pigmented neuroendocrine tumor. *Arch Ophthalmol*. 2000;118(6):841-845.
12. Hayes HM, Sass B. Chemoreceptor neoplasia: a study of the epidemiological features of 357 canine cases. *Zentralbl Veterinarmed A*. 1988;35(6):401-408.
13. Nyska A. Intraocular vascular embolization of a malignant canine pheochromocytoma. *Vet Comp Ophthalmol*. 1992;2(3):129-132.
14. Yiu G, Cummings TJ, Mruthyunjaya P. Choroidal metastatasis from a neuroendocrine tumor masquerading as choroidal melanoma. *Ophthalmic Surg Lasers Imaging Retina*. 2014;45(5):456-458.
15. Palacios E. Chemodectomas of the head and neck. *AM J Roentgenol*. 1970;110(1):129-140.
16. Eyden B, Pandit D, Banerjee SS. Malignant melanoma with neuroendocrine differentiation: clinical, histological, immunohistochemical and ultrastructural features of three cases. *Histopathology*. 2005;47(4):402-409.
17. Mulay K, Honavar SG. Primary, vasocentric uveal melanoma with pseudorosettes and neuroendocrine differentiation. *Diagn Histopathol*. 2016;22(1):37-39.
18. Carreras C, Kulkarni HR, Baum RP. Rare metastases detected by (68)Ga-somatostatin receptor PET/CT in patients with neuroendocrine tumors. *Recent Results Cancer Res*. 2013;194:379-384.