The Armed Forces Institute of Pathology
Department of Veterinary Pathology

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WEDNESDAY SLIDE CONFERENCE 2008-2009

Conference 7

29 October 2008

Conference Moderator:

Dr. Dale G. Dunn, DVM, Diplomate ACVP

CASE I – D07-045891 (AFIP 3102259)

Signalment: One approximately 3-month-old female Cooper's hawk (*Accipiter cooperi*)

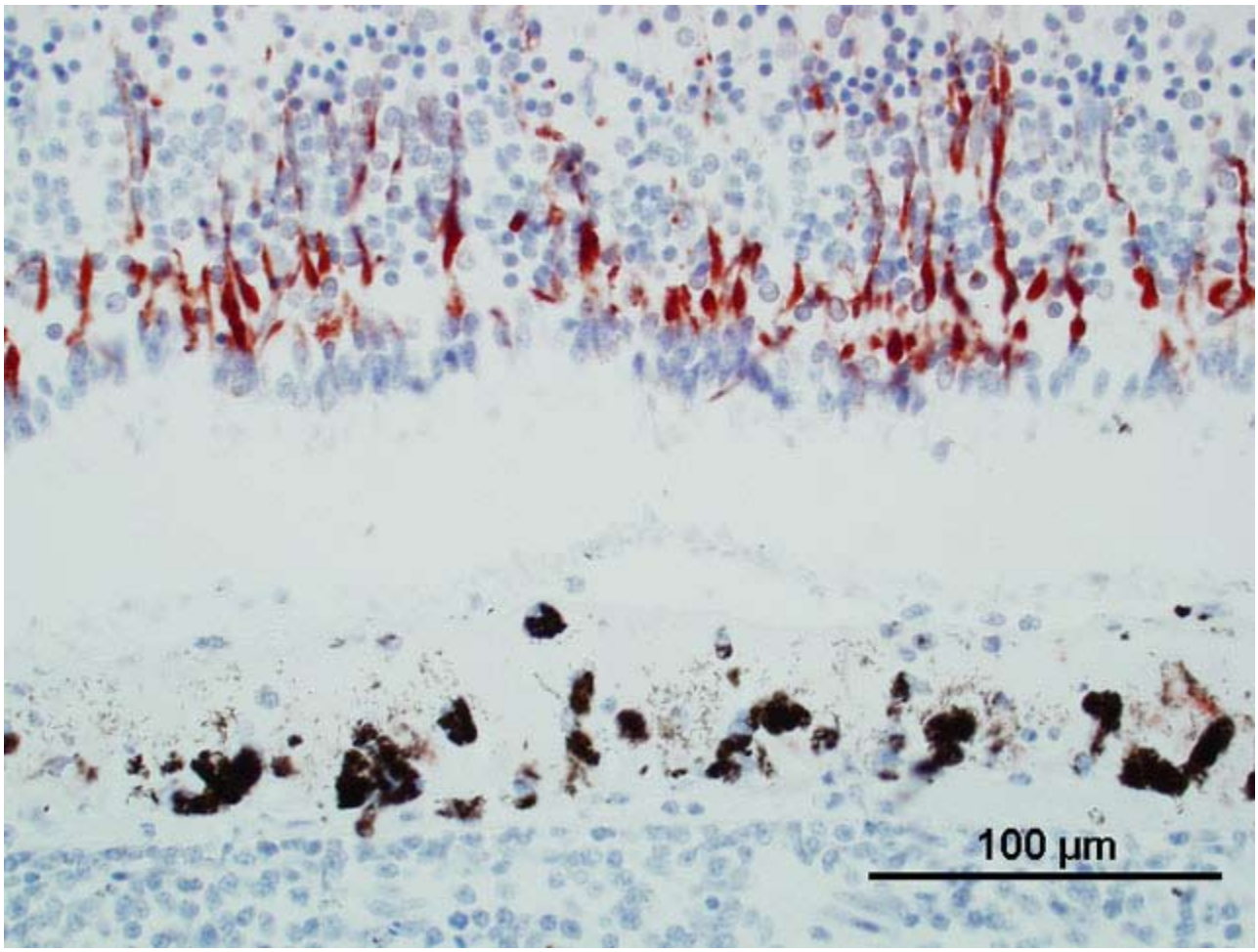
History: This animal was admitted to the Raptor Center of the University of Minnesota with neurologic signs in late August. It was emaciated and had evidence of head trauma. Funduscopic investigation revealed an "exudative" chorioretinitis. Due to the deterioration of the clinical state of the animal, and based on the funduscopic finding indicating WN disease, the animal was euthanatized two days after admission.

Gross Pathology: The vitreous of the left eye was slightly opaque after fixation. In addition, the bird had acute bilateral leptomeningeal hemorrhages at the base of both cerebral lobes. The spleen was moderately enlarged, soft and diffusely dark red.

Laboratory Results: A tissue pool containing kidney, heart and brain was positive for West Nile virus (WNV) by PCR but virus isolation using Vero cells failed to detect WNV (Animal Health Diagnostic Center of Cornell University). WNV was not detected in the aqueous humor of the right eye. WNV antigen was present in the retina of the left eye (slide A), mainly in the outer nuclear layer (**Fig. 1-1**; monoclonal antibody against envelope protein epitope of WNV; clone 7H2; BioReliance, Rockville, Maryland, USA). The animal had a high WNV specific antibody titer (> 1:320) while antibodies against Saint Louis encephalitis virus were undetectable (< 1:10).

Histopathologic Description: Sections of two blocks representing both eyes were submitted (slide A = left eye; slide F = right eye): Right eye (slide F): Numerous capillaries of the pecten were internally lined or surrounded by predominantly plasma cells and lymphocytes and fewer macrophages **(Fig. 1-2)**. The capillaries had hyperplastic endothelial cells. Clusters of inflammatory cells were also present between lamellae of the pecten. A similar infiltrate was present in the optic disc. The retina and choroid on one side of the pecten appeared to be largely unaffected except for the deposition of a small amount of faint basophilic stringy material on the nerve fiber layer that entrapped a small number of degenerate inflammatory cells and a minimal infiltration of the nerve fiber layer by plasma cells. The choroid and retina on the other side of the pecten was significantly altered. The choroid of this segment was markedly infiltrated by plasma cells and lymphocytes. The retinal pigmented epithelial (RPE) cells overlying inflamed choroidea were degenerate with loss of their delicate processes that support the photoreceptor cells.

***Sponsored by the American Veterinary Medical Association, the American College of Veterinary Pathologists, and the C. L. Davis Foundation.**



1-1. Eye, Coopers Hawk. Multifocally with the retina there is immunohistochemical staining for WNV antigen. The WNV antigen is evident in the outer nuclear layer, cell fibers of the outer plexiform layer and inner nuclear layer. Photomicrograph courtesy of Department of Veterinary Population Medicine College of Veterinary MedicineUniversity of Minnesota 1333 Gortner Ave St. Paul, MN 55108.

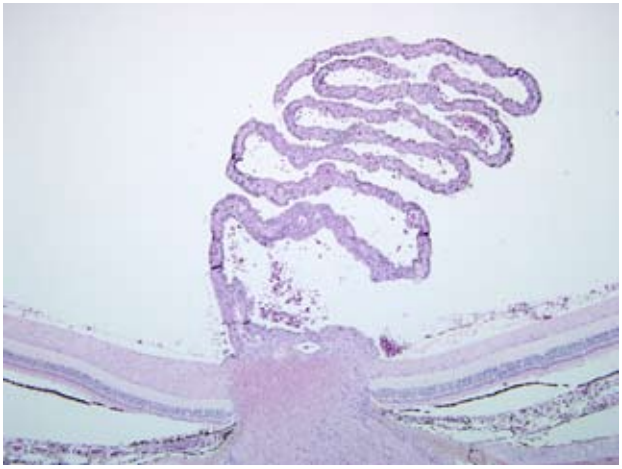
More severely affected RPE cells were detached and individualized and assumed a plump shape. The retina was detached in these areas. Occasional small aggregates of inflammatory cells (lymphocytes and plasma cells) were present within the nerve fiber layer of this retinal segment particularly close to the pecten. Swollen axons were occasionally present within the nerve fiber layer. The iris was infiltrated by few individual plasma cells and lymphocytes. The lens was absent in some of the sections either due to a processing artifact or due to an oblique angle of the initial sectioning of the eye globe. Some sections contained adipose tissue within the area of the vitreous due to a processing artifact.

Left eye (slide A)**:** The lesions were similar to the lesions described in the right eye. The degenerate changes of the retinal pigmented epithelial cells were more widespread so that non-degenerate RPE cells were essentially absent. In addition, there was multifocal acute hemorrhage into the choroid, retina and vitreous. A group of foamy macrophages (gitter cell morphology) were present at the margin of disrupted retina in one location.

Contributor's Morphologic Diagnosis: Pectenitis and choroiditis, lymphoplasmacytic, chronic, marked with retinal degeneration and detachment

Acute intravitreal hemorrhage (only left eye, slide A)

Contributor's Comment: West Nile virus (WNV) infection is common in Cooper's hawks (and red tailed hawks).[7] The disease may be transmitted to Cooper's hawks by mosquito bites but oral infection is also plausible since Cooper's hawks tend to prey on songbirds



1-2. Eye, Coopers Hawk. The pectin is expanded up to five times normal by a cellular infiltrate. (HE 40X).

some of which may constitute an avian reservoir for WNV. In a subgroup of the infected Cooper's hawks, e.g., many hatch year birds, the infection results in WN disease while the majority of infected Cooper's hawks (and red tailed hawks) likely eliminate the virus rapidly without having clinical signs, similar to the situation in humans. This is evidenced by a fairly high WNV seroprevalence in apparently healthy Cooper's hawk and red tailed hawk populations.[1,6] WN disease in Cooper's hawks (and red tailed hawks) is frequently characterized by neurologic signs (e.g., "depression" and tremors) and visual impairment ultimately potentially progressing to blindness.[5] Ophthalmologic examination of hawks with WN disease frequently demonstrates opacities in the fundus of one or both eyes that is interpreted as "chorioretinitis" by clinicians.[5] The presence of funduscopic lesions in hawks may aid in establishing a diagnosis of WN disease in the living patient. Gross lesions other than emaciation are uncommon in hawks with WN disease, but may include opacities of the fundus ("chorioretinitis") of one or both eyes, myocarditis and unilateral or bilateral cerebral malacia. Histologically, pectenitis is one of the most consistent findings in Cooper's hawks with WN disease.[5,7] As in the present case, chorioditis is frequently also present and occasionally, retinal degeneration and necrosis are additional ocular lesions. Retinal pigmented epithelial cells overlying areas of chorioditis are usually degenerate as evidenced by individualization and clumping of these cells possibly leading to detachment of the retina in the respective segment. The funduscopically or grossly visible opacities in the fundus likely represent fibrin deposition on the nerve fiber layer of the retina. Lymphoplasmacytic iridocyclitis may in some cases be a minor component of the ocular lesions.

WNV may be detectable by PCR, immunohistochemistry or virus isolation in the eyes (e.g., aqueous humor) even when other organs are negative.[4,5,7] The retina may harbor only a few individual WNV antigen positive cells (e.g., ganglion cells), or in some cases entire full thickness segments of the retina overlying areas of chorioditis may be strongly WNV antigen positive. In addition, WNV-specific antibodies are usually present in the aqueous humor of infected Cooper's hawks (and red tailed hawks) with WN disease although plasma/serum titers are usually higher.[5] Hence aqueous humor may be used as substrate for detection of antibodies when plasma or serum is not available (e.g. in carcasses submitted to veterinary diagnostic laboratories).

Besides the inflammatory and degenerative lesions that were present in both eyes, one eye had evidence of trauma in the form of intravitreal hemorrhage in the present case. Trauma likely was also the cause of the macroscopically observed leptomeningeal hemorrhage.

AFIP Diagnosis: Eye: Pectenitis, lymphoplasmacytic, diffuse, moderate with multifocal, mild choroiditis and retinal degeneration and detachment

Conference Comment: West Nile virus (WNV) is a single-stranded, icosohedral, enveloped RNA virus in the family *Flaviridae*, genus *Flavirus*. WNV is mainly transmitted by mosquitoes and circulates in the environment often through a sylvatic cycle from bird to mosquito to bird. West Nile derives its name from the West Nile district of Uganda, where the virus was first discovered. WNV was first recognized in the United States in 1999 in New York after an outbreak in the local bird population.[2]

West Nile virus has a very wide host range with the major natural amplifier being crows and corvids. Birds develop a severe viremia with virus detectable in many organs in the body. This is in contrast to horses, where the virus is only found in the CNS.[3] Horses and some birds are exquisitely sensitive to WNV, and disease outbreaks are usually seen during peak mosquito season, which is the summer and fall. Mortality rate in horses can reach 50%. Gross lesions are usually absent or unspectacular, but spinal cord lesions do occur and manifest as hemorrhage and malacia of the thoracic and lumbar spinal cord. Histologically, lesions are usually present in the brainstem and thoracolumbar spinal cord and consist of a nonsuppurative encephalomyelitis, gliosis, and glial nodule formation with or without necrosis. The gray matter usually contains more severe lesions. Birds often have lesions in the heart and liver. WNV infection is much more of a systemic disease in affected birds. Cats,

dogs, cattle, and swine are susceptible to WNV, but they often have subclinical disease.[3]

Contributing Institution: Department of Veterinary Population Medicine, College of Veterinary Medicine, University of Minnesota, 1333 Gortner Ave, St. Paul, MN 55108, USA

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CASE II – 067-78252 (AFIP 3102493)

Signalment: 14-yr-old, M(n), domestic shorthair, feline

History: Six years prior to necropsy this animal was presented to the Ophthalmology Service of the Colorado State University Veterinary Medical Center for recent onset of blindness. The animal had been examined by a veterinarian for an abscess on the left forelimb and received a prescription for oral enrofloxacin ten days prior to ophthalmic examination. The exact dosage is unknown but was thought to be either 8mg/kg/day (1 68mg tablet per day) or 17mg/kg/day (1 68mg tablet twice daily) [It was a large fat cat]. Ophthalmic exam revealed bilateral mydriasis, lack of menace response, decreased pupillary light reflexes, diffuse tapetal hyperreflectivity, retinal vascular attenuation and non-responsive electroretinogram. A clinical diagnosis of diffuse retinal degeneration secondary to enrofloxacin retinal toxicosis was made. Six years later, the day of necropsy, the animal was found dead in the owner's yard.

Gross Pathology: Both eyes were grossly normal. Other findings included severe obesity, cardiomegaly (heart weight: 31 grams), severe diffuse pulmonary edema and a mildly enlarged right thyroid gland.

Laboratory Results: N/A

Histopathologic Description: Lesions are largely confined to the retina where there is a complete loss of the photoreceptor layer, outer nuclear layer, and outer plexiform layer **(Fig. 2-1)**. The inner nuclear layer is mildly disorganized and there is mild decreased cellularity—both slightly more so in the non-tapetal region. There are scattered, small amounts of pigment within the inner nuclear layer of the non-tapetal region. Additionally, there are rare, lightly eosinophilic, intranuclear inclusions within the inner nuclear layer (present in most slides but not all). Other minor changes inconsistently present in all slides are mild ciliary body cystic degeneration and mild perivascular lymphocytic iritis.

Contributor's Morphologic Diagnosis: Eyes: bilateral severe diffuse outer retinal atrophy

Contributor's Comment: The cause of death was attributed to a suspected cardiovascular event secondary to severe myocardial fibrosis (lesion not provided). The eyes were collected in hopes of documenting the histologic lesion of enrofloxacin induced retinal degeneration/atrophy, clinically diagnosed six years prior to necropsy. Given the clinical history and ocular histopathology, a diagnosis of enrofloxacin retinal toxicosis was made.

A differential diagnosis for outer retinal degeneration/atrophy in a cat includes enrofloxacin toxicity, taurine deficiency, inherited retinal atrophy, and hypertensive retinopathy.

For an excellent summary of the events associated with

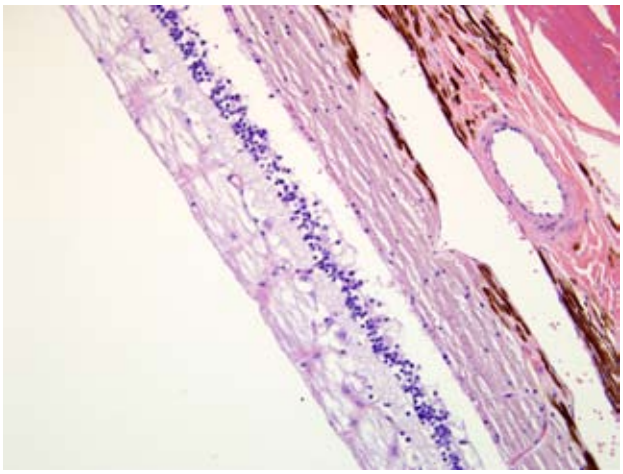
the appearance of enrofloxacin retinal toxicosis in the cat, and the clinical, histopathologic, and ultrastructural ocular lesions associated with oral administration of enrofloxacin at 10 times the recommended dose in an experimental setting, readers are referred to reference 2. While the current recommended dosage of 5mg/kg/day seems to have substantially decreased cases of retinal toxicosis, the authors of the same reference conclude with the following statement: "Investigation of the effects of administration of the recommended dosage of enrofloxacin on the retinas and CNS of cats is warranted."

The exact mechanism of enrofloxacin retinal toxicosis is not known; however, any fluoroquinolone or structurally related compounds should be considered potentially retinotoxic in cats.[11] Risk factors predisposing cats to enrofloxacin retinal toxicosis include large doses or plasma concentration, rapid IV infusion of the antibiotic, prolonged courses of treatment, and age.[11] In cats, the combination of methylnitrosourea and ketamine hydrochloride induces retinal degeneration, but neither drug does so individually.[10]

The retinal lesion seen in taurine deficiency usually starts centrally, hence the disease name of feline central retinal degeneration, but can progress to diffuse retinal atrophy given enough time.[5,8] Due to taurine supplementation of commercial feline diets, the disease is fairly rare now, however, it has been induced by feeding dog food to cats.[1] Affected cats may also have dilated cardiomyopathy. If recognized early enough, both vision and cardiac function can be partially restored with appropriate dietary taurine levels.

Inherited retinal atrophy, or progressive retinal atrophy, has been studied extensively in Abyssinians but has also been documented in Persians and speculated in several other cases.[3,6,9] In the Abyssinian there are two forms termed rod-cone dysplasia (autosomal dominant inheritance) and rod-cone degeneration (autosomal recessive inheritance), both of which may serve as an animal model of the human disease, retinitis pigmentosa.[6]

Hypertensive retinopathy classically includes retinal detachment, subretinal effusion/hemorrhage and retinal and choroidal vessel medial hypertrophy and/or degenerative changes, none of which was seen in this case. Affected cats usually suffer from concomitant renal disease or hyperthyroidism. Renal histology was unremarkable. The thyroid glands (right thyroid enlarged at necropsy) were not examined histologically; however, the owner indicated the animal was given a "thyroid medication" (dosage unknown) suggesting this animal may have been treated for hyperthyroidism. If the hyperthyroidism was



2-1. Eye, cat. Diffusely there is retinal degeneration characterized by loss of the photoreceptor layer, outer nuclear layer, and outer plexiform layer. (HE 400 X).

appropriately controlled the cat was likely normotensive although it may have experienced hypertension prior to treatment being initiated. If hyperthyroidism was insufficiently controlled the animal may have suffered from hypertension; however, as previously mentioned the eye lacks vascular changes consistent with chronic hypertension. Hyperthyroidism may have played a role in the myocardial lesion.

Causes and significance of the sporadic intranuclear inclusions **(Fig. 2-2)** are unknown. Potential artifact or nuclear membrane invaginations were considered. To the best of our knowledge, intranuclear inclusions of the inner nuclear layer in the cat are unreported.

AFIP Diagnosis: Eye, retina: Degeneration and loss of photoreceptor, outer nuclear, and outer plexiform layers, diffuse, severe

Conference Comment: During a preconference session the moderator reviewed ocular anatomy and emphasized the importance of systematically evaluating an eye for pathologic changes. One important portion of this examination is to peruse the retina to determine if all ten layers are present and normal. The ten layers of the retina are from inside (vitreous body) to outside (choroid): 1) inner limiting membrane, 2) optic nerve fibers, 3) ganglion cell layer, 4) inner plexiform layer, 5) inner nuclear layer, 6) outer plexiform layer, 7) outer nuclear layer (cell bodies of the rods and cones), 8) outer limiting membrane, 9) photoreceptor layer, and 10) retinal pigment epithelium.(12) In this case the missing layers are the photoreceptor layer, outer nuclear layer, and outer plexiform layer due to suspected enrofloxacin toxicity.

Glaucoma is less likely in this case because degenerative changes are noted primarily in the outer layers of the retina; whereas, retinal changes associated with glaucoma primarily involve the inner layers of the retina.

Additionally, there was an active discussion during the conference regarding the few to moderate number of cells within the inner nuclear layer of the retina containing intranuclear, eosinophilic bodies. The consensus was that these "bodies" are cytoplasmic invaginations into the nuclei and should not be confused with viral inclusion bodies.

Contributing Institution: Colorado State University, Department of Microbiology, Immunology, Pathology and the Veterinary Diagnostic Laboratory, www.cvmbs.colostate.edu/mip and www.dlab.colostate.edu

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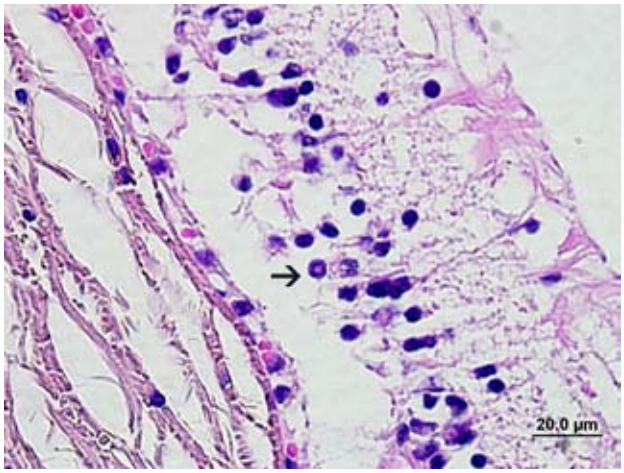

2-1. Eye, cat. Diffusely there is retinal degeneration characterized by loss of the photoreceptor layer, outer nuclear layer, and outer plexiform layer. (HE 400 X).

CASE III – 25623-07 (AFIP 3103702)

Signalment: Neutered female Pekingese dog (*Canis familiaris*), 9.5-years-old

History: The dog developed a right-sided corneal ulcer five months previously. The eye became cloudy five days ago, and severe periocular swelling and pain developed two days ago. The right globe was enucleated, fixed and submitted for microscopic examination.

Gross Pathology: NA

Laboratory Results: NA

Histopathologic Description: A perforation of the cornea is present, with debris in the defect connecting the outer aspects of the cornea and the chambers of the eye. Iridal tissue is herniated into the defect, protruding through an often fragmented Descemet's membrane, but inflammation and hemorrhage affect both the anterior and

posterior chambers and the uvea, and the inflammation extends around the periphery of the eye to involve the extra-ocular muscle. Lens liquefaction (cataractous change) is present, and neutrophils occur within the abnormal lens matrix and beneath the detaching capsule. Lenticular fibrovascular membranes are not observed. The cornea peripheral to the perforation contains embedded hemorrhage and full-thickness edema. The filtration angle is minimally visible but contains hemorrhage and debris as well. Widespread corneal ulceration is associated with a superficial infiltrate of neutrophils, and remaining corneal epithelium is undergoing squamous metaplasia and melanization. Well defined clusters of cornified material are suspended in inflammation at the surface of the cornea, along with microabscesses. Central and superficial corneal vascularization is apparent, along with localized melanin. Colonies of coccoid bacteria are most easily seen in fibrin deposits in the anterior chamber but occur throughout the eye. The iris is adhered to the posterior aspect of the cornea, and a long stretch of fibrovascular membrane extends down part of its anterior surface. Neutrophils infiltrate the iris stroma and the posterior epithelial layer is incomplete. Much of the ciliary apparatus and remaining retinal and choroidal structures are obliterated by inflammation. Neutrophils diffusely infiltrate the sclera and separate the episcleral fascia. Evidence of neovascularization and early fibroblast proliferation are seen in the latter.

Contributor's Morphologic Diagnosis:
Eye: Chronic suppurative panophthalmitis with corneal perforation, staphyloma, lens liquefaction and intralesional bacteria

Contributor's Comment: The microscopic lesions in this eye are exemplary of traumatic perforation with continued inflammation. In the absence of infection, the minimal lesions associated with canine lens trauma are characterized by breaks in the anterior lens capsule and uveitis of the anterior segment. In one study, 36/40 cases of traumatic eye injury resulted in extrusion of lens material into the anterior chamber. Of these cases, 12/14 were related to direct lens trauma. The result was endophthalmitis with or without glaucoma.

The presence of corneal perforation and associated lens inflammation point to the likelihood of a penetrating foreign body. Although the history is vague in this case, and while younger animals are more often affected, a cat claw wound was deemed most likely. These wounds cause [6] corneal and lens capsule perforation with ensuing phacoclastic uveitis. Phthisis or glaucoma resulted in 50% of the cases. Grass awns and porcupine quills are also frequently cited as sources of ocular or orbital foreign bodies in dogs.[2-4,6]

In 20 cases of lens rupture that excluded animals with intractable intraocular infection, lens-induced uveitis was characterized by capsular rupture, cataract, lymphoplasmacytic iridocyclitis, and perilenticular inflammation.[8] Moreover, capsule defects were in line with breaks in the Descemet's membrane similar to the one in this case. Even in the absence of infection, the affected lens will become invested with neutrophils, lens epithelium and/or metaplastic fibroblasts. In 13/20 cases in this study, the vitreous and posterior uvea were also inflamed. Four dogs with recent perforations had fibrinopurulent inflammation surrounding the lens.

Phacoclastic uveitis is distinguished from phacolytic uveitis in that the latter is a result of reaction to protein leakage from a cataractous lens and without other associated causes of uveal inflammation.[7] In both conditions, normal low dose tolerance to lens proteins is thought to be overwhelmed by rupture of the lens and release of high dose antigen. When lens lysis occurs, lens membrane proteins are also released, and this results in a more powerful presentation of antigens to the systemic immune system that is likely to overwhelm tolerance.

This case demonstrates the potentially catastrophic results of intraocular inflammation, which had at the time of enucleation involved every structure of the eye. Panophthalmitis, defined as inflammation of all the tunics of the eye, is much less common than endophthalmitis, defined as inflammation of the uvea, retina, and ocular cavities. The acute changes near the site of corneal rupture contrast with those inside the eye. These are of longer duration based on the presence of an anterior fibrovascular membrane, corneal vascularity, and the neovascularization at the back of the eye. Wilcock points out that many cases of traumatic lens laceration are detected by a lack of response to treatment, [8] and in his cases, the interval between injury and uveitis onset (when known) was 4-20 days.

AFIP Diagnosis: Eye: Panophthalmitis, fibrino-suppurative, diffuse, severe, with corneal rupture, iridal prolapse, phacoclasia, and intralesional bacteria

Conference Comment: This case of ocular trauma had lesions involving almost every part of the eye. The ocular anatomy's relationship to eye injury was discussed during the conference, and this review will briefly discuss anatomy of the cornea and its response to superficial ulceration.

The cornea is avascular and covered by nonkeratinized,

nonpigmented stratified squamous epithelium. This thin, non-pigmented epithelium allows for clarity of vision.[9] The stroma also maintains a state of relative dehydration aided by numerous epithelial and endothelial tight junctions in combination with a Na-K-dependent ATP-ase pump in the cell membrane of the corneal endothelium.[9] Bowman's layer is just below the squamous epithelium. Bowman's layer was discussed during the conference because it is a distinctive membrane in humans, but is not distinct in mammals. Underlying Bowman's layer, and compromising 90% of the thickness of the cornea, is the corneal stroma and layers of collagen interspersed with fibroblasts. Descemet's membrane, distinct in domestic animals, lies between the corneal stroma and the corneal endothelium.[1]

The cornea is a highly specialized area of the body; therefore, it is protected from damage by numerous mechanisms including an antibacterial tear film and a physically movable barrier known as the eyelid. After damage, the cornea often quickly takes on water. Water enters from the eye's anterior aspect via lacrimal secretions and the posterior aspect via fluid from the anterior chamber. Even more water enters the cornea if the electrolyte pump is compromised because of corneal damage.

If injury to the cornea is superficial and only involves the epithelium, this defect heals by epithelial cells "sliding over" the defect, followed by mitosis after approximately 24 hours.[9] Chronic ulcers often require additional resources to heal. These resources are drawn from the epithelium of the corneoscleral junction where permanent populations of cells available for replication reside. Cells recruited from the corneoscleral junction tend to retain phenotypic characteristics of conjunctiva including pigmentation and rete ridges. This is an easy way to recognize a chronic ulcer. This is referred to as conjunctival (or cutaneous) metaplasia.

If the underlying stroma of the cornea is damaged in addition to the epithelium, rebuilding of the damaged stroma may be required before epithelial repair can occur. Within a few hours of the initial insult, neutrophils enter the wound and begin to kill bacteria, degrade damaged collagen, and stimulate fibroplasia and vascularization. Stromal cells at the edge of the defect and fibroblasts recruited from the limbus produce new stroma and cover the defect.[9] New blood vessels begin to form approximately 4 days after an extensive injury, and this ingrowth is from the limbus and progresses at a rate of about 1 mm a day. This lag time is important because superficial wounds can heal in less than 4 days without the help of vascularization. If vascularization occurs during healing, visual impairment from stromal fibroplasia is often the result.[9]

Contributing Institution: Department of Veterinary Pathobiology and Veterinary Medical Diagnostic Laboratory, University of Missouri, http://www.cvm.missouri.edu/vpbio/ http://www.cvm.missouri.edu/vmdl/

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CASE IV – 07RD0797 (AFIP 3065935)

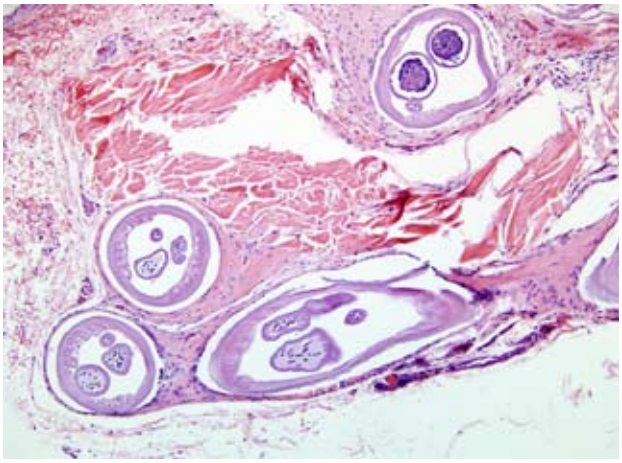
Signalment: 5-year-old male neutered Red Heeler mix, *Canis familiaris*

History: This was an unexpected finding. The dog had no clinical finding of parasites.

Gross Pathology: Gross and microscopic appearance all of the tissues of the globe appeared within normal limits including the profile and coloration of iris.

Laboratory Results: NA

Histopathologic Description: Histosections show numerous nematode adult parasites in the episclera on the superior side of the globe extending posterior to the equator of the globe **(Fig. 4-1)**. Both adult male and adult female forms are seen, and there are numerous microfilaria in the reproductive tracts of a female. The cuticular ridges are typical of *Onchocerca* in that they are circumferential so that they are seen as a series of extruding bumps on the cuticle of female worms cut in the longitudinal direction. No microfilaria are seen in the tissues. The tissue reaction is limited to fibrosis and minimal granulomatous inflammation surrounding the cavities in which the adult worms are found. There is a minimal perivascular lymphoplasmacytic inflammatory infiltrate in the episclera at sites distant from the presence of parasites. Immediately subtending the conjunctiva are numerous polymorphonuclear cells immediately adjacent to blood vessels.



4-1. Eye, dog. Cross and tangential sections of filarid nematodes characterized by coelomyarian –polymyarian musculature, small lateral chords, uteri containing microfilaria, and a very small intestinal tract. (HE 100X).

Contributor's Morphologic Diagnosis: Episcleral fibrosis and granulomatous inflammation with intralesional *Onchocerca* Filarial Nematode parasites

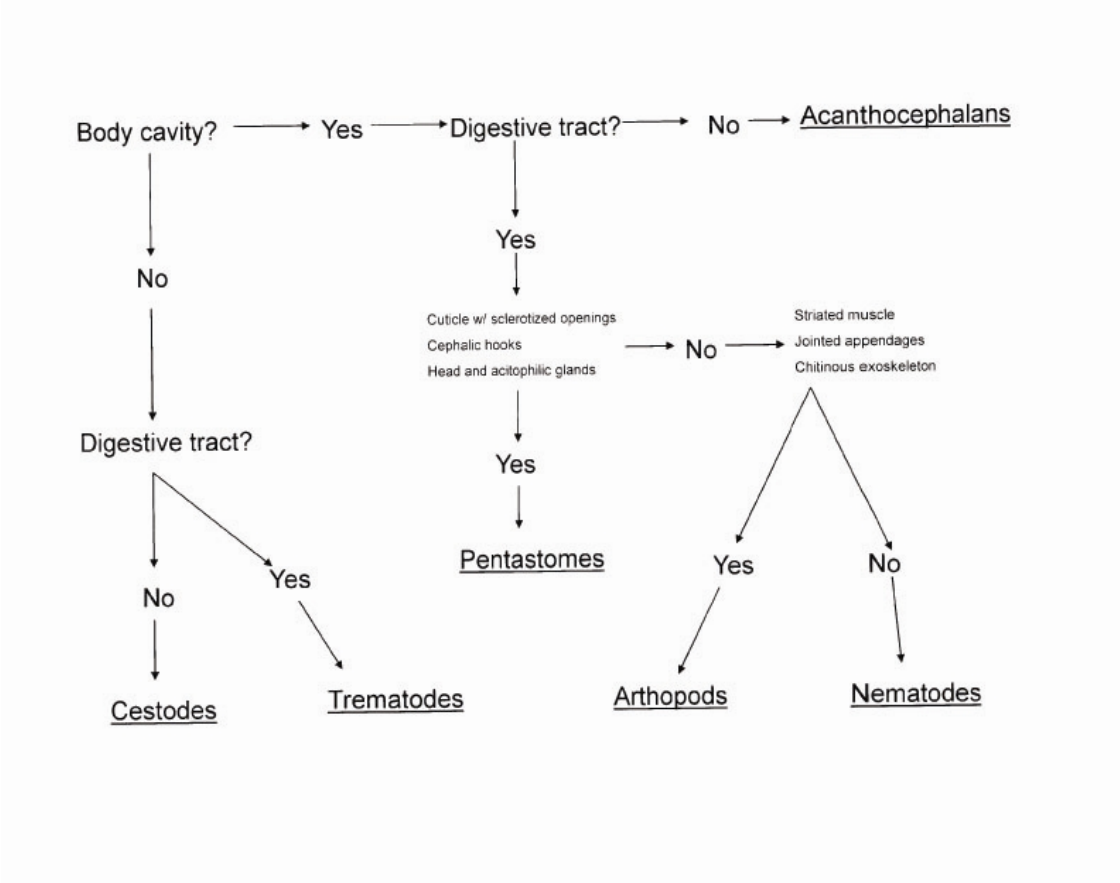
Contributor's Comment: *Onchocerca* sp. are transmitted by the insect genus *Simulium* (black flies) or *Culicoides* (gnats) during a blood meal. The insect vector injests *Onchocherca* microfilaria from subcutaneous nodules of the host. The microfilaria migrate to the insect midgut, through the hemocoel to the thoracic muscles where they develop into first stage larvae. Eventually they develop into third-stage larvae and migrate to the insect's head and proboscis and are transmitted to another host. Within the vertebrate host the larvae migrate, form nodules, become adults, mate and release microfilaria that continue the cycle.

Onchocerca sp. has worldwide distribution and infects ungulates and humans. This tissue is from a series of 9 cases of canine ocular *onchoceriasis* we received from the Western United States (California, Nevada, Utah, Arizona) since 2004. The typical lesion is an episcleral or conjunctival nodule with lymphogranulomatous inflammation, eosinophils, plasma cells, fibrosis and granuloma formation.

Series of canine cases of episcleral *Onchocerca* infestation have been reported from Greece, Hungary, and the Western US. Controversy exists as to the *Onchocerca* species causing canine infection. The Greek and Hungarian isolates are thought to be of the same species; light microscopic study indicates morphologic similarities in U.S. versus Hungarian and Greek parasites. Many previous reports regarding Greek and Hungarian cases incriminate *O. lupi* with the dog as the definitive host. Other authors believe that aberrant migration of *O. lienalis* of cattle is responsible for American canine ocular onchocerciasis. While *O. lienalis* is considered the most likely diagnosis in the cases of American canine onchocerciasis based on widespread geographic incidence of *O. lienalis* and parasite morphology, experimental infection of dogs with *O. lienalis* has not been successful, and canine *Onchocerca* has not been found in cattle-specific locations (gastro-splenic ligament). Furthermore, although the natural host of *O. lienalis* is cattle, the worms found in dogs have been gravid, suggesting patent infection.

AFIP Diagnosis: Eye, episcleral connective tissue: Adult filarid nematodes, few, with mild fibrosis

Conference Comment: There was slide variation in the presence and severity of associated granulomatous inflammation; in most slides it was minimal. The conference discussion centered largely on the identification of this filarid nematode and the distinguishing characteristics of not only filarids but *Onchocerca* sp. Filarids are small nematodes that infect a number of different domestic animals. The majority of parasites in this group produce microfilaria, which are very distinctive larvae that when seen in the adult female are helpful in identification.(1) Dr. Chris Gardiner, the AFIP parasitology consultant, has mentioned that these larvae often are very basophilic and look like "a bag of nuclei." Filarids have coelomyarian musculature. In *Onchocerca*, these muscles atrophy and are replaced hypodermal tissue. Even more important



than microfilaria in identification of filarids is their telltale intestine, which is very small and a key diagnostic feature. These characteristics help differentiate *Onchocerca* sp. from the spirurid *Thelazia* sp., another common parasitic scourge of the mammalian eye.[1] The moderator also discussed various features of metazoan parasites in histologic section. A chart used by AFIP residents is included here to aid in the classification of parasites in tissue section.

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2. Zarfoss KM, Dubielzig RR, Eberhard ML Schmidt KS: Canine ocular onchocerciasis in the United States: Two new cases and a review of the literature. Vet Ophthal 8:51-57, 2005