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Ophthalmic examination of a feline patient follows the same principles as ophthalmic examination of the canine patient. A few differences exist between dogs and cats that present the clinician examining a feline patient with a few unique challenges. The menace response is often subtle in cats. Many cats will respond with a subtle movement of the upper eyelid only. Some cats, especially brachycephalic cats, may not respond initially. A few gentle taps on the eyelids prior to repeating the menace gesture will usually solve this problem. Cats have the ability to actively protrude the third eyelid, and prevent visualization of the globe. Limiting restraint to the absolute minimum necessary in combination with avoiding very bright light during the ophthalmic examination will prevent third eyelid protrusion in most cats. If this doesn't work, it may be necessary to apply topical anesthetic, such as 0.5% proparacaine, to the cornea, and gently push the third eyelid out of the way with a cotton tip applicator. Pupillary light reflexes are usually brisk and complete in cats, limiting visualization of deeper intraocular structures. Decreasing the amount of light used during the examination usually prevents this problem, but 1% tropicamide may be necessary to dilate the pupil for complete examination of the fundus.

Conjunctivitis

Conjunctivitis is a common problem in cats and is usually of infectious origin. The most common causes for feline conjunctivitis include infection with Chlamydia psittaci, Mycoplasma felis or feline herpes virus 1 infection. Other infectious causes include salmonella, M. gatae, reovirus and calicivirus. Clinical signs of Chlamydia psittaci infection include conjunctival hyperemia and chemosis in one or both eyes. Formation of conjunctival follicles may be present. Chlamydia does not affect the cornea. Intracytoplasmic inclusion bodies may be found during the first 2-9 days after the onset of clinical signs. Polymerase chain reaction is more sensitive for detecting Chlamydia infection than culture. Treatment consists of topical tetracycline, chloramphenicol or erythromycin 3-4 times a day for 10-14 days. Chlamydia infection is seen in cattery situations in which asymptomatic queens carry the infectious agent in the urogenital tract. If chlamydia is present within a cattery, it may be necessary to treat all adult cats with 5 mg/kg doxycyline twice a day for 30 days to eliminate carriers. Non-infectious causes for feline conjunctivitis include eosinophilic conjunctivitis, allergic conjunctivitis, hypersensitivity reaction and tear film disorders.

Feline herpes virus infection

Clinical signs

Feline herpes virus 1 (FHV-1) infection is a very common infection in cats. FHV-1 is an alpha herpes virus. It has been associated with many ocular diseases in cats including conjunctivitis, keratitis, corneal ulceration, symblepharon

formation, chronic epiphora, eosinophilic keratitis, sequestrum formation, keratoconjunctivitis sicca and anterior uveitis. Primary infection with feline herpes virus manifests itself usually in the respiratory tract and the eyes. FHV-1 replicates in epithelium of nasal mucosa, conjunctiva, tonsil and nasal turbinates. Tissue damage during active infection is due to viral cytolisis.[1] Clinical signs include lethargy, fever, sneezing, nasal and ocular discharge, conjunctival hyperemia and chemosis. One or both eyes may be affected. In more severe cases, the corneal epithelium is affected as well leading to corneal ulceration. Dendritic corneal ulcerations represent viral replication within the corneal epithelium. Corneal lesions are most common on days 3 and 12 of the primary infection. Lysis of conjunctival epithelium cells with subsequent virus release is responsible for the corneal lesions seen around day 12 of the primary infection.[1] Dendritic ulcers may coalesce to form larger geographic ulcerations. Secondary bacterial infection may lead to deep corneal ulceration or corneal perforation. Iris prolaps and anterior synechiae may form after corneal perforation. Adhesions between third eyelid and the cornea or eyelids may lead to permanent protrusion of the third eyelid. The corneal epithelium may be replaced by conjunctival-like epithelium that contains blood vessels and is not completely transparent. Approximately 80% of cats infected with FHV-1 will become carriers of the virus after the initial infection. The virus has been isolated from trigeminal ganglia, olfactory bulb, optic chiasm, and optic nerve in asymptomatic cats. Extraneural latency in the cornea has also been suggested. Spontaneous shedding occurs in 30% of cats. Recrudescent infections frequently involve the eyes only. Reactivation of the virus in the trigeminal ganglion and axonal transport along the trigeminal nerve to the affected eye is responsible for recrudescent infection. Conjunctivitis with or without keratitis lasting from a few days to several weeks is seen. Epithelial and stromal keratitis with cellular infiltration and edema may be seen in recrudescent infections. Stromal keratitis is not a direct result of virus infections, but occurs as CD4+ T lymphocytes mount a specific immune response to viral proteins.

Diagnosis of feline herpes virus infection

Feline herpes virus infection should be suspected in any young cat with uni-or bilateral conjunctivitis with corneal involvement. The presence of dendritic ulcerations is considered pathognomonic for FHV-1 infection. Dendritic corneal ulcerations may initially involve the epithelium only and are therefore fluorescein negative. Use of Rose Bengal stain will allow visualization of dendritic ulcerations. Especially in recrudescent infections, dendritic ulcers are often absent.

Laboratory methods used in the diagnosis of FHV-1 infection include serum antibody titers by serum neutralization or ELISA, virus isolation, immunofluorescent assay or PCR assay. Diagnosis of FHV-1 infection may be difficult. Serum antibody titers against FHV-1 were found in 97% of normal cats and cats with conjunctivitis in one study, indicating that single or paired FHV-1 antibody titers are not useful in the diagnosis of FHV-1 infection. A significantly higher titer was found in cats without conjunctivitis as compared to cats with conjunctivitis indicating a possible protective action of a high antibody titer. Virus isolation has been used as the gold standard in research situations for many years. Sample handling is difficult and the test takes over a week to perform, making this test of limited use in clinical practice. Immunofluorescent assay performed on a conjunctival scrape detected only few affected cats in one study. False positive results may occur if the sample is taken from the eye after application of topical fluorescein. Polymerase Chain Reaction assay is a very sensitive method of detecting even limited amounts of DNA. Polymerase chain reaction amplifies small quantities of DNA to detectable amounts. The sensitivity of PCR for FHV-1 diagnosis is superior to other methods. Less than 30 copies of the FHV-1 genome is the detection limit reported for one laboratory.[1] PCR was 80% more sensitive than virus isolation in one study evaluating virus shedding in asymptomatic cats. Samples, once collected, should be frozen. Chances of obtaining a positive result are better when more cellular material is submitted. The sensitivity of nested PCR is even greater than single round PCR, but does increase the possibility of false positive results.

Treatment of feline herpes virus infection

Conjunctivitis without ulcerative corneal disease can be treated with topical antibiotic therapy only. The disease is self-limiting and lasts less than 2 weeks in most otherwise healthy cats. Examples of topical antibiotics include tetracycline, chloramphenicol, erythromycin, or gentamicin. Some cats may develop an allergic reaction to the neomycin component of triple antibiotic solution or ointment, making this a less desirable choice in cats. Antiviral medications are indicated in cats with ulcerative corneal disease, or in cats with a compromised immune system. Examples of antiviral medications, in decreasing order of potency include trifluridine, idoxuridine and vidarabine. These drugs work by interfering with DNA synthesis and viral replication. Antiviral medications need to be used frequently in order to be effective. Bacteriologic culture and sensitivity may be indicated in corneal ulcerations with secondary bacterial infections. Ciprofloxacin topically may need to be used in infected corneal ulcers. Systemic antiviral medications are used infrequently in cats because of limited efficacy (Acyclovir) or pronounced toxicity (Valacyclovir). Acyclovir inhibits viral replication by interfering with DNA synthesis. The drug has to be activated by viral-specific thymidine kinase, which makes it non-toxic to normal cells and allows it to be used systemically. The ED_{50} of acyclovir for treatment of FHV-1 is very high, however this can be lowered by combining acyclovir with interferon. Interferon facilitates incorporation of acyclovir into the viral genome, allowing lower plasma acyclovir levels to be effective against FHV-1 infection. The immune system is important in

controlling a FHV-1 infection. L-lysine is an essential amino-acid that has been shown to significantly reduce virus shedding in affected cats and decrease the duration of FHV-1 infection. It suppresses FHV-1 replication by competing with arginine for incorporation into the viral genome. Dose of l-lysine used in various studies varies between 250 mg once a day to 500 mg twice a day over the food. L-lysine appears to be most effective when used early in the course of the disease. Parenteral vaccination with FHV-1 vaccines is not recommended in the treatment of FHV-1 infection. Intranasal and ocular application of modified live FHV-1 vaccine stimulate a mucosal immune response and local antibody production. This may result in some improvement in cats with chronic low-grade FHV-1 conjunctivitis. This should not be done in cats with stromal keratitis.

Recrudescent infections are initiated by a temporary reduction in the immune system allowing the virus to become active again. Stressful situations will often precipitate recrudescent infections. Examples include moving, introduction of a new cat, dog or person into the household, general anesthesia or other systemic diseases. Reducing or preferably eliminating these stressful situations will aid in the recovery of FHV-1 infection.

Complications secondary to feline herpes virus infection

Chronic epiphora may persist after the conjunctivitis resolves. Chronic epiphora may be secondary to symblepharon formation in the area of the nasolacrimal punctae, or stricture of the nasolacrimal system. Attempts to irrigate the nasolacrimal system are usually unsuccessful. Symblepharon formation is common after severe infections. Minor adhesions between eyelids and third eyelid or between conjunctiva and cornea can be surgically corrected under general anesthesia. Extensive symblepharon formation is difficult to correct surgically. It is possible to dissect the conjunctiva-like tissue from the cornea and reconstruct a conjunctival fornix, however recurrences are very common making this surgery often unrewarding.

Keratoconjunctivitis Sicca (KCS) is uncommon in cats. The most common etiology in dogs is an immune-mediated destruction of the lacrimal gland. The most common etiology in cats is destruction of the lacrimal gland by FHV-1 infection. The diagnosis of KCS can be difficult in cats. Clinical signs can be subtle and may include blepharospasm, conjunctival hyperemia and mucoid discharge. Biomicroscopic examination of the tear film reveals a thin tear film with a granular appearance. As compared to dogs, clinical signs are always very subtle. The severe corneal changes that may be present in dogs such as vascularization, fibrosis and pigmentation are usually absent in cats. The tear production can be measured using Schirmer Tear Test strips, but the results should be interpreted with caution. A very low value for tear production can be present in normal cats and the results of the STT tests should be interpreted in light of the clinical findings. The phenol read thread tear test has been suggested as an alternative way of evaluating tear production in cats.[2] Treatment consists of artificial tear solution 2-4 times a day with artificial tear ointment once or twice a day. Intermittent use of topical antibiotics is occasionally necessary to treat secondary infections. Topical cyclosporine has not been approved for use in cats and its use is not recommended for treatment of KCS in cats.

Eosinophilic keratitis and conjunctivitis

Eosinophilic keratitis is an immune-mediated inflammatory disease of the cornea that is characterized by progressive vascularization and cellular infiltration of the cornea.[3] It most commonly affects young adult, mixed breed cats. There is often little discomfort present. The disease often starts near the lateral or ventromedial limbus, and may affect one or both eyes. Typical clinical findings include vascularization and infiltration of the perilimbal cornea, presence of gritty, white corneal plaques, inflammation of the adjacent conjunctiva and third eyelid and ocular discharge.[3] Eosinophilic keratitis should be suspected in any cat with a relatively pain-free slowly progressive corneal vascularization with white infiltrative plaques in the cornea. The diagnosis can be confirmed by cytologic examination of a corneal scrape specimen using a Kimura spatula. Eosinophils and mast cells are present. Treatment consists of topical corticosteroids such as 1% prednisolone acetate or 1% prednisolone phosphate. These medications are used initially 2-4 times a day until all clinical signs disappear and then slowly discontinued over months. Recurrences are common, especially if medications are discontinued too quickly. Systemic megestrol acetate can be used if ulcerative keratitis is present or if the character of the cat prevents treatment with topical eye medications.

Eosinophilic conjunctivitis is seen infrequently.[4] Clinical signs include thickening and hyperemia of the conjunctiva and ocular discharge. Depigmentation and ulceration of the eyelid margins and nasal canthus is seen in some cats. The cornea is not affected . Diagnosis and treatment are as for eosinophilic keratitis.

Nodular eosinophilic granulomatous inflammation affecting the nictitating membrane in both eyes has been described in a cat. The diagnosis was based on histopathologic examination of a biopsy. The lesions resolved after surgical debulking and treatment with topical steroids.[5]

Feline herpes virus infection has been shown to be present in a large number of cats with eosinophilic keratitis. Its exact role in the pathogenesis of the disease is still unknown. Topical use of corticosteroids in treatment of eosinophilic keratitis

may reactivate latent FHV-1 virus resulting in FHV-1 keratitis. Treatment with antiviral medications needs to be started and topical steroid use discontinued until the FHV-1 keratitis has resolved. It has been suggested to use both antiviral medications and corticosteroids in the treatment of eosinophilic keratitis, but this is still debated.

Non-healing corneal ulcerations

Indolent corneal ulcers are superficial non-healing corneal ulcers that are characterized by redundant epithelial edges. They are commonly seen in Boxer dogs. A basement membrane abnormality has been shown to prevent proper attachment of hemidesmosomes into the superficial stroma, preventing normal healing. Superficial corneal ulcers resembling indolent ulcers are seen in cats. Clinical signs include mild blepharospasm, epiphora, conjunctival hyperemia and a superficial corneal ulcer with redundant epithelial edges. In one study, the most common location was the central cornea, and brachycephalic cats appeared to be predisposed.[6] Average healing time was 5-6 weeks when topical antibiotic solution or ointment was used in combination with superficial debridement using a cotton tipped applicator. In contrast to dogs, performing a grid keratotomy did not decrease healing time and predisposes to development of a corneal sequestrum. Grid keratotomy is therefore not recommended in the treatment of non-healing ulcers in cats. Feline herpes virus infection may cause non-healing geographic corneal ulcerations. If signs of active FHV-1 infection are present, such as pronounced conjunctival hyperemia and chemosis, the use of topical antiviral medications may be indicated in the treatment of superficial non-healing ulcers in cats.

Qualitative tear film abnormalities have been associated with non-healing corneal ulcers in cats. Measurement of tear break-up time can be performed in cats. If tear break-up time is rapid in affected cats, mucinomimetic supplementation may aid in the healing of non-healing ulcers.[7]

Corneal sequestrum

Corneal sequestrum is a corneal disease unique to cats. Persian, Himalayan, Burmese and Siamese cats are predisposed.[8,9] It is a localized necrosis of the epithelium and anterior stroma. The affected area gets infiltrated with dark pigment that is present in the tear film resulting in the characteristic black lesion in the cornea. Sequestra are often located in the (para) central cornea. A rim of loose epithelium is frequently present around the sequestrum. Other clinical signs include increased tearing, brown ocular discharge, and blepharospasm. The sequestrum is slowly extruded by the cornea through vascularization around and beneath the sequestrum lifting off the necrotic piece of tissue. Numerous factors have been suggested in the etiology of corneal sequestration including FHV-1 infection and chronic irritation such as entropion, non-healing corneal ulcers, trichiasis and exposure in brachycephalic cats. Feline herpes virus infection is more likely to be a factor in the etiology of corneal sequestration in domestic long and short hair cats than in Persian and Himalayan cats. Diagnosis is by the clinical appearance of a black corneal lesion in an intact cornea. It is easy to distinguish a corneal sequestrum from iris prolapse associated with corneal perforation. The iris can be seen to extend to the cornea in a perforation. Treatment options include surgical removal or medical management. If an underlying predisposing factor can be identified, such as entropion, it needs to be corrected. Medical management is aimed at preventing secondary bacterial infection and providing lubrication. A topical antibiotic ointment is used three to four times a day allowing the cornea to slough the sequestrum. This may take many months, especially in brachycephalic cats. Surgical removal by use of a superficial keratectomy can shorten recovery time. If the sequestrum involves the deeper layers of the cornea, it may be necessary to place a conjunctival pedicle graft. Other surgical options described include placement of a free island graft and lamellar keratoplasty with use of donor tissue. Recurrences are not uncommon. Placement of a conjunctival pedicle graft has been suggested to reduce the chance of recurrence.

Eyelids

Upper eyelid agenesis

Upper eyelid agenesis is frequently seen in more than one cat in a litter. The Burmese cat may be predisposed. The degree of agenesis is variable and can range from barely noticeable defects to almost complete absence of the upper eyelid. In the area of agenesis, the skin makes a direct transition into conjunctival tissue without an eyelid margin. In severe cases, the conjunctival fornix is often lacking as well. Clinical signs result from an inability to close the eyelids with exposure keratitis. In addition, the hairs from the skin are often in direct contact with the cornea. Careful examination of the globe is important in any cat with upper eyelid agenesis because other ocular abnormalities such as persistent pupillary membranes or cataract are not uncommon.[10] Treatment options depend on the severity of the agenesis. In mild cases, use of artificial tear ointment twice a day may be sufficient to prevent corneal irritation. Mild cases may be treated with cryoepilation of offending hairs in combination with artificial tear ointment twice a day. Surgical reconstruction of the eyelid margin and conjunctival fornix may be necessary in severe cases. More than one surgical procedure may be necessary in severe cases to restore a functional eyelid margin.

Eyelid tumors

In contrast to eyelid tumors in dogs, which are usually benign, eyelid tumors in cats are often malignant. The most commonly seen eyelid tumors in cats include mast cell tumors, squamous cell carcinomas (especially in white cats), fibrosarcoma, adenocarcinoma and basal cell carcinomas. Eyelid tumors are most common in cats over 10 years of age. Mast cell tumors appear as a firm, pale to pink nodule often involving the skin of the eyelid without involving the eyelid margin. The biologic behavior of mast cell tumors in eyelids of cats is usually benign. Complete resection is curative and it is not necessary to observe the surgical margins recommended for mast cell tumor removal in dogs. All small eyelid tumors in cats should be surgically removed and submitted for histopathologic examination. Larger tumors should be biopsied and treated depending on type of tumor present. Carcinomas involving the eyelids in cats require aggressive surgical removal with reconstruction of the eyelids. It may be necessary in severe cases to excenterate the orbit to obtain complete surgical removal.

Apocrine hidrocystomas in Persian cats.

Apocrine hidrocystomas are cystic structures of the glands of Moll in the eyelids of human beings. Similar appearing cysts are occasionally seen in the eyelids of Persian and Himalayan cats.[11] Presenting clinical signs include one or more cysts of the eyelids, epiphora and occasional color change of the eyelids. Ocular discomfort is usually not present. A variable number of cystic structures are located in the skin of the eyelids close to the eyelid margins. The size of the cysts is variable and can be from hardly noticeable to more than 10 mm in diameter. Aspiration of the cysts yields fluid that is often brown resembling deoxygenated blood. Treatment consists of surgical removal of individual large cysts. Recurrence is common.

Anterior uveitis

The iris is continuous with the ciliary body and the choroid. Inflammation may be limited to the iris and ciliary body (anterior uveitis) or choroid (posterior uveitis or choroiditis). The retina is frequently involved in inflammatory conditions of the choroid leading to a chorioretinitis. Clinical signs of anterior uveitis include blepharospasm, corneal edema, conjunctival hyperemia, aqueous flare, miosis and a decrease in intraocular pressure. Clinical signs of chorioretinitis include hyporeflective lesions in the fundus, vitreal infiltrates and retinal detachment. Keratic precipitates (accumulations of inflammatory cells against the corneal endothelium) can be seen in severe anterior uveitis. Chronic uveitis may lead to neovascularization of the iris (rubeosis iridis), posterior synechiae formation, cataract, lens luxation, and glaucoma.

The etiology of anterior uveitis is often infectious in origin. Infectious diseases suggested to cause anterior uveitis include Feline Infectious Peritonitis, Feline Immunodeficiency virus, Feline Leukemia virus, Toxoplasma gondii, Feline Herpes virus 1 infection,[12] Bartonella spp,[13] parasites and others. Intraocular production of Toxoplasma gondii specific antibodies has been shown to be present in some cats with anterior uveitis.[14] The importance of systemic fungal diseases as a cause of anterior uveitis in cats depends on geographical location. Neoplastic diseases, either primary ocular, or secondary metastatic can cause clinical signs of anterior uveitis as well. Serologic testing for infectious diseases will fail to result in an etiologic diagnosis in some cats. This was found to be more common in older cats than younger cats. Diagnostic workup may include CBC, biochemistry profile, and serologic testing for infectious diseases that are prevalent in the area. Aqueocentesis and cytologic examination of the aqueous humor may aid in the diagnosis of ocular lymphosarcoma.

Treatment consists of treatment of the underlying disease if possible and symptomatic treatment of the uveitis. Topical corticosteroids, such as 1% prednisolone acetate or 0.1% dexamethasone are used 2-4 times a day depending on the severity of the uveitis. Atropine ointment is used as needed to keep the pupil dilated. If concurrent ulcerative corneal disease is present, treatment with topical non-steroidal medications such as 0.03% flurbiprofen or 1% diclofenac is indicated. Use of systemic corticosteroids may be necessary in refractory cases, in cats with ulcerative corneal disease or in cats that can not be treated with topical eye medications. Careful follow-up of the patient is important to monitor for the onset of complications such as glaucoma. Recurrences of the anterior uveitis are common in cats, especially in those cats in which an underlying etiology was not detected and treated. Re-examinations every 6-12 months to monitor the intraocular pressure is recommended, as glaucoma is a common sequel to chronic low-grade uveitis in cats. Secondary cataract formation with or without lens luxation is also common with persistent low-grade anterior uveitis. Chronic low-grade anterior uveitis in cats often has few clinical signs that are apparent to the owner. Therefore, medications may be discontinued too soon or recommendations for follow-up examinations ignored. Cataract or glaucoma is often the result one to several years later.

Diseases of the lens

Cataract

The most common cause for cataract in cats is chronic anterior uveitis. In contrast to dogs, in which inherited genetic defects are the most important cause of cataract, hereditary cataract is uncommon in cats. Cataract is a common complication of diabetes mellitus in dogs, but does not occur as a complication of diabetes in cats. Phacofragmentation with artificial lens implantation can be performed in the cat as it is performed in the dog. An artificial lens of a higher diopter strength is required to obtain emmetropia in cats as compared to dogs.[15] Chronic anterior uveitis with secondary cataract formation carries a guarded prognosis for successful cataract surgery in dogs because of persistent uveitis after the surgical procedure. This does not appear to be as much of a problem in cats.

Lens luxation

Primary lens luxation in dogs is the result of a genetically determined alteration of lens zonules resulting in abnormal weakness. The terrier breeds are predisposed. Secondary lens luxation may develop secondary to chronic uveitis, cataract, glaucoma or trauma. Primary or congenital lens luxation is rare in cats. The Siamese cat may be predisposed.[16] Most cases of lens luxation in cats are secondary to chronic uveitis, cataract formation or glaucoma. Treatment of choice is surgical removal of the lens. In contrast to dogs in which an anterior lens luxation quickly leads to secondary glaucoma, secondary glaucoma is less common with lens luxation in cats. Careful examination of the eye for evidence of anterior uveitis is indicated in any cat with cataract or lens luxation. Appropriate serologic testing is recommended if anterior uveitis is present.

Aqueous misdirection/malignant glaucoma

Over the past few years, a syndrome has been recognized in cats manifested clinically by a decrease in the depth of the anterior chamber. Ophthalmic abnormalities may include an increase in pupil size, slower than normal pupillary light reflex, decrease in menace response and a mildly to moderately elevated intraocular pressure. The lens is located posterior to the iris, but both lens and iris appear to have moved forward towards the cornea, leading to a decrease in anterior chamber depth. This is a unilateral condition in most cats, but bilateral cases do occur. The etiology is still being investigated. It has been suggested that aqueous misdirection into the vitreous cavity leads to expansion of the vitreous body. This results in a forward shifting of the lens and iris and a decrease in depth of the anterior chamber.[17] The shift of the iris and lens is static in most cats over time. The forward shift of the lens results in a severe refractive error in these cats. These cats are myopic (nearsighted). Several different treatment options have been suggested. Topical antiglaucoma medications are used to correct the increase in intraocular pressure that is usually present in affected eyes. Frequently used medications include 0.5% timolol maleate q 12 hours, 1% pilocarpine q 12 hours, 2% dorzolamide q 8-12 hours. The goal of topical antiglaucoma medications is to preserve optic nerve and retinal function, but it does not address the myopia created by the abnormal position of the lens. Surgical treatment options include anterior vitrectomy alone, or the combination of lens removal by phacofragmentation and anterior vitrectomy. Implantation of an artificial lens may or may not be possible to correct the refractive error created by removal of the lens. At the present time, retrospective studies evaluating the success rate of various treatment options have not been published yet.

Glaucoma

Clinical signs of glaucoma in cats are often subtle. Acute glaucoma is rarely diagnosed in cats because the prominent clinical signs that prompt perceptive dog owners to bring their dog to a veterinarian are not usually present in cats. In a large retrospective study, the most common presenting complaints were increased size of the eye, cloudy appearance of the eye, and increase in pupil size.[18] These clinical signs had been present for an average of 7 months prior to presentation. Most common abnormalities on ophthalmic examination included buphthalmos, absent menace response and absent PLR. Other ophthalmic abnormalities included corneal edema, conjunctival hyperemia and signs indicative of (chronic) uveitis such as keratic precipitates, rubeosis iridis and aqueous flare. Glaucoma had resulted in blindness in 72% of eyes prior to initial presentation to an ophthalmologist. Cataract was present in approximately one third of all eyes with glaucoma. The vast majority of eyes were judged to have glaucoma secondary to other ophthalmic diseases, less than 10 percent were judged to have primary glaucoma. Glaucoma was bilateral in 14% of cats. Congenital glaucoma has been reported in cats, but this is extremely rare.

Treatment of glaucoma can be challenging in cats. Because acute glaucoma is rarely diagnosed in cats, treatment with intravenous mannitol is rarely done in cats. Cats appear to be more sensitive to side-effects associated with use of oral carbonic anhydrase inhibitors than dogs and they should be used with caution in cats. Pronounced anorexia, lethargy, metabolic acidosis and hypokalemia can occur within the first few days of treatment. In contrast to dogs, in which side-effects usually disappear with 24 hours of discontinuation of the oral carbonic anhydrase inhibitor, these signs may not spontaneously resolve after withdrawal of the drug. Supportive care with intravenous fluids may be necessary in selected

cases. Topical glaucoma medications are the most common medications used to treat glaucoma in cats. Response to treatment is unpredictable and every cat should be treated as an individual, determining which medications are most beneficial for each individual cat. Timolol malate 0.5% timolol maleate can be used q 12 hours. This is a fairly mild glaucoma medication that is well tolerated by cats. This drug is best avoided in cats with a history of asthma, as it can cause an acute exacerbation of this disease. Miosis is a common side effect of this drug in cats. Topical 2% dorzolamide is frequently used to treat glaucoma in cats. This is a topical carbonic anhydrase inhibitor that is used q 8-12 hours. It is currently one of the most effective topical glaucoma medications in cats. A reported side effect in people is a metallic taste in the mouth. Some cats may develop anorexia or lethargy while being treated with dorzolamide. This may be prevented by feeding the cat food with a strong taste, such as tuna in oil, immediately prior to application of the eye drop. This may neutralize the effect of the dorzolamide. If the anorexia persists, discontinuation of the drug usually results in disappearance of anorexia and lethargy within 24 hours. A combination preparation of 0.5% timolol maleate and 2% dorzolamide is on the market. Topical pilocarpine is rarely used in the treatment of glaucoma in cats. The pressure lowering effect is mild. Topical irritation by the pilocarpine may make it impossible to treat the cat after a few treatments. A side effect of topical pilocarpine is exacerbation of anterior uveitis. Because anterior uveitis is a common underlying etiology of the glaucoma, pilocarpine is often contraindicated in the treatment of feline glaucoma. Dipivalyl epinephrine 1% can be used to treat glaucoma in cats. It is usually used q 12 hours. If it has an effect on intraocular pressure, it is usually a mild decrease of the intraocular pressure only. Latanoprost 0.005% is a powerful miotic agent in cats. It decreases intraocular pressure in dogs and human beings by an increase in uveoscleral outflow of aqueous humor. The effect of this drug on intraocular pressure in cats is still debated. Uveoscleral outflow is only responsible for drainage of a fraction of aqueous humor in cats, 97% of aqueous humor is removed from the eye through the iridocorneal angle. For that reason, the effect of latanoprost on feline eyes can be expected to be minimal. A small research study evaluating the effect of once a day 0.005% latanoprost in normotensive eyes found no effect on intraocular pressure in cats.[19] Further research needs to be done evaluating the effect of latanoprost on glaucomatous feline eyes before concluding that this drug should not be used to treat glaucoma in cats. Topical application of 0.5% apraclonidine resulted in vomiting in 8 out of 9 cats in a research study and this drug should not be used to treat glaucoma in cats.[20] If anterior uveitis is present, treatment with topical corticosteroids should be started as well. The use of atropine to treat concurrent uveitis should be avoided.

Surgical, rather than medical management best treats eyes that have been blinded by glaucoma. Treating cats with topical eye medications long term is difficult, even for the most dedicated owner. Surgical options include enucleation or insertion of an intrascleral prosthesis. Lasercycloablation using a diode laser is less effective in cats than in dogs. Injection of substances in the vitreous with the purpose of chemical ablation of the ciliary body should be avoided in cats because of the potential risk of post traumatic sarcoma.

Diseases of the retina

Retinal degeneration

Hereditary retinal degeneration resembling progressive retinal atrophy (PRA) in dogs has been extensively studied in Abyssinian cats. Early onset rod-cone dysplasia has been described in this breed resulting in retinal degeneration within the first few months of life. Late onset progressive retinal atrophy has also been described in this breed resulting in slowly progressive loss of vision and blindness by middle age or older. In a retrospective study describing retinal degeneration in 26 cats, Siamese cats appeared to be predisposed to retinal degeneration.[21] The average age of affected Siamese cats in this study was 12 years. Clinical signs of retinal degeneration are often not noticed by owners until late in the disease. Nyctalopia (decrease in vision at night) is usually present in dogs in early stages of progressive retinal atrophy. This is not usually seen in cats. Ophthalmic examination reveals changes in the fundus that are similar to PRA in dogs. Retinal vascular attenuation and tapetal hyperreflectivity are usually pronounced by the time the cat is presented for evaluation of progressive vision loss. Pigment clumping in the non-tapetal area and optic nerve pallor are less frequently observed. Cataract formation secondary to retinal degeneration is common dogs, but not seen in cats. Cats adapt well to blindness.

Other causes of retinal degeneration include systemic hypertension with retinal detachment and re-attachment, nutritional deficiencies, inflammatory diseases, chronic glaucoma, genetic abnormalities and toxic insults to the retina. Inflammatory diseases usually result in (multi) focal areas of retinal degeneration with possible involvement of the retinal pigment epithelium and evidence of previous uveitis. Retinal detachment results in acute blindness in the affected eye rather than slowly progressive blindness as is seen with retinal degeneration. Fundoscopic appearance of a fundus after the retina has re-attached may reveal retinal degeneration.

An example of a toxic insult to the retina is acute retinal degeneration that is sporadically seen with enrofloxacin administration in cats.[22] This is most commonly seen with doses above the manufacture's recommended dose of 5 mg/kg once a day, or with routes of administration other than approved by the manufacturer. Clinical signs include an acute onset of mydriasis and decrease in vision. Blindness is common and irreversible in many cats. During the acute stage of

the disease, the retina appears normal. Electroretinographic examination of the retina reveals a lack of recordable response, suggesting diffuse extensive outer retinal disease in the cats in which this test was performed. Return of vision is possible after prompt discontinuation of the drug, but blindness is often irreversible. Within a few weeks after the onset of blindness, signs of retinal degeneration including retinal vascular attenuation and tapetal hyperreflectivity are visible in the fundus. These changes are rapidly progressive. Treatment consists of immediate discontinuation of enrofloxacin when the first clinical signs (such as mydriasis) are noticed.

FCRD

Feline Central Retinal Degeneration, or taurine deficiency, is a disease unique to cats. Cats have a nutritional requirement for taurine. At the present time, all commercial cat foods have an adequate concentration of taurine for the vast majority of cats, making this disease rare among cats that are fed a proper diet. It is still sporadically seen in cats that are on home-made diets, or cats fed dog food. In addition, it is occasionally seen in cats on an appropriate diet, suggesting that the requirement for taurine may be even higher for selected cats. Taurine deficiency affects the cones in the retina, which are most prominent in the area centralis which is located dorsotemporal to the optic disc. Deficiency will results in a cigar-shaped hyperreflective lesion in the area centralis. As the disease progresses, a similar appearing lesion will appear dorsomedial to the optic disc. Gradually, the two areas will connect and a hyperreflective band will form dorsal to the optic nerve. If left untreated, slow progression throughout the entire retina may result in blindness. Correction of the taurine deficiency will stop progression of the disease, but will not result in correction of lesions that are already there.

Hypertensive retinopathy

Systemic hypertension is commonly seen in older cats. Ophthalmic abnormalities associated with systemic hypertension include hyphema, mydriasis, blindness, vitreal and retinal hemorrhages, retinal edema, retinal arteriolar tortuosity, and retinal detachment.[23] Common causes for hypertension in cats include chronic renal disease and hyperthyroidism. Primary hypertension appears to be uncommon in cats, but does occur. Measurement of blood pressure is indicated in any cat with hyphema, retinal or vitreal hemorrhage or retinal detachment.

Treatment consists of lowering the blood pressure. The most commonly used medication for this purpose in cats is amlodipine at a dose of 0.625 mg once or twice a day.[24] A re-evaluation of the blood pressure is indicated in 5-10 days to monitor the blood pressure and adjust medications if needed. Additional treatment with a carbonic anhydrase inhibitor, such as methazolamide, at a dose of 2.2 mg/kg twice a day has been suggested to aid in re-attachment of the retina. This drug can be discontinued when the retina has re-attached. The possible benefit of using this medication should be carefully weighed against the potential side effect of anorexia and lethargy in cats. Topical treatment with corticosteroids may be indicated if hyphema is present. The prognosis for recovery of vision is variable and depends on the severity of the ocular lesions. A subtle retinal detachment without severe hemorrhages in retina or vitreous carries a favorable prognosis for return of vision. The prognosis for recovery of vision is guarded if extensive vitreal hemorrhages with a complete bullous retinal detachment is present. Recurrence of retinal detachment is common if the blood pressure is not controlled adequately.

Intraocular neoplasia

Iris melanoma

Iris melanoma is the most common intraocular tumor in dogs and cats. The biologic behavior is different for dogs and cats. In dogs, a rate of metastasis of 4% was found in a large retrospective study evaluating biologic behavior of intraocular melanomas. In contrast, the rate of metastasis of intraocular melanoma in cats has been reported to be between 35 and 65%. In a retrospective study describing 34 cats with diffuse iris melanoma, no significant difference was found in survival between cats with early melanoma and a control group of cats.[25] Early melanoma was defined as a melanoma involving the iris and trabecular meshwork only. A progressive decrease in survival rate was found in cats with moderate to advanced stages of diffuse iris melanoma. The presence of glaucoma in the affected was a bad prognostic indicator. Eighty percent of cats in which the affected eye had glaucoma at the time of surgery died from metastatic disease. It is important that any pigmented lesion in the iris of cats is evaluated carefully using slitlamp biomicroscopy. The lesion needs to be evaluated for degree of pigmentation, elevation above the surface of the iris, involvement of the iridocorneal angle, measurement of intraocular pressure and presence of pigmented cells in the aqueous humor. Most iris melanomas in cats are heavily pigmented, but amelanotic iris meloma is occasionally seen. Amelanotic melanoma and a focal area of lymphosarcoma can appear identical on ophthalmic examination. If the presence of an intraocular melanoma is suspected, early enucleation may prevent death due to metastatic disease. Radiographs of the chest cavity as well as abdominal ultrasound to check for metastases should be performed prior to surgery. Histopathologic examination of the globe after enucleation may further aid in the assessment of the potential for the presence of (micro) metastases.[26] Invasion of the scleral venous plexus by tumor cells, full thickness involvement of

the iris stroma and a high mitotic index are commonly seen in cats with metastases. Neoplasms limited to the anterior surface of the iris are rarely associated with metastases.

Lymphosarcoma

Lymphosarcoma is one of the most common tumors in cats. Ocular lymphosarcoma is the second most common intraocular tumor in cats. It usually manifests itself in the iris as either diffuse involvement of the iris, or a (multi)focal lesion. Involvement of the posterior segment is uncommon. Ophthalmic examination reveals the presence of pink tissue in the iris with neovascularization. Concurrent anterior uveitis is often present with aqueous flare and cells in the anterior chamber. The abnormal tissue may be either a focal raised lesion, or diffusely present in the iris. The diagnosis of lymphosarcoma can be confirmed in many cases by cytologic examination of an aqueous humor sample obtained by aqueocentesis. Evaluation of the cat for the presence of lymphosarcoma elsewhere in the body is indicated. Treatment consists of systemic chemotherapy. It is not necessary to enucleate affected eyes as the lesions usually respond well to chemotherapy. Concurrent administration of topical corticosteroids with chemotherapy is indicated if anterior uveitis is present. Secondary glaucoma may develop. Monitoring the intraocular pressure is indicated on a regular basis.

Post traumatic ocular sarcoma

Post traumatic ocular sarcoma is a rare, but potentially fatal disease in cats. This is associated with a traumatic event which usually happened many years prior to the development of the sarcoma, or chronic uveitis. Globes with trauma to the lens appear to be most susceptible to developing an ocular sarcoma later in life. Histopathologic studies have suggested that the lens epithelium is the cell of origin for feline post traumatic sarcoma. Others have suggested that these tumors may have originated in pluripotent uveal cells. Presenting clinical sign is usually leucocoria. Ophthalmic examination reveals the presence of a white to pink mass behind the iris. These are aggressive tumors, and metastases are often already present at the time of initial diagnosis. The tumor may extend through the sclera and infiltrate into the optic nerve. Blindness secondary to tumor extension into the optic chiasm has been reported.

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