Once Was Blind, But Now I See

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Introduction

Cataracts are reported most commonly in the dog, with a 2.42% prevalence seen in the last decade. The increased prevalence is due to the improved diagnostic techniques and training in veterinary ophthalmology, and increased popularity for pure breed dogs.[7] Inheritance is the most common cause of cataracts in pure breed dogs, with other causes such as diabetes, toxins, trauma, developmental disorders of the eye, nutritional deficiencies, and other ocular diseases such as uveitis, being less common in dogs. Several breeds, including the toy and miniature poodle, have a cataract prevalence greater than 10%.[7] Identification of a responsible gene can be detected through inheritance testing of animals with cataracts. A genetic cause has been demonstrated in several equine and bovine breeds, as well as over 20 canine breeds such as the Afghan hound, American cocker spaniel, bichon frise, and Boston terrier.[7]

There are many ways in which cataracts are classified. The criteria of cataracts are by stage of development (incipient, immature, mature, and hypermature), age of onset (congenital, infantile, juvenile, and senile), etiology, speed and progression, appearance (punctate, stellate, and wedge-shaped), and location (capsular, subcapsular, zonular, cortical, nuclear, sutural, axial, and equatorial).[8] The most common form of classification is by stage of development; incipient, immature, mature, and hypermature stages. These four stages can be differentiated by the presence or absence of a tapetal reflex, degree of obstruction, and visualization. Incipient cataracts contain a focal opacity and obstruction less than 10% of the lens, with presence of a tapetal reflex and visualization still present. Early immature cataracts obstruct 10-50% of the lens and still contain a tapetal reflex with mild reduction in visual acuity. Late immature stages of cataracts contain 50-90% of obstruction, evidence of a tapetal reflex, and reduced visual acuity. Mature cataracts contain 100% obstruction, absence of the tapetal reflex, and an absence of visualization. A mature cataract can progress to form a Morgagnian cataract in which the capsule becomes shrunken and wrinkled, and the lens material is in the process of liquification.[7]

Cataracts present as an increased opacity of the lens due to the buildup of insoluble proteins. This loss of transparency can be easily confused with nuclear sclerosis. Like cataract, nuclear sclerosis is a condition that causes increased lenticular opacity that can be diagnosed on an ophthalmic examination. Nuclear sclerosis is a normal lens alteration in dogs over the age of 6 years old.[9] Dogs with nuclear sclerosis have a gray to blue haze at the location of the nuclear density. This is because lens cells grow from the equator to the nucleus. Since the nucleus contains the older cells, they become tightly packed over the years, causing the nucleus to become harder and denser. Both cataracts and advanced nuclear sclerosis can be identified properly through a full ophthalmic exam with mydriatics (tropicamide 1%) and a transilluminator. The transilluminator is used to perform retroillumination, which highlights the lens by reflecting the tapetum behind it. The examiner can perform an adequate fundic examination through nuclear sclerosis. With an immature to hypermature cataract, the lens fibers are too dense and the fundus cannot be seen adequately. Not only that, with most cases of nuclear sclerosis, animals are still visual, however with advanced cases of cataracts, animals are blind or demonstrate vision loss.

History and Presentation

Major Morris, a 14-year-old male neutered Yorkshire Terrier who presented to Mississippi State University- College of Veterinary Medicine Ophthalmology Service on August 28th, 2018 for cataract surgery in the right eye. On presentation he was bright, alert, and responsive. He weighed 2.3 kilograms and was mildly thin with a body condition score of 4/9 (5 being ideal). All vitals were within normal limits (temperature: 102.6 *F, pulse: 124, and respiratory rate 28). His mucus membranes were pink and moist with his capillary refill time was less than 2 seconds. He had evidence of medial patella luxation bilaterally, a presumptive collapsing trachea due to clinical signs of a cough that could easily be elicited with light neck pressure, and renal insufficiency. No other significant findings were present at this time.

Before referral to Mississippi State University-College of Veterinary Medicine Ophthalmology Services, Major presented to his RDVM on March 3rd, 2017 where it was first noted that nuclear sclerosis was seen in both eyes on physical examination. On October 11th, 2017 the RDVM noted incipient cataracts as well as nuclear sclerosis in both eyes. Nothing was done at that time. On April 4th, 2018 the RDVM recorded dense nuclear sclerosis of both eyes. Again, nothing was done at that time. However, on June 14th, 2018, there was a mature cataract in the left eye causing blindness in that eye. This was confirmed with a negative menace response and tracking response on examination. The right eye had dense nuclear sclerosis, allowing Major to still be visual on that side. It was at that time, the owner was informed of the possibility of cataract surgery and a consultation from Mississippi State University-College of Veterinary Medicine Ophthalmology Service. On June 18th, he presented to the Ophthalmology Department where he received an evaluation for his cataracts. On June 20th, 2018 he underwent cataract surgery of his left eye and recovered uneventfully. Two months later, Major returned to MSU-CVM on August, 29th for an elective cataract surgery for the right eye due to development and progression of cataract in the right eye.

Diagnostic Approach/Considerations

There are many diagnostic tests and considerations when a dog presents for cataracts. There are inherited, congenital, traumatic, metabolic, toxic, and geriatric causes of cataracts. It is important to rule out underlying causes of cataracts prior to determining that they are hereditary.

Prior to cataract surgery, a pre-anesthetic diagnostic approach was taken, which included a complete blood count that did not reveal any significant findings and a serum chemistry that revealed a mild azotemia (BUN: 47 mg/dL, creatinine: 1.6 mg/dL) most likely due to a history of mild renal insufficiency, and a mildly decreased total protein (5.2 g/dL), but no significant findings that would prevent surgery. A urinalysis revealed a urine specific gravity of 1.030. A thorough ophthalmic examination was performed to evaluate the progression of the right cataract and to evaluate how well the left eye was doing since surgery in June. The menace response was negative for the right eye and positive for the left eye. Schirmer tear test (15 mm/min OD, 19 mm/min OS) and fluorescein staining were within normal limits. The intraocular pressure was measured with applanation tonometry and was 5 mmHg on the right eye and 7 mmHg on the left eye, which can be an indication of mild anterior uveitis. No aqueous flare was seen. Iris atrophy was present in both eyes, but a positive pupillary light reflex could still be elicited. The lens of the right eye was a mature cataract and the left eye was psuedophakic (false lens) from previous cataract surgery. The fundus of the right eye was not able to be examined due to the presence of a mature cataract, however was normal on the left side.

With no history of trauma, no elevations of blood glucose indicating diabetes, no history of being born with cataracts, Major was diagnosed with cataracts, with a presumption that they were hereditary. His ophthalmic examination suggested he was a good candidate for cataract surgery, but further testing was necessary. When animals are selected as a possible candidate for cataract surgery, an electroretinogram (ERG) and an ocular ultrasound are necessary pre-operative tests in order to evaluate the health of the retina, which is obscured by the cataract. The flash ERG tests the retinal function, specifically photoreceptors and can be used to help determine prognosis prior to cataract surgery. Like cataracts, retinopathies can be inherited and often coexist at presentation, making it crucial to perform an ERG when cataract formations obscure the retinal. ERG is a useful tool to rule out toxic causes of cataracts such as progressive retinal atrophy.[4] Progressive retinal atrophy (PRA) can cause toxic cataract formation because it has been postulated that toxic substances are released when there is a degenerating retina causing posterior lens cataract formation.[1] If an inherited retinopathy is diagnosed with an ERG, it is contraindicated to remove the cataract because surgery will not restore vision[7]. On ophthalmic examination, it is important to note that when a patient has a cataract and PRA, a pupillary light reflex is usually positive until the retinal atrophy is very advanced. Therefore, animals that are functionally blind due to retinal diseases can still show pupil response to bright light. However, these animals may have pupils that are dilated more than normal in a room because they do not react to incident light.[7] Ocular ultrasound is another important imaging technique to perform prior to cataract surgery. It is used for visualization of structures in the posterior segment of the eye. It can help diagnose retinal detachment, lens dislocation or rupture, and vitreous degeneration, which are all problems that are commonly seen with cataract formation.

At this time, Major did not have an ERG or an ocular ultrasound performed because both of these tests had been performed on both eyes for his previous cataract surgery in the left eye only 2 months prior to presentation. Normal retinal function and a normal posterior segment were seen at this time.

Pathophysiology

Major's ophthalmic exam, bloodwork, ERG and ocular ultrasound findings definitively confirmed the presence of a cataract in his right eye. The cataracts were presumed to be inherited due to his breed and exclusion of other causes. While the pathophysiology of diabetic cataracts is widely understood, the exact biochemical disorders responsible for the formation of cataracts is imperfectly understood. It is noted that anything that affects the lens metabolism such as lens nutrition, energy metabolism, protein metabolism, or osmotic balance may result in opacity. Unfortunately, once these disturbances occur, they will cause irreversible changes in lens protein contents, metabolic pumps, ionic concentrations, and antioxidant activity.[5] A multitude of events amplify and cascade such as increased numbers of non-soluble proteins in the lens, a decrease in epithelial Na^+/K^+ ATP pump, as well as diminishing antioxidant activity in the lens.[5] Proteolytic enzyme activity increases in the lens, which causes a breakdown of cell membranes as well as degradation of lens proteins.[7] All these events result in noticeable changes in the lens, which leads to an increased opacity to the lens due to lens fiber rupture, water-cleft formation, and cell death.[2] Cataracts can progress quickly, which is commonly seen in young dogs, or can remain stationary for an extended time period before progressing or interfering with vision. Whether cataracts remain stationary or progress quickly, when the cloudiness of cataractous lens does occur, light is scattered as it enters the eye, which initially results in a blurry image, and progresses to cause blindness.[10]

There are many ways in which cataracts can be classified. However, the most common method of classification is by the stage of development. Incipient cataracts are defined as a focal opacity that causes less than 10% of fundic obstruction.[8] Immature cataracts are further separated into early and late. Early immature cataracts contain 10-50% of fundic obstruction, while late immature cataracts contain 50-90% obstruction.[8] Visual acuity is reduced, however the tapetal reflection is still visible at this time. With mature cataracts, 100% of the fundic is obstructed, causing the individual to be functionally blind in that eye. There is no tapetal reflection and the fundus cannot be evaluated during this stage of development. The pupillary light reflex (PLR) and dazzle reflex are normal with a bright light, however a menace response is not present.[8]

Hypermature cataracts are defined as the time in which the lens begins to liquefy and resorb. At this stage, proteins leak through the lens capsule eventually causing lens-induced uveitis as well as a shrunken, wrinkled capsule. The total liquification of the cortex can lead to the nucleus sinking ventrally, which is called a Morgagnian cataract. If, however there is marked resorption, and no other pathology, the animal may regain a variable amount of vision, but is predisposed to several other ocular diseases, such as glaucoma, retinal detachment, and chronic uveitis that can result in phthisis bulbi in some cases.[8]

Lens induced uveitis (LIU) is a common complication that is seen with cataract development and progression, as well as following cataract surgery. Glaucoma and retinal detachment can occur secondary to cataract formation and uveitis. As mentioned above, lens induced uveitis usually forms with quickly progressing cataracts or in later stages of progression, most commonly with the mature or hypermature stage. There are two forms of LIU that are present in the dog, phacoclastic and phacolytic. Phacoclastic uveitis is inflammation of the zonal lens involving intralenticular neutrophils and perilenticular fibroplasia development due to lens capsule rupture and lens fiber leakage.[6] This can commonly happen with lens swelling, particularly with diabetic cataraction. Lens proteins cause inflammation when leaked from the lens capsule due to being protected from the immune system before birth and are therefore regarded as foreign when in the anterior chamber.[12] This inflammatory response can quickly lead to secondary glaucoma that cannot be cured with anti-inflammatories. The treatment for large lens capsule ruptures is but instead responds to early removal of the lens material.[13]. Phacolytic uveitis is the more common a form of LIU seen with cataract development where there is a slow leakage of small amounts of lens proteins through an intact lens capsule typically seen with a resorbing cataract. This form of LIU incites a mild lymphocytic-plasmacytic anterior uveitis.[13]

This type of uveitis is very common in dogs and responds well to anti-inflammatories. Overall, cataract formation and associated lens-induced uveitis in dogs are a common cause of secondary glaucoma, either at the time of cataract development or even several years after the development of cataract.[3]

And finally, retinal detachments in dogs can occur as a complication of surgery or due to other causes.[11] A retinal detachment is when there is a separation between the neurosensory retina and the underlying layer. It can form in three ways: build-up of material behind the retina, slowly detaching it, a retinal tear at the ora ciliaris, or traction on the retina from the attachment to the vitreous.[1] Many common causes include inflammation, glaucoma, trauma, and systemic hypertension. It is noted in the literature that post-operative retinal detachments due to cataract surgery are not very common at 1-2 %.[1]

Treatment and Management

Treatment for cataracts is focused on diagnosing cataracts at an early stage and monitoring for progression. The success rate for cataract surgery is improved if the surgery is performed during the immature stage. Success rates for cataract surgery are high with 85-90% of patients regaining vision.[5] Success rate depends on breed, age of diagnosis, cataract stage, and preexisting conditions such as chronicity of lens induced uveitis, retinal degeneration, and corneal disease.[5] Mitigating any other ophthalmic conditions such as uveitis, glaucoma, or corneal ulcers are imperative prior to surgery and can decrease the success rate if they are not controlled.

With Major's case it was presumed that he had hereditary cataracts. His cataract was treated through a procedure called phacoemulsification, which is the most widely accepted technique for removal of cataracts in people and animals. Phacoemulsification allows for a smaller limbial incision which results in a faster recovery and healing time post-operatively.[10] This method also decreases postoperative complications such as inflammation and patient discomfort.

The most common post-operative surgical complication is uveitis due to the immunogenicity of the lens proteins. This is almost an inevitable complication to surgery however, it can be reduced with topical and systemic anti-inflammatory medications.

On August 29th, the day of Major's surgery, a pre-surgical dilating protocol was performed that included tropicamide, flurbiprofen, and neopolydex. These were used to combat any infection, reduce inflammation, and to dilate the pupil, making access to the lens easier. After Major was placed under general anesthesia and prepared for surgery, a small incision in the limbus was performed allowing access for the probe. The probe shatters the lens through high-frequency ultrasonic waves, while debris was removed via automated irrigation and aspiration. An intraocular lens was implanted into Major's eye after the lens material was removed. This was implanted because after cataract extraction, the patient is severely hyperopic due to the loss of the refractive power of the lens. The intraocular lens that is implanted allows for post-operative emmetropia. Due to his collapsing trachea, 0.1mg of acepromazine was administered as well as 0.02 mg of hydromorphone at extubation. The rest of his recovery from anesthesia was uneventful.

To manage any post-operative complications such as uveitis and glaucoma, Major was prescribed several ophthalmic medications. The medications included Ketorolac given every 12 hours and used as a topical anti-inflammatory, prednisolone acetate 1% given every 6 hour and used as another anti-inflammatory, Timolol 0.5% given every 12 hours and to prevent elevated intraocular pressures, ofloxacin given every 12 hours as an antibiotic to decrease the chances of infection, and finally, gabapentin 25 mg capsules given orally every 8-12 hours as needed for pain.

Case Outcome

Major's vision was restored after phacoemulsification was performed. The results of cataract surgery are good with 85-90% of patients regaining vision.[5] However, over time, some patients may lose their vision due to the unpredictable nature of uveitis, failure of the owners to follow long-term treatments and rechecks, secondary complications, and more. Major's post-operative ophthalmic examination included positive results with a menace response, maze, and dazzle positive bilaterally. The fluorescein stain was negative bilaterally, the intraocular pressure was 10 mmHg on the right eye and 11 mmHg on the left. There was mild edema of the cornea on the right eye. The pupil had a miotic size, and direct pupillary light reflex and consensual were positive bilaterally. Iris atrophy was noted bilaterally. There was 2+ aqueous flare noted in the anterior chamber, the fundus was normal. He was scheduled for a recheck 5-7 days after his surgery to evaluate for any signs of inflammation, glaucoma, or any other complications from surgery. Major was discharged the day after his surgery with a better look on life.

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