# “Phac It ‘Til You Make It”

Hannah R. Robertson

Mississippi State University

College of Veterinary Medicine

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Advisor:

Becky Telle, DVM, DACVO (Ophthalmology)

**Introduction:**

Cataracts are an irreversible disease of the lens that are reported to effect 2.42% of dogs that can lead to blindness.[5] In dogs diagnosed with diabetes mellitus, it is estimated that 80% will develop cataracts within the first 16 months of diagnosis, but these cataracts may mature in just a few weeks or even days of diagnosis with diabetes. [1,2,5,6] Once cataracts are mature, patients will lose vision which often brings about the question of the animal's and owner's quality of life into discussion. Because of the management that comes along with diabetes mellitus, one study found that one out of ten pets diagnosed with diabetes would be euthanized at diagnosis and another one out of ten would be euthanized within a year due to concurrent illness.[6] Due to this, dogs diagnosed with diabetes mellitus should always be monitored and thorough eye exams should be performed to watch for the development of cataracts.[6] It is of the utmost importance to monitor canines with diabetes mellitus for concurrent ocular disease such as cataracts and communicate thoroughly with owners about the potential of cataracts.[4]

**History and Presentation:**

Cooper, an eight-year-old male neutered black Miniature Poodle, presented to the Mississippi State University College of Veterinary Medicine (MSU CVM) Ophthalmology Service on June 15, 2021 for bilateral cataracts that developed after diagnosis of diabetes mellitus in October of 2020. The owner reported that Cooper had not been able to see well for two months, but was only diagnosed with cataracts by his referring DVM two weeks previously. Cooper was being maintained on 11 units of Vetsulin every 12 hours as prescribed by his referring veterinarian.

On presentation, Cooper was bright, alert, and responsive. He was overweight, weighing 10.6 kilograms with a body condition score of 8/9. His vitals included a temperature of 103F, a

heart rate of 120 beats per minute, and he was panting. He appeared adequately hydrated and a 2/6 left systolic heart murmur was auscultated. On ocular exam, his Schirmer tear tests were within normal range (20/24 mm/min); his eyes were free of ulcers and fluorescein stain negative; and his intraocular pressures were measured at 6 mmHg in the left eye and 9 mmHg in the right eye using applanation tonometry. His slit lamp biomicroscopy and indirect ophthalmoscopy demonstrated Cooper had in fact developed bilateral late immature cataracts. This means that the fundus is not visible due to degree of lens opacification.[2] His menace and tracking tests were negative, but he was positive for his maze test in the light and his dazzle test. This meant that Cooper was mostly blind but may be able to see some shadows to get around in the light. A urinalysis was performed and trace blood was seen along with a specific gravity of 1.022, and some protein (2+) and glucose (3+) was observed. Abnormalities seen on his preanesthetic neurochemistry profile included a moderately elevated glucose (132 mg/dl), mildly elevated ALP (968 U/L), a mildly elevated bilirubin (1.1 mg/dl), and a moderately elevated CK (450 U/L). His preanesthetic complete blood count abnormalities included a high plasma protein count (9.1 g/dl). Thoracic radiographs, a urine culture, and a urine protein:creatinine ratio were recommended before surgery to ensure Cooper was a good anesthetic candidate prior to the surgery to investigate his abnormal urinalysis and his heart murmur, but these were declined by the owner due to finances.

**Pathophysiology:**

Cataracts are one of the most frequent complications of diabetes mellitus in dogs. The majority of dogs diagnosed with diabetes mellitus will develop cataracts quickly. The pathophysiology of these cataracts forming is due to excess glucose in the lens of the diabetic dog. In the healthy eye, glucose in the aqueous humor provides energy needed for the avascular

lens and is broken down via the hexokinase pathway into lactic acid.[5] When the hexokinase enzyme is overwhelmed due to excess glucose as is the case in diabetes mellitus, glucose metabolism is shifted into the sorbitol pathway.[5] Dogs have high levels of aldose reductase which is the enzyme that mediates the conversion process of glucose to sorbitol. The sorbitol then quickly is accumulated in the lens of the dog causing imbibition of water from the aqueous humor into the lens which causes the cataract to form via swelling from water accumulation in the lens of the dog. This swelling of the lens begins to cause vacuole formation in the equatorial regions of the lens, progresses to cortical streaking, and finally creates suture clefts. [6] As the lens swells, the opacity of the lens also increases which eventually can lead to total blindness in the effected dog and, as discussed earlier, a decreased quality of life in the dog and owner due to the loss of vision.

Other complications can arise due to the diabetic cataract formation. The lens is composed of 35% proteins and 65% electrolytes, with 85% of the proteins consisting of soluble proteins called crystallins. [5] As the lens becomes cataractous, the proportion of insoluble albuminoid proteins rises. [5] As the swelling of the cataractous lens continues, lens induced uveitis (LIU) may occur through phacolytic or phacoclastic means due to leaking of lens proteins or rupture of the lens, respectively. [5,6] LIU is a major complication of mature and hypermature cataracts as well as cataract surgery. [5] LIU can be medically treated using corticosteroids or NSAIDS as a topical or systemic therapy. [5] This uveitis could lead to other complications such as posterior synechia due to adhesions between the lens and iris, retinal detachment due to cellular infiltration from the choroid, and secondary glaucoma due to impairment of the aqueous humor outflow. [5,6]

**Diagnostic Approach:**

On initial presentation to MSU-CVM on June 15, 2021, two major diagnostics were performed to see if Cooper would be a good candidate for treatment of his diabetic cataracts. These tests evaluate the health of the retina to make sure there are no other underlying causes of blindness that would deem treatment of the cataracts unbeneficial. The first test was an electroretinogram, or ERG, which tests the retina's ability to respond to light entering the eye by measuring nerve impulses. An ERG is the preoperative assessment of choice for evaluating the integrity of the retinal layers in addition to an ophthalmic retinal exam. [2,3] In Cooper's case, the retina could not be observed due to the degree of opacification of his lens by ophthalmic exam, so an ERG was essential to check on the health of the retina. This test is used for early detection of progressive retinal degeneration or PRD. [2] Retinal degeneration also causes the retina to become thinner and increases the likelihood of retinal detachment following surgery. PRD does not disqualify a dog for phacoemulsification, but it can lead to blindness within months to a few years, which would be important for the client to understand before pursuing the surgery. [2] The second test, an ocular ultrasound, checks for retinal detachment, lens capsule rupture, and vitreal disease. Retinal detachment incidence increases as cataracts mature up to 19% in hypermature cataracts. [2] In Cooper's case, both of these tests came back within normal limits. The stage of cataracts is also an important factor in considering a candidate for phacoemulsification surgery. Immature cataracts have the highest success rate. [1]

**Treatment and Management:**

Cooper was sent home with ketorolac ophthalmic drops to place in both eyes every 12 hours as a topical NSAID and scheduled for a phacoemulsification surgery in two weeks on June 30, 2021. The ketorolac was prescribed to prevent lens induced uveitis that may occur due to the swollen diabetic lens leaking proteins as discussed earlier.

On June 30, Cooper was given a regime of eye drops consisting of alternating topical steroids (NeoPolyDex) to prevent postoperative infection and to prevent uveitis, ketorolac to help prevent uveitis and pain postoperatively, and mydriatics (tropicamide and phenylephrine) to dilate his eye pre-operatively. A phacoemulsification surgery was performed successfully that afternoon. The phacoemulsification surgery consisted of ultrasonic breakdown of the diseased lens, removal of the lens, and replacement with an artificial intraocular lens. There are several possible methods for extracting cataracts, with phacoemulsification being the most favored. [2,5] The phacoemulsification surgical procedure involves a small corneal incision, fragmentation of the lens and removal of the lens.[2] Intraocular lenses can then be placed in the eye to aid in vision return after cataract removal. [2] These lenses can vary from hard to soft and foldable. [2] A soft hydrophilic acrylate lens was used in Cooper's surgery.

Post operatively, Cooper was prescribed timolol drops (one drop per eye every 12 hours) and dorzolamide drops (one drop per eye every 8 hours) to prevent glaucoma, trazodone (5 mg/kg orally every 12 hours) as an anxiolytic, and a topical corticosteroids, NeoPolyDex, (one drop per eye every 6-8 hours) to prevent inflammation. Cooper was recovered in the ICU uneventfully with an Elizabethan collar. The day after surgery Cooper was moved to wards and his medication was switched to refresh eye drops (one drop per eye given 4-6 times a day), a topical steroid (NeoPolyDex) (one drop per eye given 4-6 time a day), timolol (one drop per eye every 12 hours), a systemic NSAID, carprofen, (4 mg/kg by mouth every 12 hours), and trazodone (5 mg/kg given by mouth every 12 hours). The refresh eye drops were given as an added lubricant for Cooper's eyes as anesthesia and the mydriatics given can decrease tear production, the topical corticosteroid and antibiotic combination (NeoPolyDex) was given again to help prevent uveitis in the eye following surgery and to prevent postoperative infection, the

timolol was given to prevent glaucoma in the eye and work as a beta blocker to decrease aqueous humor production, the carprofen was given as a systemic NSAID to decrease inflammation in the eye and help decrease discomfort post-operatively, and trazodone was given to help keep Cooper calm during his recovery period. These were the medications sent home with him for his owners to continue.

The success rate for phacoemulsification in dogs is 80-90%, but the surgery is not without complication. Complications in dogs can include anterior uveitis, corneal edema, transient ocular hypertension, aphakic glaucoma, hyphema, posterior capsular opacification, and retinal detachment, wound dehiscence, secondary glaucoma, and retinal detachment. [2,4] There are also intraoperative complications such as fibrin accumulation, ciliary body origin hemorrhage, bacterial contamination, and vitreous expansion and prolapse that can occur. [2] Corneal ulceration is also a risk due to intensive mydriatic therapy decreasing tear supply,[1,2] self-trauma without Elizabethan collars, and intensive corticosteroid therapy delaying healing of small abrasions on the cornea. [2]

On July 1, 2021, his ophthalmologic exam changed to a positive menace, tracking, and maze indicating that Cooper had regained his vision. Cooper was sent home July 1st and greeted his owners with excitement and a recheck was scheduled for one week later. It should also be noted that throughout his stay, Cooper was also given his prescribed 11 units Vetsulin subcutaneously unless he had not eaten in which case his blood glucose was checked and if it was above 250 mg/dL then only 5.5 units of Vetsulin was given.

Although successful in Cooper's case, surgery may not always be an option for patients with diabetic cataracts either due to finances or patient compatibility. These dogs seem to cope with blindness well and can often maneuver around their own familiar home. These patients

would still need to be monitored long term for lens-induced uveitis and be medically maintained to suppress uveitis that may occur with topical or systemic steroids and NSAIDs. [2] It should be noted that patients have a 65 times higher chance of developing glaucoma and inflammation when no medical management is given according to some studies. [6] However in 2020, a study of 100 dogs noted that there was not a higher incidence of complication between dogs that underwent surgery versus those that did not. The complications monitored for in this study included ocular surface disease, uveitis, glaucoma, or retinal abnormalities. The difference in this study than previous studies is that this study separated the dogs that did not undergo surgery into two groups: those that were candidates for surgery and owners elected against it, and those who were poor candidates for surgery. So it appears that the poor surgical candidates may have been increasing the complication rates previously notes in other studies. [4]

**Case Outcome:**

Cooper returned to MSU CVM Ophthalmology department on July 8th for his first recheck, and a full eye exam was performed including a Schirmer tear test (25/20 mm/min), fluorescein stain (negative/negative), tonometry (9/5 mmHg TV), slit lamp biomicroscopy, and indirect ophthalmoscopy. Mild inflammation was noted in both eyes with some fibrin formation. His medications were continued with a tapering dose added to his neopolydex solution to decrease in 1 week to 3 times a day rather than 4-6 times a day, and a recheck was scheduled for 2 weeks later.

July 20th, Cooper presented for his second recheck. It was noted at this time that that his tear production on his Schirmer tear test had decreased to 13/14 mm/min and Cooper was diagnosed with keratoconjunctivitis sicca, which is a common complication of diabetes mellitus and cataract surgery. His medication was changed to continue to taper his neopolydex solution to

2 times a day for 2 weeks then decreased to 1 time a day until recheck, the timolol drops were stopped, the carprofen was stopped, and the refresh eye drops were continued at 3 times a day. Optimmune (cyclosporin 0.2%) ointment was added to be given in both eyes every 12 hours to stimulate tear production in Cooper's eyes. At this appointment, Cooper was allowed to discontinue wearing his E-collar and a recheck was scheduled for 3 weeks later.

On August 19th, Cooper's Schirmer tear test had risen slightly and were within normal limits (17/17 mm/min) and his other exam parameters remained within normal limits. His inflammation was noted to have resolved and some pigment was noted at the surgical incision sites probably due to dry eye and inflammation. His medication was changed again to stop the neopolydex solution, continue the refresh eye drops at 3 times a day, and his optimmune (cyclosporin 0.2%) ointment was switched to a tacrolimus (0.03% solution) one drop per eye every 12 hours to better address the pigmentation. He was also started on diclofenac drops one drop per eye per day as an NSAID. A recheck was schedule for Cooper in 4-6 weeks.

His last recheck up to this date was on September 20th, Cooper presented for another recheck appointment. Cooper continued to have vision at this time. His Schirmer tear test remained the same and at this appointment his ophthalmic exam showed some small areas of early retinal degeneration which would be progressive and may lead to blindness over time. His medication was changed to only the diclofenac eye drops given one drop per eye once a day for inflammation, and tacrolimus (0.03% ophthalmic solution) given one drop per eye every 12 hours for dry eyes. A recheck appointment is to be scheduled 3-4 months after this appointment.

**Conclusion:**

Patients that are diagnosed with diabetes mellitus should be closely monitored for the development of cataracts. [6] Phacoemulsification surgery is an excellent way to correct cataracts

that have formed in the lens of diabetic dog eyes, but they should continue to be monitored for development of concurrent disease such as keratoconjunctivitis sicca in Cooper's case. [1,2] Although dogs often cope well with vision loss, curative surgery may improve the human-animal bond and improve quality of life for the dog and the owner such as it did in Cooper's case.

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