

Vision Without Action: Merely a Hollywood Dream

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Introduction

The precorneal film that lies on top of the cornea of the eye has the vital responsibility of protecting underlying structures and ultimately affects the vision of an equine patient. Equine patients, in particular, serve different jobs and their role plays a factor into the need for visualization. Horses may need full visual equity for cutting and seeing cattle, racing in narrow lanes or seeing as their owner works via horseback, whereas others may not require full vision for their daily lives such as broodmares or pasture pets.⁴ Any trauma or mechanical disturbances to the cornea can quickly lead to corneal ulceration, infection or and even loss of vision or globe. Therefore, diagnosing and treating disturbances of the tear film, especially in the equine species, takes critical timing and diligent examination to prevent negative sequelae that could potentially cause vision loss or lead to loss of the eye.

Signalment

“Hollywood,” also known by his registered name as Kodo Karaoke, is a 16-year-old Quarter Horse gelding that presented to his primary veterinarian in Madison, Mississippi on January 31, 2021 after being in a barn fire. After his initial triage and observation of extensive damage to the eyelids and potential ocular injuries, Hollywood was referred to MSU CVM Equine Service.

Diagnostic Examination

On arrival to Mississippi State University College of Veterinary Medicine Equine Service on February 8, 2021, Hollywood had minimal function in his eyelids bilaterally due to the burn injuries around his eyes causing swelling of the conjunctiva, crusting of the eyelid skin and pain

upon normal movement of blinking. On examination by the Ophthalmology Service, sedation with detomidine and butorphanol was needed to achieve the most optimal evaluation possible. Menace response bilaterally was decreased with approximately 80% function in the right eye and 75% function in the left eye. This was most likely because of the decreased function of the eyelids from the injury and not because his actual vision had been affected. The pupil size bilaterally was normal with appropriate direct and consensual pupillary light response. Fluorescein stain followed with slit lamp biomicroscopy was performed. Tonometry was unable to be utilized due to copious amounts of ointment in both eyes and pain elicited on manipulation of eyelids. The anterior chamber was difficult to assess but there was no obvious aqueous flare. Superficial corneal ulceration of the right eye, corneal fibrosis with possible small corneal ulceration of the left eye and lagophthalmos bilaterally from a combination of swelling of the eyelids, contracture of eyelid skin and damage to the meibomian glands the eyelids were diagnosed. At this time, meibomian gland damage was difficult to interpret due to the swelling of the eyelids, but normal meibomian glands were not appreciated on slit lamp examination.

Pathophysiology

During the entirety of Hollywood's hospital stay, he was diagnosed with destruction of meibomian glands leading to alteration of the tear film which led to rapid drying of the cornea and ulceration. In addition, he experienced contracture that causes mechanical inability to close the eyelids and spread the tears ultimately leading to exposure keratitis.

There are three major components of tear film. The most superficial layer is made up of lipids that are secreted by the meibomian glands. This layer stabilizes and prevents evaporation of the layer underneath it, the aqueous layer. The aqueous layer is the intermediate level of tear

film and is produced by the orbital gland and the gland of the 3rd eyelid. It is responsible for providing corneal nutrition and removing waste products. The third and final layer is mucus. This layer is the deepest layer of tear film. It is produced by conjunctival goblet cells and serves as the interface of tear film with the hydrophobic cornea.⁵

The meibomian glands are intricately located just inside the margins of the upper and lower eyelids. While nestled close to the surface of the cornea, they secrete meibum which consists of lipids that, when in contact with the tear film, spreads across the cornea to provide protection. Meibum also works to reduce evaporation of the aqueous component of the cornea.¹ There are roughly 40-50 glands per eyelid.² Destruction of these sebaceous glands from direct trauma, severe smoke damage or raging heat can lead to scarring of the secretory components leaving the individual without full ability to protect or moisten the cornea.

One challenge to Hollywood's treatment plan that occurred was waiting for healing of the eyelid skin. Upon arrival, no one could predict the extent of his burn injuries and how they would contribute to the function of his eyelids. As his skin healed, contracture inhibited full closure of his right eyelids, leaving him vulnerable to exposure keratitis. Exposure keratitis is inflammation of the cornea due to lagophthalmos. The cornea that does not come in contact with the eyelids during blinking will not be protected by the tear film that is spread during this act; thus, putting the exposed cornea at risk. Combine lagophthalmos with the inability to appropriately produce tear film component and the patient will be at ever greater risk of corneal ulceration.

Corneal ulcerations, no matter the size or depth, should be attended to promptly. The layers that make up the cornea in order of most superficial to deep are as follows: stratified

epithelium, collagenous stroma, Descemet's membrane and endothelium. The cell production of the most superficial layer, epithelium, is a continuous cycle since the epithelium is constantly being worn down with each eyelid movement. With rapid cell turnover and normal tear film production, it provides adequate protection for the cornea. However, without sufficient tear film spread via the eyelids with regular blinking the cornea is at risk for ulceration. A simple corneal ulceration is characterized by the ability to obtain reepithelization within 7 days. Nonetheless, for this to be able to happen, the patient must have normal function of the components that provide support to the cornea: upper and lower eyelids, third eyelid, and production of tear film.³

The factors that put the cornea at risk for ulceration include inadequate protection or excessive epithelial loss. Tear film deficiencies can be due to keratoconjunctivitis sicca, qualitative tear deficiencies or meibomitis. Eyelid dysfunctions can stem from lagophthalmos, CN V or VII paralysis, ectropion or a macropalpebral fissure. Excessive loss of epithelium can be from endogenous or exogenous causes. Trauma, foreign bodies or infectious causes fall into exogenous reasons and endogenous sources include entropion, distichiasis, ectopic cilia, trichiasis, lid tumors or blepharitis.³ In Hollywood's case, it was important to distinguish that his corneal lesions likely originated from both eyelid dysfunction and exogenous source such as smoke injury.³

Treatment

The extensiveness of Hollywood's lesions presented multiple challenges especially in addition to managing burns ranging from 1st to 3rd degree that covered 50% of his body. Initial medical treatment on February 8th included neomycin-bacitracin-polymyxin ophthalmic ointment bilaterally every 4-6 hours and amnion drops on the upper eyelid of the right eye 3-4 times a day.

The purpose behind amnion drops was to act as a protective dressing. In recent research, it has been seen to prevent contamination and fluid loss, minimize pain and ward off further trauma acting as a protective shield.⁶ On the morning of February 18th another ophthalmic examination was performed. With concern of pending infection and stromal loss, cytology of the right corneal ulcer was collected. The slide revealed numerous neutrophils and cocci. Additional medications were added to his treatment due the corneal ulceration of the right eye resembling an infectious nature with redness, pain and irregular discharge. For the right eye, ofloxacin every 2 hours, voriconazole every 4 hours, EDTA every 4 hours and atropine every 48 hours were added to his medical plan. During this exam, it was noted that the meibomian glands were mostly absent or very irregular bilaterally. However, the functionality of his eyelids had improved with the left having more improvement than the right. Optixcare Eye lubricant was initiated in both eyes every 4 hours around this time of treatment. Conventionally, a subpalpebral lavage system would be warranted in the treatment plan at this point to expedite healing; however, due to the degree of burns on his head a subpalpebral lavage system could not have been properly placed and attached with security. Placing a subpalpebral lavage system at this point might have also brought great discomfort given the nature of his skin condition.

As time passed in the hospital, regular ophthalmic examinations were performed. During the exams between February 22-February 24, the corneal ulceration in the right eye was markedly better and the eyelid function had improved to 90-100% in the left eye and 80% in the right eye when prompted. At this time, EDTA and neomycin-bacitracin-polymyxin ophthalmic ointment were discontinued. On March 2nd, no fluorescein stain uptake was noted on either eye and voriconazole and atropine were discontinued from his treatment plan.

Due to persistently decreased eyelid function of the right eye, the decision was made to perform tension relieving incisions on the upper eyelid in hopes of regaining more eyelid function. A temporary tarsorrhaphy was also placed along with the tension relieving sutures to stretch the skin. To continue having access to the eye, a subpalpebral lavage system was placed to administer medications directly on the surface of the sclera. At this point in his stay, it was safe to do so since his burns were healed enough for his skin to withstand this procedure. The tarsorrhaphy and tension relieving sutures were decided upon to provide protection to the cornea and to stretch the eyelid skin enough to allow full closure over the globe during his blink. So, on March 11th, Hollywood was sedated with a total of 7 mg detomidine and 7 mg butorphanol intravenously and it was titrated throughout the procedure. A rough surgical prep with 1:50 betadine solution was performed on the eyelids of the right eye and surrounding skin, including in areas where blocks would be performed. Carbocaine was used to perform both auriculopalpebral and supraorbital nerve blocks. A line block was performed on the upper and lower eyelids. A total of 6 mL of carbocaine was used. A 2% lidocaine gel was used on the periocular skin as well as the skin on the forehead where sutures for the subpalpebral lavage would be fixated. A cotton swab debridement was performed on the indolent ulcer of the right eye to encourage healing of the ulcer. Next, sterile technique was used to perform tension relieving incisions on the upper and lower eyelids. A #10 scalpel blade and Jaeger lid plate were used to make 10 approximately 1cm long partial thickness linear tension relieving incisions on the upper eyelid, being careful not to go full thickness and trying to avoid important muscles and nerves. Three similar incisions were made near the lower eyelid margin. Next, a dorsal subpalpebral lavage system was placed in a standard manner. Last, a lateral temporary tarsorrhaphy was placed using 0 PDS suture and IV tubing as stents. Sheets of amnion were

placed on the periocular skin. At this time, the medical treatment remained the same with the exception of medications being administered through the subpalpebral lavage system on the right eye.

By March 30th, Hollywood had regained 100% of palpebral function of both eyes. No corneal ulcerations were noted at this time although a corneal scar in the right eye was observed and will likely always be present. His ectropion of the upper eyelid of the right eye was mostly corrected with his most recent procedure as well. After this examination, optixcare eye lubricant in both eyes every 8 hours was the only treatment warranted.

When April 14th rolled around, the values of a tear film break up test were 5 in the left eye and 15 in the right eye. This non-invasive test indicates quality of tears and how long a patient can withstand having to blink due to longevity of tear production. A patient experiencing dry eye will feel the need to blink as the tears break up on the corneal surface meaning the shorter values received from this test, the lower quality of tears are being produced.

On July 20th, his final ophthalmology examination revealed no corneal ulceration with film break up time of 15-17 seconds in both eyes. Although mild scarring of his meibomian glands were still present and a small area of fibrosis was observed on his right cornea, the extent of these lesions will likely not affect his vision, but he will always be at higher risk for corneal ulceration due to his injuries. The recommended medical intervention was for optixcare eye lubricant to be administered every 8-12 hours and no further follow up exam was needed unless clinical signs occurred.

Case Outcome

On a sunny day in July, Hollywood was finally able to make his way back home to his new barn and many pasture mates of multiple species. At discharge, there was no indication that his sight was diminished, and the only concern was for potential keratitis from damaged meibomian glands. Today, Hollywood stays cozy in his immaculate middle barn stall during the day with access to the pasture starting at sundown hours. With the best care of his owners, he receives optixcare eye lubricant daily and gets to enjoy going to horse shows as support to his fellow barn mates while cheering them on from the sidelines. Although the horrifying event in January that no one saw coming was devastating, with the care from his primary veterinarian and the MSU Ophthalmology and Equine services Hollywood's future is illuminating as far as the eye can see.

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