Corneal Perforations and Iris Prolapse in the Dog

Kathryne de León

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Advisor: Caroline Betbeze, DVM, MS, Diplomate, ACVO

Introduction

Corneal damage is a common condition that can present to the small animal veterinary practitioner. With aggressive treatment and early diagnosis, minor damage to the cornea can heal without complications; however some conditions threaten the transparency of the cornea and can result in a loss of vision or the eye. Once a simple ulcer progresses to a complicated corneal ulcer, a corneal perforation can occur, resulting in an iris prolapse[8].

Corneal ulcers are caused by a break in the epithelial layer of the cornea, exposing the underlying corneal stroma. Superficial ulcers involving the loss of corneal epithelium are the most common form of corneal ulceration. Treatment is aimed at alleviating the underlying cause of the ulcer, promoting healing, and preventing a deeper bacterial infection. If an ulcer fails to heal and it reaches the deepest layer of the cornea, or Descemet's membrane, this indicates that the epithelial and stromal layers of the cornea have been destroyed. This defect is commonly referred to as a descemetocele. A descemetocele can lead to a corneal perforation, and potentially an iris prolapse which severely threatens the globe and vision[1].

A corneal perforation with an iris prolapse should be treated as an ocular emergency, and surgical treatment is recommended for the best prognosis. Surgical treatment involves debriding the necrotic tissue of the iris and cornea and placement of a corneal or conjunctival graft to provide stability to the perforated cornea. A xenograft is placed over the defect, followed by a conjunctival graft in order to provide support and nutrients to the cornea[1]. Medical therapy is also usually continued to treat corneal infection and prevent pain.

History and Presentation

Corneal perforations are caused by the continued progression of a corneal ulcer, descemetocele, or trauma. Corneal ulcers are the result of a break in the epithelial layer of the cornea which leads to the exposure of the underlying corneal stroma. A corneal ulcer results in significant pain typically manifested as blepharospasm, protrusion of the nicititans, lacrimation, and miosis. Additional signs include corneal edema, conjunctival hyperemia, photophobia, and aqueous flare[1]. Causes of corneal ulceration include trauma, tear deficiencies or defects, irritants, foreign bodies, and eyelid or eyelash abnormalities. In addition to trauma or deficiencies related to the eye, some canine breeds are more prone to corneal defects than others. Four conformational risk factors present in brachycephalic breeds make them 20 times more likely to develop a corneal ulcer compared to non-brachycephalic dogs. These four conformational risk factors include the presence of a nasal fold, the width of the palpebral fissure relative to the length of the cranium, brachycephalic skull morphology, and scleral exposure[7].

Once the ulcer reaches the depth of Descemet's membrane (the basement membrane), the epithelial and stromal layer has been destroyed, and the defect is medically defined as a descemetocele[1]. A descemetocele is identified by looking for a translucent, bulging 'blister' at the base of a deep ulcer, which is confirmed with a fluorescein stain, revealing a characteristic ring of stain, or a "donut". Since Descemet's membrane is only 10 microns thick, it can easily rupture resulting in a release of aqueous humor. This in turn can cause iris prolapse and anterior synechiae[3]. With the development of a corneal perforation, it is important to perform a full ophthalmic exam to establish the patient's vision. If the patient does not have a menace response, a consensual pupillary light reflex, or dazzle reflex, the prognosis for vision is poor following surgical correction[1].

Dogs presenting with an iris prolapse and corneal perforation can present with a pigmented mass protruding out from the eye at the corneal perforation site, which is the tissue of the iris. In acute phases, a fibrin plug may be present, impeding leakage of aqueous humor[1,8]. Additional clinical signs that can be seen with an iris prolapse include epiphora, blepharospasm, photophobia, and conjunctival hyperemia.

There are several causes of corneal ulcers that can lead to a corneal perforation and iris prolapse if left untreated. Eyelid abnormalities such as distichia, ectopic cilia, trichiasis, entropion, and eyelid tumors can cause non-healing corneal epithelial defects. It is important to examine eyelids under magnification for abnormal hairs or conformation disorders of the lid margins. Keratoconjunctivitis sicca (KCS) is a deficiency in the aqueous portion of the tear film, and can cause superficial or deep corneal ulcers. Exposure keratitis develops secondary to lagophthalmos in the brachycephalic breeds, predisposing patients to corneal ulcers[5].

Anatomy and Pathophysiology

The outer, fibrous coat of the anterior aspect of the eye is the composed of the transparent cornea. The cornea has four layers: the epithelium, the stroma, descement's membrane, and the endothelium. The corneal stroma consists of keratocytes, collagen, water, glycosaminoglycans and constitutes 90% of corneal thickness. The basement membrane of the endothelium is known as Descemet's membrane. Below Descemet's membrane is the endothelium, a layer that is one cell layer thick and prevents influx of aqueous humor into the cornea from the anterior chamber[3].

The cornea transmits 90% of the light that strikes it and serves as a protective layer for the intraocular contents, therefore is it imperative for vision that the cornea remains healthy and transparent[9]. The corneal epithelium has a high regenerative capacity. Once the cornea has been injured, epithelial cells begin to cover the lesion. When the epithelial layer is reestablished, the

new epithelial layer is attached to the basement membrane. This process allows the cornea to epithelialize within 4 to 7 days. If an ulcer fails to heal within 7 days, healing is considered abnormal and the corneal ulcer is classified as "complicated" or "non-healing". Once an ulcer becomes non-healing, it can be distinguished by three different categories: the underlying cause of the ulcer was undiagnosed or untreated, the ulcer has become infected by bacteria, or the ulcer has become indolent[4].

An iris prolapse is a common sequela to penetrating corneal wounds or ruptured corneal ulcers. The defect in the cornea allows aqueous humor to escape and the iris is carried forward through the perforation, forming an anterior synechia. An iris prolapse appears as a mass of pigmented tissue on the cornea[6]. It is important to distinguish an iris prolapse from a foreign body[1]. Once the iris passes through the defect, the vascular supply of the iris can be compromised and cause venous congestion and edema. Additionally, prolapsed tissue can allow bacteria to enter the eye[3,6].

Diagnostic Approach and Considerations

To diagnose a corneal ulcer, two types of stains are used. Rose Bengal is a stain used to identify very superficial ulcers that are limited to the corneal epithelium. Ulcers that have progressed through the epithelial layer to the stroma will stain with green with fluorescein[6]. Since a common cause of corneal ulcers includes KCS, a schirmer tear test (STT) should be performed to evaluate tear production and determine whether treatment for KCS should be considered[3]. Finally, deep ulcers can be characterized by a fungal or bacterial infection. Infectious agents secrete collagenases and proteases that break down stromal collagen and the cornea. Through this mechanism, complicated ulcers can quickly progress to a corneal perforation or descemetocele. It is important to perform a corneal culture and cytology of

progressive or stromal corneal ulcers to determine the correct antibiotic treatment and whether antifungal medications are necessary[6].

If the cornea is perforated, the Seidel test helps determine the presence of a perforation. The Seidel test is performed by applying a single drop of fluorescein directly onto the perforated site. The cornea is then observed to see whether aqueous flows clearly through the orange fluorescein, if it does, the perforation is present and has not sealed[1]. An iris prolapse is diagnosed by visualizing a pigmented mass on the surface of the cornea, which indicates that the iris has attempted to close the defect in the cornea[8].

Treatment and Management

Medical Management of Corneal Perforations

Most superficial ulcers should heal quickly within approximately 7 days and are prophylactically treated with topical antibiotics, cycloplegics, and oral nonsteroidal anti-inflammatory drugs (NSAIDs) for pain relief. Once the ulcer has progressed to a descemetocele or corneal perforation, medical therapy should be instituted prior to, and post surgery. Medical treatment of corneal perforations and descemetoceles is similar to that of a simple corneal ulcer. First, it is important to identify, and if possible, correct the cause of the descemetocele or perforation. As with simple ulcers, due to the disruption of the epithelium and stroma, the globe is predisposed to infection. Therefore, topical treatment with a broad spectrum antibiotic (ofloxacin, cefazolin) should be instituted. Due to the severity and risk of globe rupture, antibiotics should be applied every 1-2 hours. Antibiotics should be administered in the form of drops rather than ointments because the petroleum vehicle used in topical eye ointments can cause a severe granulomatous uveitis if it enters the eye. Systemic antibiotics are indicated with

corneal perforations because of the increased risk of endophthalmitis. They can also help to treat corneal ulcers if the cornea is heavily vascularized[3].

Mydriatics are used to treat ulcers to prevent a reflex anterior uveitis and painful ciliary body spasm. By reducing pain, mydriatics, such as atropine 1%, can help prevent animals from rubbing their eyes and risking globe rupture. However, in cases of corneal perforations with iris prolapse, mydriatics should be used cautiously before surgery can be performed because they can cause a prolapse to move, resulting in an open perforation. Systemic NSAIDs should be used to reduce corneal white blood cell infiltration and pain. Finally, prevention of further self-trauma with an Elizabethan collar can prevent the patient from rubbing its eye, causing a globe rupture[3].

Surgical Management

Once a complicated corneal ulcer has progressed to corneal perforation and iris prolapse it is considered an ocular emergency and surgical intervention is needed. First, the iris prolapse must be replaced. The adhesions between the protruded iris and cornea must be gently separated and any necrotic tissue must be debrided. Once debrided, the iris is placed in its normal position[8]. Conjunctival grafts are commonly used in corneal surgical procedures due to their healing rate and versatility in many corneal conditions. Conjunctival grafts provide structural support to the injured cornea as well as bring blood supply and nutrition to the corneal lesion. Additionally, grafts provide a continuous supply of serum containing growth factors and a source of fibroblasts that form collagen[3]. Many variations of conjunctival grafts exist such as the pedicle, advancement, and complete grafts. The decision to perform one graft over the other usually depends on the surgeon, the size of the defect, and the blood supply necessary for healing. Before the graft is placed, it is important to debride all necrotic tissue to avoid graft failure due to infectious agents or corneal malacia[4].

Xenografts placed on the corneal defect before conjunctival flaps are useful in the repair of full-thickness corneal wounds. In the past, graft materials used in veterinary medicine included fresh or frozen corneal tissue, however recently porcine small intestine submucosa (SIS) has gained popularity. SIS is used as a natural bioscaffold and helps provide additional structural support and brings additional blood supply to the compromised cornea. SIS is an inexpensive biomaterial and studies have shown that placement of an SIS graft is suitable for the repair of full thickness corneal wounds[2].

Expected Outcome and Prognosis

The prognosis of a corneal perforation and iris prolapse is dependent on time of intervention, size, presence of vision at the time of surgery, owner compliance, and appropriate surgical treatment by an ophthalmologist. Use of a xenograft such as SIS, with a conjunctival graft aids in healing. Prognosis for vision and cosmetic appearance in cases of prolapsed irides is fair to good if the damaged cornea is repaired and the intraocular structures are not damaged by trauma[8]. Absence of a menace response, consensual pupillary light reflex, or dazzle reflex indicates a poor prognosis for vision of the globe following surgical correction[1]. Complications associated with an iris prolapse are uveitis, endopthalmitis, anterior synechia, corneal endothelial pigmentation, and dehiscence of the flap [8].

Conclusion

In conclusion, corneal perforations are considered ocular emergencies and the best prognosis is obtained with surgical treatment. Common causes of corneal perforations are complicated corneal ulcers or traumatic corneal lacerations, therefore it is important to correctly treat, diagnose, and monitor simple corneal ulcers for progression in a patient. Prompt diagnosis and surgical treatment leads to a good prognosis.

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