Infectious Bovine Keratoconjunctivitis

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Abstract

Infectious bovine keratoconjunctivitis (pinkeye) plagues up to 80% of the herds in the United States. Calves are more affected than adult cattle resulting in devastating losses in average daily gain. On average, calves affected with IBK will weigh 15-30 pounds less at weaning and often bring a reduced price at sale depending on the severity of the condition and degree of visible ocular damage. The cattle industry has an estimated annual loss of $150 million from IBK due to production losses, lost revenue at sale, and treatment costs. Many different treatments have been tried with comparable efficiency. Early diagnosis and treatment is key to decrease the severity of clinical disease in an individual animal and the transmission within a herd.

Keywords

Pinkeye

Infectious bovine keratoconjunctivitis

Text

Infectious bovine keratoconjunctivitis (IBK), more commonly referred to as pinkeye in cattle, is a contagious bacterial ocular infection characterized by pain, ocular discharge, corneal edema, and corneal ulcers. The causative organism is spread when noninfected animals come in contact with ocular discharges of animals infected animals. Although not a nonfatal disease, IBK can have a devastating impact on cattle production and welfare.

The highest incidence of disease is in late summer and early fall, correlating with the increase in fly populations, plant growth, pollen production, and an abundance of UV light. The condition can affect up to 80% of the herd. Calves are more susceptible than adults, as adult cattle have often developed immunity following previous infection(s). *Bos taurus* cattle appear to be more susceptible to pink eye than *Bos indicus* cattle. Bull calves tend to be affected more commonly than heifers. On average, calves affected with IBK will weigh 15-30 pounds less at weaning and often bring a reduced price at sale depending on the severity of the condition and degree of visible ocular damage. The cattle industry has an estimated annual loss of $150 million from IBK due to production losses, lost revenue at sale, and treatment costs.

Etiology

The most common causative agent of IBK is a gram-negative rod, *Moraxella bovis.* The organism possesses hair-like structures on the surface of the bacterial cell called pili, which facilitate the attachment of the organism to the surface and colonization the cornea. Two specific pili are known, Q and I. The Q pili facilitate attachment to the corneal surface, while I pili facilitates maintenance of infection. It this theorized that Q pili may convert to I pili once the initial attachment has occurred, facilitating maintenance of the infection. Attachment of bacteria to the cornea and conjunctival surfaces results in conjunctivitis and keratitis.

M. bovis also produces hemolysins which are toxic to neutrophils recruited to combat the infection. Degenerating neutrophils release collagenases which induce the liquefaction (melting) of the cornea. Corneal inflammation associated with M. bovis infection frequently progresses to formation of a corneal ulcer and can potentially lead to rupture of the bulbus oculi, resulting in blindness. Strains of *M. bovis* which do not possess pili or hemolysins are non-pathogenic. Other potential virulence factors of *M. bovis* includes phospholipases, outer membrane proteins, iron acquiring systems, and proteolytic and hydrolytic enzymes.

Clinical cases of pinkeye most commonly occur in the summer through the early fall. Environmental factors including seed awns, pollen, dust, sunlight, wind, and high ammonia can increase the risk of developing IBK by irritating the conjunctiva and disrupting the integrity of the corneal surface, facilitating the attachment of *M. bovis*. Ocular irritation also increases tear production and the associated epiphora can attract face flies which readily spread the organism.

Transmission

Infection of animals occurs following contact with ocular secretions containing *M. bovis* bacteria. The major vector for disease transmission is usually the face fly (*Musca autumnalis)* but inanimate objects (fomites) can also spread the infectious organism.

Face flies are attracted to ocular and nasal discharges and readily transmit the bacteria to naïve animals. Face flies efficiently spread the bacteria as they often feed on the ocular secretions of several animals in one day, facilitating rapid spread through a herd.

Asymptomatic carriers may harbor the organism for up to one year and provide a constant reservoir of infection. Young animals are more susceptible to disease as older animals typically develop surface immunity following exposure as a calf.

Predisposing Factors

Predisposing factors include dusty conditions, the presence of flies, physical irritants such as tall grasses and weeds, lack of pigmentation around eyes, and exposure to bright sunlight. Nutritional imbalances, such as deficiencies in protein, energy, vitamins, and minerals, can influence the disease outcomes.

Clinical Signs

Clinical signs can include conjunctivitis, chemosis, excessive lacrimation, corneal edema, ocular pain, blepharospasm, epiphora, photophobia, corneal ulceration, corneal rupture, and blindness. Ocular pain and visual impairment can cause reduced appetite and feed intake due to discomfort or an inability to locate feed. Minimizing the impact through preventive measures and cost-effective treatments are important measures for lessening the impact on the producers' bottom line.

The course of the condition may vary for days to weeks with recovery taking three to five weeks. Most cases of IBK heal with minimal to no loss in vision, however, severe cases can result on corneal rupture and blindness. Prospective breeding bulls with lost vision are limited their future reproductive capacity, which can affect the financial and genetic future of the operation.

Four stages of IBK are described. Although the condition may resolve during any one of these stages, severe cases may progress through all four stages.

Four Stages of the Disease

Stage 1. Animals in this stage have excessive tearing and photophobia. Affected animals tend to seek shade and spend less time grazing. Inflammation to the eye will result in frequent blinking and injected sclera. A small centrally located ulcer often develops as the condition progresses, appearing as a small white spot. Corneal edema may result in a cloudy grayish appearance to the ocular surface. The condition can be unilateral or bilateral. Pain associated with this stage may decrease feed intake and time spent grazing, reducing daily gains.

Stage 2. The clinical signs in this stage are the same as stage 1 with progression of the corneal ulceration. The cloudy area in the cornea will enlarge as the disease state progresses. Portions of the iris are still visible through the anterior chamber, but vision can be impaired. Blood vessels migrating across the cornea from the limbus at a rate of approximately 1 millimeter per day aid in healing of the ulcer. This neovascularization imparts a pink or red color to the eye and led to the disease being known colloquially as “pink eye”.

Stage 3. Ulceration progresses to cover much of the cornea at this stage of clinical disease. Inflammation spreads to the interior of the globe and fibrin and white blood cells accumulate within the anterior chamber. The accumulation of inflammatory products results in a yellow discoloration of the globe and blocks the examiners view of the typically brown pigment of the iris.

Stage 4. The ulceration extensively covers the cornea in its entirety in Stage 4. In some cases, the iris protrudes into the ulcerated cornea and adhesions form between the iris and cornea. Impairment of internal drainage of the anterior chamber can lead to glaucoma and partial to complete blindness. In severe cases, the globe may rupture resulting in permanent blindness. Typically, enucleation is recommended for this stage of disease.

Corneal Scarring. After healing of the corneal epithelium, the blood vessels may remain visible for a variable period of time, along with the blue to white cloudy opacity to the cornea. The majority of cornea will eventually become transparent but there is typically a persistent white scar at the site of the initial ulceration which may impair vision slightly. Vision never returns to eyes of Stage 4 cases in which the globe ruptures.

Diagnosis.

Diagnosis is most commonly based on typical clinical signs and the characteristic central ulceration. In herd outbreaks, it can be beneficial to perform culture and sensitivity testing to facilitate accurate treatment options. The best samples to submit are conjunctival swabs and lacrimal secretions. Samples should be plated onto blood agar within 2 hours of collection for maximum sensitivity of detection.

Fluorescent antibody test on lacrimal secretions can sometimes be used to demonstrate the causative organism.

Concurrent culture for *Mycoplasma* should be considered in cases where a herd outbreak is not responsive to treatment.

Treatment.

Early identification and treatment are critical to salvaging the eye. Treatments plans should always include methods to reduce transmission and bacterial shedding. If possible, animals with clinical signs should be isolated to minimize decrease transmission in the group.

Available treatments include an array of local and systemic agents. Topical products such as ointments or sprays are effective when applied multiple times per day but may be too labor intensive for the average producer. It is important to remember that many commercially available ophthalmic ointments contain medications which are prohibited for use in food animals.

In the early stages, systemic antibiotics are often effective in treating IBK and perhaps in minimizing shedding of the infectious organism. *M. bovis* is susceptible to oxytetracycline, ceftiofur, tulathromycin, and florfenicol at labeled dosages.

Although labor intensive, administration of antibiotics or antibiotic/corticosteroid mixtures by sub-conjunctival injection is widely practiced. Procaine penicillin G is the most commonly used antibiotic. Dexamethasone or other corticosteroids are often included, particularly in cases where the corneal epithelium is not disrupted.

If the ulceration has become severe, it is necessary to protect the eye from flies, UV light, tall grass, and other irritants. Application of eye patches, third eyelid flaps, or tarsorrhaphy can provide good protection with minimal discomfort.

Studies have consistently shown that although treatment will reduce healing time and decrease the discomfort in the animal, it does not prevent decreased weigh gains in affected animals.

Prevention

Prevention should be centered on decreasing the transmission of the bacteria, making fly control essential. A moderate fly infestation is characterized as 10-20 flies per animal during the middle of the day.

Fly control can be difficult and frustrating. On most farms a single fly control system is ineffective. Implementing an integrated fly control program that addresses egg, larval, and adult life cycle stages can greatly decrease the incidence of IBK within a herd but can be time consuming for a producer.

Insecticidal ear tags (Fly tags) are an excellent product when used correctly. Newer tags provide a higher concentration of insecticide. Most tag labels require two tags per adult animal and one per calf for adequate control. Application of an insufficient number of tags can potentially lead to insecticidal resistance in the fly population, making control in future years more difficult.

If fly tags are put in too early in the year, there will be a decrease in late season effectiveness. It is important to remind producers that tags should stay in for 3-5 months and must be removed to minimize development of insecticide resistance.

Pour-on deworming products do aid in fly control, however it is important to remember that using these products multiple times throughout the year will favor in internal parasite resistance to the drug.

Dusters or rubs provide an economical approach to fly control but to have many disadvantages. Strategic placement of dusters is critical- they must be placed in areas where cattle will have to move through, need to have draped curtains to contact the face, and require maintenance.

Sprays can be effective if done several times during the fly season but are hard to apply if cattle are grazing larger pastures.

Feeding of a larvicidal or growth inhibitor products is a common practice for many producers targeting the larva form of the fly that hatch from egg that are laid in feces. These products should be mixed into rations 30 days prior to fly emergence and feed continuously until 30 days after a killing hard frost. One caveat is that face flies can travel up to 2 miles. Therefore, if the neighbors are not using these products, there may appear to be a poor response due to fly migration. Promoting dung beetles which breakdown the feces will also decrease the survival rate of the larval stage.

Commercial and autogenous vaccinations are available for producers to use. Most commercially available vaccines target the pilus antigen, however there is a great antigenic variety among these surface organelles. Experimental evidence has yielded mixed results on efficacy for prevention of clinical disease.

Biosecurity is always necessary in the control and prevention of any disease. Remember to isolate new additions or animals which have been transported and are returning to the property for a minimum of 30 days.

It is important not to forget environmental factors which can contribute to the disease state. Pasture maintenance will aid in controlling incidence of disease. Tall grasses, seedheads, and weeds can facilitate ocular irritation. Mowing of pastures in May after seedheads develop and mid-summer when the weeds have emerged as well as providing adequate space around bunks and hay feeder will reduce the risk of irritation. Mineral feeders, bunks, and hay rings should be routinely inspected for frayed or rough edges which could damage the corneal surface.

The vaccination program on the farm should include a modified live IBR vaccine. IBR infections increase the risk of *M. bovis* colonizing on the corneal surface.

In attempts to decrease the sensitivity to UV light, producers of white-faced cattle have started to select animals with pigmented eyelids.

IBK will continue to be a problem in the southeast. A well-formulates prevention and treatment program will greatly decrease the losses of animals and minimize production losses in a herd.

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