Wayamba Journal of Animal Science – ISSN: 2012-578X; P1603 - P1609, 2017
First Submitted November 20, 2017; Number 1511874342

EFFECT OF DIFFERENT TREATMENT PATTERNS ON INFECTIOUS KERATO-CONJUCTIVITIS IN GOATS

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Infectious kerato-conjunctivitis (IKC) is a highly contagious disease in goats. The present study was conducted to investigate the effects of combining antibiotics and an anti-inflammatory drug to treat IKC in goats. A total of 77 clinically diseased goats were treated using seven different methods at the SAQ teaching veterinary hospital, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh from April 2010 to September 2012. The goats were divided randomly into seven groups with the following treatments: Group A: silver nitrate solution (1%); group B: chloramphenicol eyedrops (1%); group C: subconjunctival injection of oxytetracycline; group D: chloramphenicol eyedrops and subconjunctival injection of oxytetracycline; group E: chloramphenicol eye drops and subconjunctival injection of dexamethasone; group F: chloramphenicol eyedrops and subconjunctival injections of dexamethasone and oxytetracycline; and group G: subconjunctival injections of dexamethasone and oxytetracycline. Silver nitrate (1%) and the chloramphenicol eyedrops were applied twice daily, and all injections were administered on alternate days up to day 18. Subconjunctival injections of dexamethasone and oxytetracycline or chloramphenicol eyedrops significantly ($P < 0.05$) reduced IKC in goats compared with that in the other treatment groups. However, this infection was observed throughout the year in wave motion, and the incidence was highest from July to September. Females 1–12 months of age goats were subject to infection more frequently than males of all ages. These findings suggest that subconjunctival injections of dexamethasone and oxytetracycline or chloramphenicol eyedrops are useful as standard prophylactic treatment for conjunctivitis in goats with IKC.

Keywords: Infectious kerato-conjunctivitis, subconjunctival injections, dexamethasone

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Infectious kerato-conjunctivitis (IKC) is recognized worldwide as “pink eye” and causes inflammation inside the eyelids. The disease usually involves only the surface of the eye. Many descriptions of the clinical signs of the disease have been reported. An animal that develops IKC will frequently only have one eye infected initially, and the other eye may become cross-infected later. This disease is highly contagious and can infect up to 80% of a herd within 3 weeks.

A number of etiological agents have been proposed to cause IKC, some of which appear to be primary pathogens and others are secondary invaders. Among them, a variety of mechanical irritants to the conjunctiva and cornea, such as dust, tall grass, and grass seed, have been implicated in the pathogenesis of IKC (Samra et al., 2016). *Mycoplasma* and *Chlamydia* are believed to be the most common causes of IKC in small ruminants, such as goats. *Mycoplasma conjunctivae* experimentally induce IKC in sheep and goats (Al-Rammahi and Al-Fatlawy, 2012). In addition, *Rickettsia* and *Branhamella sp*. and other bacteria, such as *Escherichia coli and Staphylococcus aureus*, play a secondary role in increasing the ocular reaction.

A wide variety of topical and parenteral drug preparations have been used to treat eye diseases. Topical applications include eyedrops, ointments, gels, and emulsions and remain the preferred option due to their ease of administration and low cost. Drug absorption by the conjunctiva is limited compared with that in the cornea due to the presence of conjunctival blood capillaries and lymphatics, which cause significant loss of drug into the systemic circulation, thereby lowering ocular bioavailability (Gaudana et al., 2010; Palani et al., 2010); however, ophthalmic ointments are more persistent in the conjunctival sac than solutions (Piercy, 1985)]. The inflammatory reaction cascades continually during an IKC infection, and the inflammation aggravates the condition. Thus, decreasing inflammation usually improves IKC. Some reports indicate that oxytetracycline ointment is useful to eliminate *Rickettsia* within 3 days from eyes treated at the early stages and within 2–3 weeks from those at the advanced stage. A chloramphenicol eyedrop preparation has also been used effectively as a broad-spectrum antimicrobial agent against a wide range of bacteria, including *S. aureus*, *Pseudomonas sp.*, *Proteus*, and many coliform bacilli (Elton, 2005; Balamurugan et al., 2012). Reports of using an anti-inflammatory drug along with an antibiotic during the course of IKC treatment are scarce (Rajesh et al., 2009). The effect of topically administered corticosteroids on ocular diseases in goats has not been investigated. Additionally, it is important to determine whether combined administration of a corticosteroid and antibiotic eyedrops changes the efficacy of the topical antibiotic treatment. Therefore, the present study investigated the effect of an anti-inflammatory drug and antibiotic for treating IKC in goats.

MATERIALS AND METHODS

A total of 77 clinically diseased goats were examined at the SAQ teaching veterinary hospital, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh from April 2010 to September 2012. Age, sex, breed, and other factors described by Balamurugan [8] were recorded for the affected goats. IKC was characterized by scleritis, keratitis, and white opacity of the cornea with copious lacrimation. The goats were divided randomly into the following treatment groups: Group A: silver nitrate solution (1%); group B: chloramphenicol eyedrops (1%); group C: subconjunctival injection of oxytetracycline; group D: chloramphenicol eyedrops and subconjunctival injection of oxytetracycline; group E: chloramphenicol eye drops and subconjunctival injection of dexamethasone; group F: chloramphenicol eyedrops and subconjunctival injections of dexamethasone and oxytetracycline; and group G: subconjunctival injections of dexamethasone and oxytetracycline. Silver nitrate (1%) and the chloramphenicol eyedrops were applied twice daily, and all injections were administered on alternate days up to day 18.

Statistical analysis

The data were obtained from hospital case records held in a Microsoft Access database and transferred to Excel 2007 (Microsoft Inc., Redmond, WA, USA). Descriptive statistics were conducted to examine the frequencies and annual patterns of IKC. Three years (2010–2012) of data were aggregated into monthly estimated numbers of diagnosed cases. Causal associations between factors, such as breed, age, and sex, were assessed using the χ^2 Fisher's exact test. Effectiveness of the treatment was analyzed by one-way analysis of variance, followed by Duncan's multiple range test. Data are presented as mean ± standard error. A P-value < 0.05 was considered significant.

RESULTS

During the study period (2010–2012), 77 goats infected with IKC were admitted to the veterinary hospital. Among them 15, 20, and 42 animals were admitted in 2010, 2011, and 2012, respectively. Figure 1 illustrates the monthly distribution of clinical IKC cases in the hospital. Regarding the animal admission pattern, there was a wave of admissions throughout the year, and July and August had higher incidences of IKC cases than those in the other months throughout the study period. Table 1 shows that there was no difference between the numbers of Jamunapari and black Bengal goat-infected cases among the different age categories. However, Jamunapari goats (58.44%) were

Tabele-1: Distribution of IKC according to age, breed and sex of affected goats

Parameters		No. of animals were affected with IKC in regards to age category (month)				Total (%)
		1-12	**>12-24**	**>24-36**	**>36**	
Breed	Jamuna Pari	15	22	4	4	45 (58.44)
	Black Bengal	16	9	3	4	32 (41.56)
	P value	*0.1632*	*0.0986*	*1.0000*	*0.7120*	
Sex	Male	13	5	1	2	21 (27.27)
	Female	18	26	6	6	56 (72.73)
	P value	*0.0215*	*0.1164*	*0.6664*	*1.0000*	

Table-2: Effects of different treatment patterns on IKC in goats

Treatment group	Number of animals treatment	Number of animal cured (%)	Average time need to cure (day) Mean ±SEM
Group A	11	7 (63.64)	20.64 ± 1.09^{a}
Group B	12	9 75.00)	15.33 ± 0.61^{b}
Group C	8	6 (75.00)	13.88 ± 0.64^{bc}
Group D	8	6 (75.00)	12.38 ± 0.38^{cd}
Group E	12	10 (83.33)	8.58 ± 0.19^{e}
Group F	17	14 (82.35)	8.65 ± 0.19^{e}
Group G	9	7 (77.78)	10.11 ± 0.31^{e}

Values with different superscripts within same column are significantly different ($P<0.05$). The data are mean± SEM.
Group A: Silver nitrate solution (1%),
Group B: Chloramphenicol eye drop (1%),
Group C: Inj. Oxytetracycline (subconjunctival),
Group D: Chloramphenicol eye drop + Inj. oxytetracycline (subconjunctival),
Group E: Chloramphenicol eye drop + Inj. Dexamethasone (subconjunctival),
Group F: Chloramphenicol eye drop and Inj. Dexamethasone + Inj. oxytetracycline (subconjunctival),
Group G: Inj. Dexamethasone and Inj. Oxytetracycline (subconjunctival).

admitted more frequently than black Bengal goats, and females tended to be more prone to infection with IKC than males, although no significant difference was detected. However, only 1-year-old female goats were more susceptible to IKC than male goats ($P < 0.05$).
In this study, seven treatment groups were used to treat IKC in goats (Table 2). Among them, the mean time to cure was significantly ($P < 0.05$) shorter in the combined treatment groups than that in the single treatment groups, except in group D. However, mean time to cure was significantly ($P < 0.05$) shorter in groups E, F, and G within the combined treatment groups than that in group D. The range of the time to cure IKC with the combined treatments was 8.58 ± 0.19–12.38 ± 0.38 days.

DISCUSSION

Identifying infected animals in remote segments of their habitat under free-ranging conditions is difficult. This infection may have occurred several weeks before the first infected goat was observed, and the *M. conjunctivae* infection would have likely already spread within the entire herd. The ocular lesions began as conjunctivitis and progressed to deep keratitis within a few days. However, spontaneous recovery may have occurred in some cases. Therefore, culling affected animals is an inappropriate

Fig. 1. Keratoconjunctivitis of a goat, a) day 1-before treatment, severe lesion on conjunctiva, reddening and whitish of conjunctiva; b) day 3 the reddening is reduced and, c) day 6, reddening is disappeared and the pupil was visible.

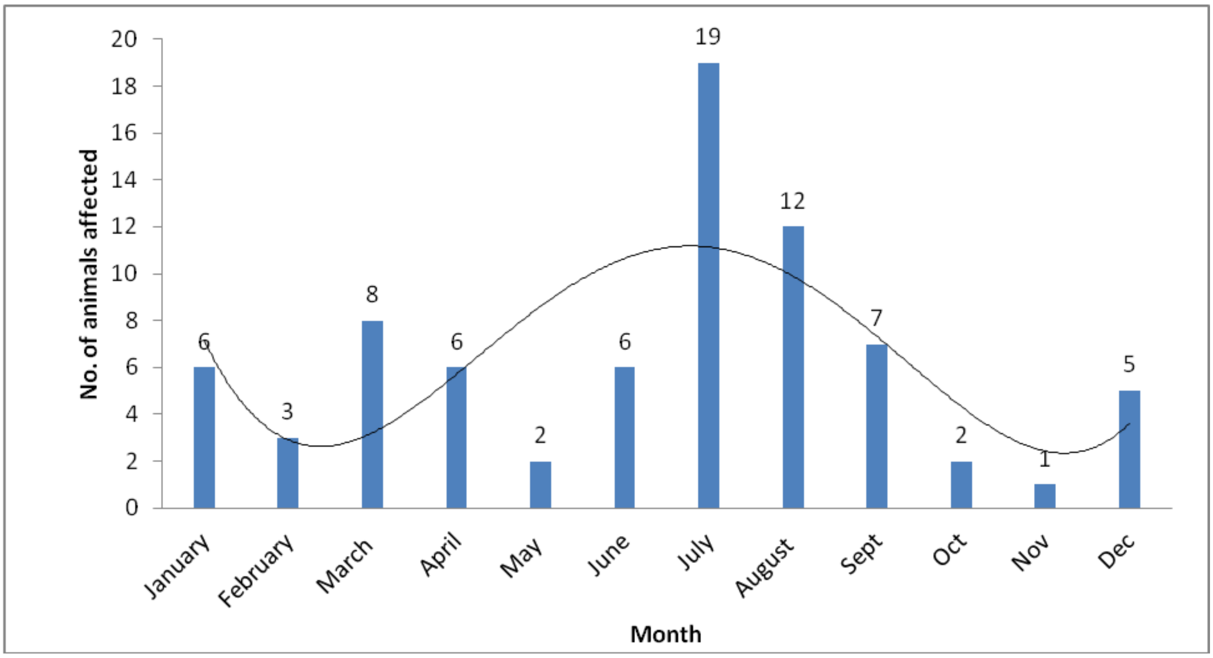

Fig. 2. Distribution of IKC according to different month (April, 2010 to September, 2012).

disease control method. Several treatment strategies have been used to treat IKC in cattle, sheep, goats, and other species; for example, topical and systemic antibiotics and a non-inflammatory drug help this condition to subside. In general, a histological examination is important to rule out postmortem degeneration, which may help with the correct diagnosis. Inflammatory cells infiltrate the conjunctiva during an infection of the eye with *Mycoplasma sp.*, which primarily consist of macrophages and some plasma cells, lymphocytes, and polymorphonuclear leukocytes. The cornea showed slight intracellular edema with an intense mixed-cell infiltrate in the anterior half of the stroma. Mild keratitis is characterized by either edema with accompanying neutrophil infiltration or by prelimbic neo vascularization with mostly mononuclear inflammatory infiltration. Neo vascularization occurs in response to a variety of cytokines released by damaged corneal epithelium, stromal keratocytes, or immigrant leukocytes (Friedlander et al., 1995). In particular, slight corneal opacity can develop into permanent blindness. An exhaustive description of the microscopic lesions observed at different IKC stages in goats has been reported elsewhere (Kováč et al., 2003). The eye lesions can be classified into stages I–IV (mild to severe) based on macroscopic and histological findings, and the present lesions corresponded to stage II.

IKC occurred throughout the year, but its incidence varied by month, being higher during June-September. This variation might have been due to different ambient temperatures and is similar to the findings in other studies stating that ocular infection rates are higher during the summer (40.5%) than during other seasons (Osmani et al., 2000). The transmission of infectious agents usually requires insects that frequent the eyes. The fly population is greater during the hotter months in Bangladesh, so flies may have been involved in transmitting the infectious agents to healthy goats. Almost all goats in Bangladesh are reared indoors at night, rather than in individual pens. However, goats of different ages, sexes, and breeds are reared in a single building in the backyards of farms. We determined that all breeds and ages were susceptible to IKC, but that young females (up to 1 year) were more susceptible to infection than other age groups, which agrees with the findings of Tamilmahan et al. (2013). This may have occurred because females require more food and are always searching for food to meet their extra energy demands [Speakman, 2008]. They can be injured by grass thorns while searching for food and damage the conjunctiva, subsequently leading to infection by the bacterium and its transfer to other healthy animals.

The traditional treatments for IKC are topical, systemic, and subconjunctival injections of antibiotics and anti-inflammatory drugs. Antibiotics normally reduce the bacterial load and steroids help reduce inflammation in the eye; however, steroids can impair formation of the vasculature, which would otherwise help in the healing process. We included seven treatment groups in this study on treating IKC in goats. However, the subconjunctival injections of corticosteroid and long-acting oxytetracycline HCl and the topical use of chloramphenicol HCl eyedrops significantly reduced IKC infection in goats. Topical treatments speed up the recovery process of infected animals (Boileau and Gilmour, 2012) and subconjunctival injections are effective if the injected material remains localized (Luginbuhl, 2015). Oxytetracycline HCl was chosen as the antibiotic as it is a broad-spectrum bacteriostat that is effective against *Mycoplasma*, *Chlamydia*, and *Rickettsia* (Borghi et al., 2014). We also used a chloramphenicol HCl eyedrop preparation six times daily as a broad-spectrum bacteriostat. The pathogenesis of IKC is complex and injured conjunctival cells release enzymes, such as phospholipases, proteases, and nucleases (Bhandari and Asnani, 1998). The inflammatory response to the infection is a cascade reaction. A steroid anti-inflammatory drug has been used successfully to treat IKC in buffalo (Friedlander et al., 1995). Topical use of corticosteroids can reduce soft tissue inflammation. In this study, we subconjunctivally injected a corticosteroid along with oxytetracycline HCl, which dramatically reduced inflammation and may have inhibited nuclear factor κB and abrogated the arachidonic acid cascade by inhibiting phospholipase A2 through the synthesis of lipocortins (Chivers et al., 2004). On the other hand, the combination of chloramphenicol HCl eyedrops and oxytetracycline HCl subconjunctival injections did not reduce the infection significantly compared with that of the combined dexamethasone group, but subconjunctival injections of dexamethasone and topical use of chloramphenicol HCl also significantly reduced the infection, indicating that the subconjunctival injections of dexamethasone were beneficial for reducing IKC in goats (Bian et al., 2016). In conclusion, the combined dexamethasone/chloramphenicol and oxytetracycline therapy was significantly superior to treatments without dexamethasone group for treating IKC in goats. Therefore, these methods should become standard for the prophylaxis of conjunctivitis.

ACKNOWLEDGMENTS

We acknowledge Director of the SAQ Teaching Veterinary Hospital, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong-4202, Bangladesh for allowing doing this research. The research was self-sponsored.

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