

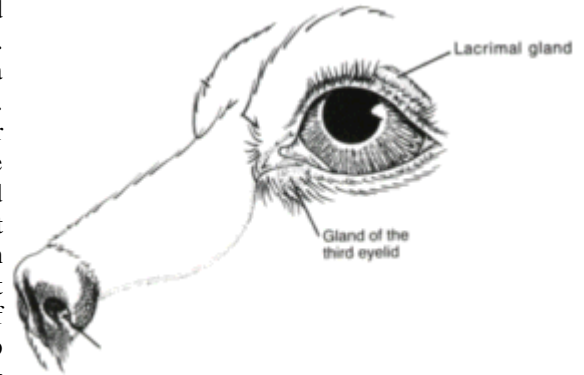
“Dry Eye” (More formally known as “Keratoconjunctivitis Sicca” or “KCS”)



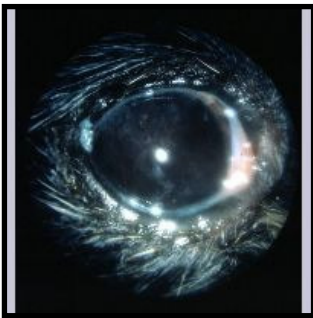
We can all imagine the discomfort of dry, irritated eyes and the soothing provided by eye drops. Tears are essential to the comfort of our eyes but they do more than just provide lubrication. Tears contain anti-bacterial proteins, salts, sugars, and even oxygen to nourish the eye. Tears flush away irritants and infectious agents that are constantly getting in our eyes. Since the outer portions of the eye does not have a blood supply, the tears must bring sugars and oxygen and must remove metabolic waste.

Tears consist of oil secreted by the eyelid glands, mucus, and (mostly) water. Tears are secreted by two “lacrimal” glands in dogs and cats: one just above the eye and another in the third eyelid (or so-called “nictating membrane”). Keratoconjunctivitis sicca is a fancy way of saying the eye is dry.

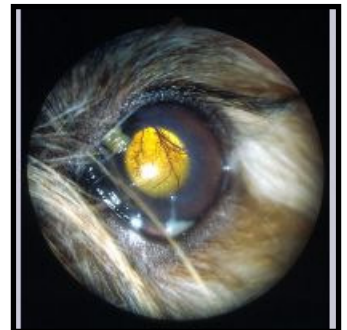
“Kerato” refers to the cornea or clear covering of the eye that faces the outside world. “Conjunctivae” are the moist pink membranes of the eye socket. “Itis” means inflammation and “sicca” means dry. KCS means inflamed, dry cornea and conjunctiva. It occurs when there is a deficiency in the water portion of the tear film which normally accounts for 95% of the tear volume. Without the water, one is left with oil and mucus; hence, the gooeey yellow eye discharge characteristic of this condition. Early diagnosis, appropriate treatment, and timely follow-up are essential to the successful management of this painful and potentially blinding disease.



Without tears, eyes become dull, irritated and painful, the conjunctival tissues around the eyes get red, the cornea itself in time will turn brown in an effort to protect the eye, a gooeey, yellow discharge (called mucopurulent) predominates, and the eyelids can spasm. Secondary bacterial infection of the conjunctiva is common. Possible complications include corneal ulcer, blood vessel infiltrating the cornea, scarring, blindness or reduced vision, and even perforation and loss of the eye can result. Symptoms are often gradual in onset and progressive, although acute onset of clinical signs also occurs occasionally. Some dogs may exhibit intermittent symptoms early in the course of disease.



Severe changes have rendered the eye on the left clinically blind, as the cornea has become black. Infiltration of blood vessels (vascularization) is present in the eye on the right, and mild corneal scarring are present. Inability to close the eyelids fully (lagophthalmos) may have contributed to the KCS.



WHY DO EYES BECOME THIS DRY?

The prevalence of KCS is currently reported as approximately 1% in dogs presented to Veterinary Colleges in North America. There are many causes of dry eye. Here are some of them:

- Distemper infection attacks all body interfaces with the environment including the eyes. Dry eye is part of the constellation of symptoms that can occur with distemper infection.
- In cats, Herpes upper respiratory infection can lead to a chronic dry eye.
- There could be a congenital lack of tear producing gland tissue.
- Drug-induced KCS may be temporary or may be permanent due to toxic effects on the gland. Drugs that cause temporary suppression of tears include anesthetic agents, sedatives, topical anesthetics and atropine. The duration of tear suppression with these agents varies widely. When toxic effects on the lacrimal gland occur, tear production may return following discontinuation of the inciting drug but, more commonly, permanent KCS results. Generally, longer duration of therapy with the causative drug is associated with a poorer prognosis for return of tear production. Caution should be used when administering topical atropine for pain in the management of corneal ulcers, as it may cause diminished tear production in

normal as well as KCS-affected dogs. Failure to recognize this potential side effect may delay healing of the ulcer or lead to progression of disease.

- Exposure to sulfa containing antibiotics (such as Trimethoprim sulfa combinations) can lead to dry eye (which can be either temporary or permanent and occurs unpredictably). Examples include sulfadiazine, sulfasalazine, trimethoprim-sulfonamide, Primor, Bactrim, Tribrissen, Albon, etc.
- Recently, administration of the anti-inflammatory etodolac (Etogesic®) has also been documented to cause KCS in dogs.¹⁴
- Anesthesia will reduce tear function temporarily (thus eyes are lubricated with ointment by the attending nurse).
- Removal of the third eyelid tear producing gland (instead of replacing the gland in its proper location) during surgery for Cherry Eye can lead to KCS as can too much damage to the gland prior to proper gland replacement.
- A knock on the head in the area of one of the tear producing glands can lead to nerve damage causing KCS. This is called “neurogenic KCS.” Damage to these nerve fibers is often associated with facial nerve dysfunction – drooping of the ear and/or lip on the same side. Neurogenic KCS most commonly affects only one side and, due to common nerve supply, it is often also associated with a very dry nostril (xeromycteria) on the same side (see photo on the right).
- A less common cause of KCS in dogs is radiation therapy.
- **The most common cause of KCS appears to be immune mediated destruction of the tear producing gland tissue. We do not know what causes this type of inflammatory reaction but certain breeds are predisposed:** Breeds predisposed to KCS include Dachshund, Boston terrier, Chihuahua, Lhasa Apso, Shih Tzu, cocker spaniel, Bloodhound, Cavalier, Springer Spaniel, Miniature Schnauzer, Pekingese, Pug, Samoyed, Westie and Yorkie.



HOW WE MAKE THE KCS DIAGNOSIS

When KCS is in advanced state it is pretty obvious but in earlier cases it may look like a simple case of conjunctivitis. In either case it is important to actually measure the tear production to determine how dry the eyes are. The test that accomplishes this is called the “Schirmer Tear Test.”



To perform the test, a strip of special paper is inserted just inside the lower eyelid in the outer corner of the eye for 60 seconds. The moisture of the eye will wet the paper. At the end of the 60 second period, the height of the moistened area is measured. A height of 15mm or more is normal. A height 11-14mm is a borderline result. A height of less than 10mm is dry. A height of 6-10mm is moderately dry, and less than 5mm is severely dry. In order to properly interpret the Schirmer Tear Test, especially in cases of borderline tear production (i.e. 10-14 mm/min), clinical signs must also be taken into account.

In early disease, applying a vital stain such as Rose Bengal will reveal positive uptake by devitalized cells of the corneal and conjunctival surface.

HOW DO WE TREAT THIS CONDITION?

Not that long ago all we had to treat this condition was tear replacement formulas and mucus dissolving agents. These are still helpful but require an impractical frequency of administration – every 2-4 hours. A breakthrough came with the discovery of cyclosporine topical therapy to control the immune mediated gland destruction.

Cyclosporine is an immunomodulating drug that had already been found helpful to organ transplant patients. When applied as an eye drop or ointment, it suppresses the immune destruction that is the most common cause of KCS and tear production is restored. The success of this treatment plus its convenient dosing interval (once or twice a day) has made this medication the primary treatment for KCS. This drug will not help the less common neurogenic



KCS. Cyclosporine is used as a 0.2% ophthalmic ointment (Optimmune) or 1-2% oil-based solution. It is applied to the affected eye(s) two to three times daily. Most dogs respond within a couple of weeks, but up to 12 weeks may be required in some cases. Lifelong use is generally required. After beginning cyclosporine eye drops or ointment, a recheck in three weeks or so is a good idea to check for improvement. If the Schirmer tear test is still showing poor results, the medication can be given three times a day; similarly if excellent results are seen, the medication can be dropped to once a day. Dogs with Schirmer tear tests as low as 2mm have an 80% chance of responding to cyclosporine. Unfortunately, it is relatively expensive as eye medication goes but after messing around with less effective treatments requiring more frequent administration for less predictable results, cyclosporine is probably worth it.

Tacrolimus is another medication able to locally suppress immunity, like cyclosporine. This product has recently gained popularity in human medication as a topical anti-inflammatory treatment that is cortisone-free. It is used in a manner similar to cyclosporine and is generally of similar cost. 0.02% aqueous suspension or a 0.02-0.03% oil-based solution or ointment can be used. The drug is applied to the affected eye(s) two to three times daily. Response time and efficacy is similar to cyclosporine. Lifelong use is generally required. In cases that are non-responsive to topical immunosuppressive medication (e.g. cyclosporine or tacrolimus) as determined by Schirmer tear tests, continued use of these medications is warranted to help control or minimize keratitis.

Pilocarpine is what is called a “cholinergic” drug which means it works on the autonomic nervous system (the part that controls tear gland secretion). This medication can be given in the eye or even orally to stimulate tear production, when there is neurogenic KCS. It will likely not help most animals with KCS who have immune mediated destruction of their tear glands. 0.25% solution is applied to the affected eye(s) every 6 hours. If eye drops fail, administer 1-4 drops of 2% pilocarpine twice daily on the food. Dosing should be started with 1 drop and increased if there is no improvement in tear production, until side effects are encountered. In very small dogs (less than 5 kg), a 1% solution should be used. Side effects when dose is too high can include diarrhea, drooling, vomiting or drop in heart rate. If pilocarpine oral therapy works and is tolerated well, it must be continued indefinitely, usually twice a day.



Artificial Tears can be purchased in most drug stores. These can be combined with other therapies and are certainly very soothing. The problem is that they are typically recommended for use 4-6 times a day. Artificial tears are generally not required if STT values are >7 mm/min. Also available are sterile ophthalmic lubricant ointments with no medications in them, like Lacrilube, which will provide lubrication for much longer than tear replacement drops will.

Antibiotic Products are often needed especially when starting treatment for KCS as secondary infections are common when there are inadequate tears to wash infectious agents away. These products do not increase tear production but may be important, especially early in therapy. Use them for 10-14 days at a time, and when infection is under control, if lubrication is still needed, replace with an ointment without medication like Lacrilube.



Corticosteroids. Short-term (1-2 weeks) topical application of corticosteroids may improve symptoms of conjunctivitis, but should be used with utmost caution due to the common occurrence of corneal ulceration with KCS. Corticosteroids should be used only after confirming absence of ulceration using fluorescein dye. Long-term use should be avoided. Corticosteroids may be alone in an ointment or drops, or they may be combined with antibiotics. Prednisone, prednisolone and dexamethasone are all corticosteroids.

Mucomyst® Eye Drops are made from a respiratory product used to dissolve thick mucus. In an eye formula, Mucomyst (active ingredient Acetylcysteine) helps remove the thick eye discharge that accompanies dry eye. These eye drops can be used as needed as often as every 6 hours.

Severin's Solution is a mixture of Mucomyst, pilocarpine, artificial tears, and antibiotic which can be made up and prescribed. The “recipe” originated in an article published by a veterinary ophthalmologist named Dr. Severin in 1996. Many animal hospitals mix up their own conglomerations based on this recipe. In most cases, cyclosporine has made these mixtures obsolete.

Good hygiene. It is important to remove secretions from around the eyes multiple times daily, to minimize irritation of the eyelids. If secretions are allowed to dry on the hairs around the eyes, they can be difficult and painful to remove. If necessary, hairs can be shaved from around the eye to make cleaning the area easier. The best method is to cleanse the area gently with a clean, warm, wet wash-rag or 4x4 gauze.

SURGICAL SOLUTIONS?

There are surgical solutions to KCS. One is a delicate procedure in general only done by veterinary ophthalmologists. This is called the **Parotid Duct Transposition**. The parotid duct comes from the salivary gland on either side of the cheek. It produces saliva which is carried to the mouth. This duct can be carefully dissected out and moved so as to deliver saliva over the eye. Saliva actually makes a

reasonable substitute for tears though in time some mineral deposits will form on the eye surface and eye drops may be needed to control this. The dog's eyes will water when he is fed and facial wetting may be objectionable.

The pigment on the surface of the cornea resulting from long standing KCS is like the lens of dark sunglasses and interferes with a dog's vision especially in dark situations. If tear function is restored, vision may also be restored via a procedure called a **Superficial Keratectomy** where the pigmented surface of the cornea is sanded away. This is obviously not worth doing if the tear issue is still problematic as the pigment would in that case just return. As with the parotid duct transposition, a veterinary ophthalmologist is probably best suited to perform this procedure.

Placing plugs in the ducts that normally carry excess tears from the eyes to the nose (the nasolacrimal ducts) may be of benefit in refractory cases with some (but inadequate) tear production. This procedure is usually not helpful with absolute dry eye, where no tears are being produced.

PREVENTATIVE MEASURES

There are no specific preventative measures for spontaneous disease. However, certain steps can be taken to minimize the risk of KCS caused by medications. Schirmer tear values should be obtained prior to administration and during the course of therapy. Also, because surgical removal of the gland of the nictitating membrane has been associated with an increased risk of KCS, this should not be performed as a treatment for nictitans gland prolapse (Cherry Eye).

References:

- 1) Peterson-Jones SM. : Quantification of conjunctival sac bacteria in normal dogs and those suffering from keratoconjunctivitis sicca. Vet Comp Ophthalmol 1997 Vol 7 (1) pp. 29-35.
- 2) Helper LC: The tear film in the dog. Causes and treatment of diseases associated with overproduction and underproduction of tears. Anim Eye Res 1996 Vol 15 (1-2) pp. 5-11.
- 3) Kaswan RL, Martin CL, Chapman WL: [Keratoconjunctivitis sicca: Histopathologic study of nictitating membrane and lacrimal glands from 28 dogs](#). Am J Vet Res 1984 Vol 45 (1) pp. 112-118.
- 4) Kaswan RL, Martin CL, Dawe DL: [Keratoconjunctivitis sicca: Immunological evaluation of 62 canine cases](#). Am J Vet Res 1985 Vol 46 (2) pp. 376-383.
- 5) Kaswan RL, Salisbury MA: [A new perspective on canine keratoconjunctivitis sicca: Treatment with ophthalmic cyclosporine](#). Vet Clin N Am (Small Anim Pract) 1990 Vol 20 (3) pp. 583-613.
- 6) Kern TJ, Erb HN: [Facial neuropathy in dogs and cats: 95 cases \(1975-1985\)](#). J Am Vet Med Assoc 1987 Vol 191 (2) pp. 1604-1609.
- 7) Vestre WA, Brightman AH, Helper LC, Lowery JC: [Decreased tear production associated with general anesthesia in the dog](#). J Am Vet Med Assoc 1979 Vol 174 (9) pp. 1006-1007.
- 8) Herring IP, Pickett JP, Champagne ES, Marini M: [Evaluation of aqueous tear production in dogs following general anesthesia](#). J Am Anim Hosp Assoc 2000 Vol 36 (5) pp. 427-430.
- 9) Ludders JW, Heavener JE: [Effect of atropine on tear formation in anesthetized dogs](#). J Am Vet Med Assoc 1979 Vol 175 (6) pp. 585-586.
- 10) Hollingsworth SR, Canton DD, Buyuchmichi NC, Farver TB: [Effect of topically administered atropine on tear production in dogs](#). J Am Vet Med Assoc 1992 Vol 200 (10) pp. 1481-1484.
- 11) Bryan GM, Slatter DH: [Keratoconjunctivitis sicca induced by phenazopyridine in dogs](#). Arch Ophthalmol 1973 Vol 90 (4) pp. 310-311.
- 12) Diehl KJ, Roberts SM: Keratoconjunctivitis sicca in dogs associated with sulfonamide therapy. Prog Vet Comp Ophthalmol 1991 Vol 1 (4) pp. 276-82.
- 13) SL Berger, RH Scagliotti, EM Lund: [A quantitative study of the effects of Tribissen on canine tear production](#). J Am Anim Hosp 1995 Vol 31 (3) pp. 236-241.
- 14) Klauss G, Giuliani EA, Moore CP, et al: Canine keratoconjunctivitis sicca associated with etodolac administration. Proceedings 34th Meeting of the Am Coll Vet Ophthalmol 2003 pp. 44.
- 15) Sansom J, Barnett KC: Keratoconjunctivitis sicca in the dog: A review of 200 cases. J Small Anim Pract 1985 Vol 26 pp. 121-131.
- 16) Williams DL: [Use of punctal occlusion in the treatment of canine keratoconjunctivitis sicca](#). J Small Anim Pract 2002 Vol 43 (11) pp. 478-81.
- 17) Schmidt G, Magrane WG, Helper LC: Parotid duct transposition: A follow-up study of 60 eyes. J Am Anim Hosp Assoc 1970 Vol 6 pp. 235-41.
- 18) Morgan RV, Duddy JM, McClurg K: [Prolapse of the gland of the third eyelid in dogs: A retrospective study of 89 cases \(1980 to 1990\)](#). J Am Anim Hosp Assoc 1993 Vol 29 (1) pp. 56-60.
- 19) Wilkie DA: [Keratoconjunctivitis Sicca](#). Tufts Animal Expo 2002.
- 20) Colitz CMH: [Keratoconjunctivitis Sicca: Cause, Effect & Treatment I and II](#). Western Veterinary Conference 2004.
- 21) Veterinary Information Network, Ian P. Herring, DVM, MS, DACVO.
- 22) Veterinary Partner.com

