WESTIE FOUNDATION OF AMERICA, INC
Leading the Way to Westie Health

Westie WELLNESS

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Darlene Reilly, Editor
Reilly Designs, LLC • reillys44@gmail.com

PRESIDENT'S MESSAGE

Bebe Pinter

In spite of the Coronavirus Pandemic, the board and its committees have been very busy at a safe distance. We are involved with an important study in Scotland, choosing the 2020 veterinary scholarship winner, preparing to launch a new website this year, developing additional policies, planning the annual WFA Facebook Auction (date to be announced), and working to assure good communications with our donors and the Westie public. It's an ambitious agenda but our board of directors and Advisory Council are up to it!

In this issue, start off by reading about a special sense—the eye, titled "Juvenile Cataract in West Highland White Terriers" by Lindsey Buracker, DVM and John Robertson, VMD, PhD from **The Westie Health Book.** According to the authors "Juvenile cataract may form before birth and develop shortly after birth as the dog's eyes mature." Subtopics include: Introduction, The Anatomy of the Eye and the Phenomenon of Vision, An Introduction to Cataracts, Juvenile Cataracts, Noticing Your Dog's Eyes and Behavior, and Eye Examination by a Veterinarian, Prevention of Cataracts, Treatment, Prognosis and Follow-up Care. It is important to have your dog's eyes examined by an opthalmologist as part of his/her CHIC health clearance.

Please allow a little time to peruse the Donors, Memorials and Honorariums pages. We thank our donors one and all! Without our dedicated donors, the WFA would be unable to do the work necessary to help improve the health of all Westies. We need your support and encourage you to become an annual or monthly donor. We are an active board for a canine foundation that functions as an advocate and catalyst to make real progress in the health arena through research and education. You may contact Jim McCain, Donor Manager at donormanager@westiefounation.org or visit our website www.westiefoundation.org for assistance. In addition, I would be delighted to visit with you about what the WFA has accomplished, major projects and research underway, as well as ways you may volunteer if you are interested. My email is president@westiefoundation.org.

Another great article on the special sense of the eye continues with "Keratoconjuctivitis Sicca (Dry Eye)" by Stephanie Shrader, DVM and John

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(President continued from page 1)

Robertson, VMD, PhD. Many Westies encounter this disease as they age. It is also a disease affecting human eyes. Shrader and Roberson said, "There are several potential causes… the common feature among these causes is that they impair the ability of the tear-secreting tissues in the eye to perform their basic functions." This article will help you notice the condition early so you can alert your veterinarian in case a Schirmer Tear Test is needed to diagnosis the disease. Subtopics in the article include: Introduction and Overview, Relevant Anatomy of the Eye, How Tears Are Produced, What Causes Keratoconjunctivitis sicca?, How is Keratoconjunctivitis sicca diagnosed?, and Treatment of Keratoconjuctivitis sicca. Information included about the eye anatomy is very interesting to know..

Don't forget to order your personal copy of *The Westie Health Book*. An order form is included on page 19 for your convenience. It is my pleasure to mail the book to you.

We appreciate your notes and send our condolences to those of you who have had your dear Westie cross The Rainbow Bridge. Please know that everyone involved with the WFA truly understands.

In closing, I would like to share how in all this COVID-19 chaos that my Westies have created a very comforting and stabilizing environment for my husband and me while we are sheltering at home. My seven Westies continue to demonstrate love and clownish fun that definitely decreases our stress of the unknown, what lies ahead with this virus. In addition, my daily caring for them generates the structure I need for a feeling of wellbeing and family. May you all find comfort during this time with your Westie(s) and other pets. We are so fortunate to have them in our lives. Stay safe and well!

Thank you for your continued involvement and support of the WFA but most of all, your love of Westies!

Bebe Pinter

PINTEREST HUMOR

https://www.pinterest.com/lindyb2014/westie-humor/

On The Health Front

By Kay McGuire, DVM, MS

Again our Newsletter is running a little behind, this time due to COVID-19. I don't believe any of us would have predicted a Spring like this as our country and world has been sat on its ear. Many of us are considered essential so luckily we have been able to continue working, although with patterns we would never have thought. Those that have been relegated to their homes for the last 6 weeks know that our Westies have been a huge part of our existence. God bless them!

We are excited and proud of how our Health Committee has chosen projects that show we are on the forefront in our Research efforts:

The Westie Foundation of America's (WFA) research dollars have been important to the COVID-19 crisis. Last fall the WFA learned of research being conducted at Yale University by Dr. Naftali Kaminski. Dr. Kaminski was using Sobiterome, a thyroid mimetic hormone on bleomycin-induced pulmonary fibrosis in mice. The findings on this model were that the fibrosis did not worsen and even improved with the use of Sobiterome. The WFA introduced Dr. Kaminski to Dr. Elizabeth Rozanski at Tufts University to collaborate and start a study of Sobiterome on Westies with pulmonary fibrosis. The patrons of the Facebook page "Westie Lung Disease" were instrumental in helping raise funds for the WFA to support this work. This study is currently underway, delayed of course by universities closing due to the pandemic.

From ***Yale News*** *taken from the Canine Health Information website*: "Sobetirome is at the top of a list of over 20 Yale compounds and devices in various stages of development that could be useful in treating the devastating impacts of COVID-19 and are being explored both by the Advanced Therapies Group and experts at the Yale Office of Cooperative Research (OCR), which manages and promotes university discoveries for commercial development. All involved are racing against the clock to get new treatments to patients in need."

The WFA has also agreed to support several Grants through the Canine Health Foundation for 2020. The topics include atopic dermatitis, treatment modalities on methicillin resistant *Staphlococcus intermedias* and lymphosarcoma.

We are also in the process of finalizing a grant through the University of Edinburg in Scotland for Dr. Brendon Corcoran on a pulmonary fibrosis project. Again, all of this is at a standstill until schools and Universities return to session.

As Atopy continues to be the number one health concern for our dogs, we also have a grant proposal we are working to finalize with the University of Florida and Dr. Dominico Santoro. He is interested in the use of a plant extract as a safer and more cost effective treatment to atopic dermatitis.

As the pandemic continues, there are questions concerning our pets and COVID-19. Obviously there is much to learn about this virus but evidence that this virus can cause a reverse zoonosis and spread the virus from the dog or cat to a human has not been founded. It seems that cats might be more susceptible and will show a mild respiratory response. So far, the few dogs that have tested positive for COVID-19 are not showing clinical signs.

Please, everyone stay safe and take precautions. This virus will be around a long while and life as we knew it a few months ago will be a long time returning.

Juvenile Cataracts in West Highland White Terriers

By Lindsey Buracker, DVM and John Robertson, VMD, PhD

Introduction

Dogs have a very keen sense of vision, with an ability to see in extreme conditions of light and darkness, and to be highly perceptive of movement. Although we generally don't think of them as primal predators, Westies are born with these instincts and need excellent vision. To make sense of what happens when cataracts develop, it is important to first have a solid understanding of the anatomy and physiology of the eye.

The Anatomy of the Eye and the Phenomenon of Vision

The eye is comprised primarily of two connected chambers. The smaller of the two chambers, called the anterior chamber, is bounded by the transparent cornea at the front of the eye and the lens posteriorly. The larger posterior chamber, which is bounded externally by the tough outer layer called the sclera, contains the lens, the gelatinous vitreous humor, and the retina. The retina is a membrane comprised primarily of neural receptors that respond to light and initiate the visual pathway. The eye also contains blood vessels in the uveal tract and connective tissue.

The lens is an amazing tissue. It is a tight clustering of specialized cells, enclosed in a capsule, located behind the iris and in front of the vitreous body, held in place by fibers, the anterior vitreous face, and the iris (Magrane, 1972). The lens is normally quite flexible, and its shape is controlled by small muscles and fibers that either tense or relax its edges. By changing its shape, the lens alters its refractive power to bring objects into focus, depending on whether they are near or far away. The lens grows in size with age, and requires nutrients that reach it by diffusion through the aqueous and vitreous humors. It also can be damaged by injury and disease, and has a limited ability to heal. Consequently, the shape of the lens changes during life.

There are three main components of the lens, namely the capsule, surface layer or epithelium, and fibers. The capsule is a thickened smooth membrane made of collagen and produced by the lens epithelium and fibers. It completely surrounds the lens and has elastic properties, so when not under tension, the lens assumes a rounded shape. The epithelium is comprised of cells that elongate over time and are eventually transformed into lens fibers, which contain high concentrations of the protein crystalline. It is this protein that helps the lens refract and transmit light. The fibers are tightly packed and extend the full length of the lens. Continual growth of the lens adds more elongated cells and fibers and produces an arrangement similar to the layers of an onion (Magrane, 1972). Damage to any of the components of the lens can result in a cataract.

The formation of the lens helps orchestrate the overall development of the eye, as it forms relatively early and helps induce the formation of both chambers and other parts of the eye. This pivotal role of the lens in controlling development of the eye is important for several reasons. First, if the lens does not properly form, this can affect the development of other parts of the eye. Second, disease or defective gene expression that occurs during pregnancy can significantly affect formation of the lens and, by extension, the development of healthy eyes. Third, the presence of cataracts at birth not only is indicative of abnormalities in lens development, but also may signal the potential for problems elsewhere in the eye. Finally, it is important to remember that puppies are born with incompletely matured eyes and some of the process of development takes place after birth. A good rule of thumb is that formation of the

Common Clinical Findings

Age When Recognized Varies

Autosomal Recessive Trait

Common Ancestors or Selective Breeding

Examination by Veterinary Ophthalmologist

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Figure 1 - *Examination of a dog's eyes using a specialized slit lamp ophthalmoscope.*

eye is complete by about 12 weeks of age, in most breeds of dog. Dogs should have good visual acuity by this age.

Vision is an interesting phenomenon. In essence, light energy from the surroundings produces electrochemical changes in specialized nerve cells called rods and cones in the retina. These changes result in the generation of signals called 'nerve action potentials' that are relayed to the brain, where they are processed and consciously appreciated as a vision (Magrane, 1972). The lens is a key part of the system that focuses and transmits light to the retina so that signals that eventually produce vision are received on the retina.

An Introduction to Cataracts

Simply defined, a cataract is an irregularity and opacity in the lens. In most cases, the cataract appears as a cloudy white discoloration in the lens. It is important to know, that cataracts can affect only one or both eyes. When cataracts develop in the center of the lens, they will interfere with the path of light energy to the retina at the back of the eye, thereby impairing visual acuity. Cataracts often are classified as either 'immature' or 'mature,' terms that refer to the developmental stage of the cataract. Immature cataracts are newly formed and may occupy only a portion of the lens, whereas mature cataracts have been present longer and may involve the entire lens. In some mature cataracts, the cells in the lens have degenerated and liquefied. This debris persists within the lens capsule.

Many cataracts are more common in older dogs than young dogs, and develop in older dogs as a result of ocular disease (e.g., glaucoma, panophthalmitis and uveitis), systemic disease (e.g., diabetes mellitus), exposure to certain chemicals, as a side effect of radiation therapy of the head and neck, or direct penetrating trauma to the eye that damages the lens capsule and lens cells. These cataracts are considered to be "acquired" as a result of the initiating process.

Two specific ocular diseases associated with cataracts deserve specific mention: uveitis and glaucoma. Uveitis, an inflammation of the vascular ('uveal') layer of the eye, can be caused directly by degeneration of the lens, in some cases. With the formation and disruption of mature and hypermature cataracts, lens protein can leak from inside the lens capsule into the anterior chamber, spontaneously or as a result of trauma, and induce severe inflammation.

The relationship between glaucoma and cataract formation is complex. Glaucoma is a disease condition characterized by elevated intraocular pressure. In some cases of glaucoma, interference with the production and drainage of fluids within the eye is the primary disease process that increases intraocular pressure. The increased pressure within the eye may damage the lens, resulting in the formation of cataracts. In other cases, cataracts and other lens diseases may be a cause of glaucoma. For example, lenses with cataracts may become dislodged from their normal fibrous connections and migrate into the pupil, where they occlude the normal flow of fluid from the posterior chamber to the anterior chamber. This essentially blocks the drainage of fluid and pressure increases within the eye, resulting in glaucoma.

Juvenile Cataracts

Cataracts also may form as the result of a defect during development of the eye. These cataracts, which are known as juvenile cataracts, either may form before birth or develop shortly after birth as the dog's eyes mature. Juvenile cataracts may be caused by the expression of defective genes and/or viral infections that occur during gestation or in newborns. In some breeds of dogs, the incidence of cataracts increases with age; these cataracts are considered to be hereditary in origin. Regardless of the cause, the outcome is the same – a decrease in visual acuity for the dog. Some inherited cataracts that appear early in the dog's life may result in blindness by the time the dog is 3 years of age. Other late onset inherited cataracts often do not interfere with vision and are identified before the dog reaches 8 years of age.

(Continued on page 6)

(Juvenile Cataracts from page 5)

"Juvenile cataracts may form before birth or develop shortly after birth as the dog's eyes mature."

Most inherited cataracts in dogs are inherited as autosomal recessive traits, such as the mutation in heat shock transcription factor gene, HSF4, which is responsible for recessively inherited cataracts in Boston Terriers, Staffordshire Bull Terriers and French Bulldogs (Mellersh et. al., 2006). Typically, dogs are affected bilaterally, the cataracts are located in the posterior region of the lens, and the rate at which they grow is highly variable. Interestingly, Muller and coworkers (2008) were not able to identify mutations in HSF4 in Dachshunds or Enttlebucher Mountain Dogs with hereditary cataracts.

Another mutation of the HSF4 gene affects Australian Shepherds, but is different from the mutation in Boston Terriers, French Bulldogs and Staffordshire Bull Terriers (Mellersh et. al., 2009). This mutation is dominant, meaning that only a single copy is needed to predispose a dog to the disease. Fortunately, not all dogs with this mutation develop cataracts, suggesting that one or more other gene interactions are involved in the process.

Many breeds of dogs appear to be predisposed to developing juvenile cataracts, including the West Highland White Terrier. To examine this concept, Oberbauer and colleagues recently compared the prevalence of ten inherited disorders, including early onset cataracts, in purebred and mixed breed dogs in a study of more than 88,000 dogs. They determined that the prevalence of early onset cataracts in most purebred groups was not different from that in mixed breed populations. They concluded that groups with higher specific disorders may have common ancestors or this could be an effect of selecting for specific structural features (e.g., shape or size).

Many puppies appear normal at birth, many do not show signs until six months to two years of age, and some may have the cataracts appear after five years. Consequently, there is no way to know if the puppy you are buying is going to develop juvenile cataracts. Fortunately, juvenile cataracts do not always lead to blindness. In many cases, the puppy or young dog still sees basic shapes, but they may be blurry. In some cases, the disease leads to the development of glaucoma.

The only way to eradicate juvenile cataracts in dogs is for breeders to have both parents evaluated fully by a licensed veterinary ophthalmologist no more than a year before breeding. Because not all breeders do this, it is advisable to ask for eye registry papers for both parents before agreeing to purchase a puppy.

Noticing Your Dog's Eyes and Behavior

Owners and breeders are often the first to detect a problem with a dog's eyes and vision. Some common signs that something is not right include:

- The eyes, lids, and membranes of the eye just don't look right; there may be milky white/opaque discoloration, irregularities in shape and size, or perhaps the eyes are inappropriately proportioned to the dog's head.
- Puppies may bump into things in their path, and observations that must be differentiated from just clumsiness or poor coordination.
- Puppies appear reluctant to move about or are overly shy; most Westie puppies are pretty affable and playful.
- Puppies are reluctant to explore darkened areas.
- Puppies appear to cue interactions based on hearing rather than on both hearing and seeing.

If a problem with vision is suspected, your dog's eyes should be examined by your veterinarian.

Eye Examination by a Veterinarian

All thorough physical examinations of dogs include an evaluation of the eyes. Most evaluations by veterinarians include common elements, and some of the routine evaluation is done with simple tests:

- Evaluation of the gross appearance of both eyes, comparison of one eye with the other and with the head in terms of size, shape, coloration, tone, and integration with facial shape,
- Visual signal processing, based on the pupillary responses (constriction) to light shined in one eye. This is actually a simple test of a complex process, as it tests whether light focused on the retina then creates a visual 'signal' that is then transmitted via nerve fibers to the brain. At that point, the signal is interpreted as vision.
- The ability to track movement in a lighted area is assessed by the dog's responses to hand movements near the eyes. The veterinarian will determine if the dog will blink in response to movement near the eyes – assessing both visual perception and the automatic blink response.
- Tone (palpable firmness) of the eyes can be first evaluated by gently applying pressure through the lids. Most dogs do not mind this part of the examination and it helps determine if the eyes are firm, but not too firm, and if there are irregularities or pain,
- Ophthalmic evaluation of the anterior chamber, posterior chamber, and intraocular structures (lens, iris, pupil, retina).

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(Juvenile Cataracts from page 6)

Figures 2 - 4 - *Example of the different ways that cataracts can appear in dogs.*

The value to Westie owners in seeking regular evaluations of their dogs should be evident. Health problems can be detected, diagnosed and most are treated effectively. Many eye problems can be detected with the above approach. When more complex treatments, such as surgery, are needed to treat problems and to correct defects, it makes sense to seek the services of a specialist, such as a veterinary ophthalmologist. These specialists have the facilities and equipment needed for more extensive diagnostic approaches and for treatment *(Figure1)*. Because they concentrate exclusively on treating diseases of the eye, they have seen more cases, many of which are the more difficult ones, and will be more familiar with the variety of abnormalities affecting the lens *(Figures 2 – 4)*. Veterinary opthalmologists are certified by examination boards after years of advanced training and experience treating diseases of the eye.

Prevention of Cataracts

Since we know that some types of cataracts have a hereditary basis (Table 1), it is essential for dog breeders to keep thorough records of litters and diseases affecting each pup. Breeders should keep in regular contact with the owners of pups from their litters throughout the lives of these dogs. The presence of cataracts in young dogs (less than 6 months old) and in multiple dogs from the same breeding is very suggestive of an underlying genetic problem. One caveat – if, during gestation, there is evidence of ill-health in the dam, cataracts may be the result of damage to the developing puppies. Most experienced breeders are very aware of the need to keep pregnant dams well-nourished and free from exposure to potentially damaging viruses and chemicals in the environment.

In the event that a litter is delivered and one or more pups develop cataracts, the breeder has a responsibility to 1) seek veterinary diagnosis and discuss treatment options for affected pups, 2) examine the breeding and pedigree of both dam and sire for similar problems (or the presence of other congenital defects from this paired breeding), and 3) refrain from breeding either sire or dam until the relationship between breeding and cataract development can be clearly determined. Hereditary cataracts were first identified as a significant problem in the Miniature Schnauzer breed in the 1970s and 1980s. Following the leadership provided by breed associations, veterinarians and research scientists, this autosomal recessive trait was identified and bred against, resulting in a substantial decrease in the incidence of the disease in Miniature Schnauzers today. By identifying those dogs that are carriers of the disease and not breeding them, juvenile cataracts can be controlled and eventually eliminated. The importance of keeping accurate breeding records and long-term follow-up information on litters cannot be overstated.

Potential owners need to do an extensive "background check" before purchasing a Westie from a breeder. These potential Westie owners need to be sure there are accurate records for each dam and sire, a solid bloodline, and no overt problems or diseases noted in each litter from the time of whelping. If Westie owners and breeders work together, this disease will eventually be eliminated from breeding stock.

Treatment

Before dogs with cataracts undergo surgical treatment, it is important to determine whether or not the dog is experiencing any vision problems. In other words, if the cataracts are relatively small and the dog is able to see sufficiently or can compensate for the impairment in vision, treatment isn't needed. In some dogs, juvenile cataracts do not become more severe or do so very slowly. In other dogs, the severity of the cataracts may change and other problems, such as glaucoma and inflammation of the eye, may develop. Consequently, it is advisable to have the dog's eyes checked on a regular basis. When cataracts interfere with vision, the dogs may have trouble finding their way in their environment, locating food or water, and be reluctant to walk or run. In these cases, a visit to the veterinarian is warranted.

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(Juvenile Cataracts from page 7)

Table 1. Inherited Cataracts In The Dog *(Gelatt, 2008)*.

Breed	Age of Onset
Afghan Hound	6-12 Months
American Cocker Spaniel	6+ Months
Boston Terrier	Congenital
Chesapeake Bay Retriever	1+ Years
German Shepherd	8+ Weeks
Golden Retriever	6+ Months
Labrador Retriever	6+ Months
Miniature Schnauzer	Congenital or 6+ Months
Old English Sheepdog	Congenital
Siberian Husky	6+ Months
Staffordshire Bull Terrier	6+ Months
Standard Poodle	1+ Years
Welsh Springer Spaniel	Congenital
West Highland White Terrier	Congenital

If cataracts are interfering with the dog's vision, the treatment requires surgical intervention by a veterinary ophthalmologist. Before this is done, however, specialized tests including an ERG and ocular ultrasound will be performed to ensure that the dog's retina is functioning normally. If the retina is not normal, the end result of surgery is not likely to be an improvement in visual acuity.

The most commonly used surgical technique involves using ultrasonic waves to transform the lens to a liquid, which then can be removed through a small incision. This technique, which is performed with the dog under general anesthesia, also is referred to as phacoemulsification. In many cases, an acrylic implant will be inserted to replace the lens that has been removed.

Prognosis and Follow-up Care

Although there is a risk of complications with any surgery, the short-term prognosis for the return of visual acuity after surgery exceeds 90%. The long-term outcome regarding restored or improved vision ultimately depends on the stage of the cataract at the time surgery is performed and other co-existing conditions. A protective collar will be applied to prevent the dog from scratching the eye and initially frequent eye drops or lubricants will need to be administered. Typically, dogs that undergo surgery are examined 1 week after surgery, at which time additional long term follow-up examinations will be scheduled, since there remains a risk for complications.

Current Research About Juvenile Cataracts in West Highland White Terriers

There has been a considerable amount of new information in the veterinary scientific literature in the past decade regarding the pathogenesis, diagnosis and treatment of cataracts in dogs. The following three recent studies would seem to be of most interest, as one concerns the clinical manifestations of the condition in small breeds of dogs examined in Korea, one reviews the clinical presentation of dogs with the disease in France, and the third compares the prevalence of another important eye disease of dogs covered in this eBook, keratoconjunctivitis sicca, in two populations of dogs after surgical treatment for cataracts.

Park SA, Yi NY, Jeong MB, Kim WT, Kim SE, Chae JM, Seo KM. Clinical manifestations of cataracts in small breed dogs. Vet Ophthalmol. 2009 Jul-Aug;12(4):205-10.
Because the majority of earlier clinical studies of cataracts in dogs had involved middle and large breed dogs, this study was performed to characterize the condition in small breed dogs presented to a veterinary teaching hospital in Korea. More than 560 small breed dogs were included in this study, with the most frequently presented breeds being the Miniature/Toy Poodle (n = 112, 20.0%), Yorkshire Terrier (n = 110, 19.6%), and Shih Tzu (n = 95, 16.9%). The investigators noted that significantly more female dogs were presented with cataracts than male dogs. The average age of affected dogs was 8.3 years, with Miniature/Toy Poodles and Yorkshire Terriers being significantly older and Miniature Schnauzers being significantly younger. While this study focused primarily on the incidence of cataracts and their clinical features, additional studies will need to be performed to determine the prognosis associated with different types of treatments.

Donzel E, Arti L, Chahory S. Epidemiology and clinical presentation of canine cataracts in France: a retrospective study of 404 cases. Vet Ophthalmol. 2016 Apr7. 1-9.
Although the prevalence of cataracts in dogs has been reported previously in North and South America and Korea, little was known about the disease in Europe. Consequently, the investigators undertook this study of more than 2,700 dogs presented for evaluation at a veterinary school in France. Of these dogs, 404 had cataracts; 54% were males and 46% females. The mean age of all dogs with cataracts was 9 years, and 54 breeds were represented. Of these, the Yorkshire Terrier was the only breed significantly overrepresented. The major causes of cataracts in this population were breed predisposition, aging, and progressive retinal atrophy.

(Continued on page 9)

(Juvenile Cataracts from page 8)

Gemensky-Metzler AJ, Sheahan JE, Rajala-Schultz PJ, Wilkie DA, Harrington J. Retrospective study of the prevalence of keratoconjunctivitis sicca in diabetic and nondiabetic dogs after phacoemulsification. Vet Ophthalmol. 2015 Nov;18(6):472-80.

Diabetes mellitus occurs commonly in dogs, and often is complicated by the formation of cataracts. In fact, 50% of diabetic dogs have been reported to develop cataracts within 6 months of being diagnosed with cataracts. When cataracts interfere with visual acuity, phacoemulsification is used to help improve vision. It has recently been determined that tear production, as measured using the Schirmer tear test, is significantly lower in diabetic dogs with cataracts than in nondiabetic dogs with cataracts. Therefore, the investigators hypothesized that keratoconjunctivitis sicca would be more common in diabetic dogs after phacoemulsification. This study, which involved 117 nondiabetic dogs and 118 diabetic dogs, determined that the greatest risk for the development of keratoconjunctivitis sicca for all dogs is during the first 2 weeks after surgery, and that the populations at greatest risk are small dogs, small diabetic dogs, and large dogs with preoperative Schirmer tear test results <22 mm/min.

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Keratoconjunctivitis sicca ("Dry Eye")

By Stephanie Shrader, DVM and John Robertson, VMD, PhD

Introduction and Overview

Keratoconjunctivitis sicca (KCS) is a disease of the eyes, characterized by inflammation of the cornea and conjunctiva. This condition occurs secondary to a deficiency in formation of the tear film that normally protects the cornea (Best et al, 2014), which leads to dry, irritated eyes. As a result, KCS is commonly known as "dry eye" or in veterinary terminology, xerophthalmia. This disease occurs often in West Highland White Terriers, but is also common in many other breeds, including Lhasa Apso, English Bulldog, American Cocker Spaniel, English Springer Spaniel, Pekingese, Pug, Chinese Shar Pei, Yorkshire Terrier, Shih Tzu, Miniature Schnauzer, German Shepherd, Doberman Pinscher, and Boston Terrier. While the reported incidence of KCS across all dog breeds ranges from 1% to 2%, there appears to be an increased predisposition reported for both neutered male and female dogs, and for female West Highland White Terriers, in particular.

Relevant Anatomy of the Eye

To understand how KCS develops and ultimately how it is treated, if is important to have a good appreciation of the relevant anatomy of the eye and the glands that produce tears. The relevant components of the eye are the clear outer cornea, the conjunctiva, the eyelids, and the Meibomian and lacrimal glands *(Figure 1A, 1B)*. The Meibomian glands are located along the edge of the eyelid. There are two lacrimal glands associated with each eye. One lacrimal gland is located slightly above and lateral to the eye, and the other is located medially by the third eyelid (also called the nictitating membrane.

How Tears Are Produced

The tear film that covers the eyes is made up of three distinct layers. The outermost layer is made up of oils, which are secreted by the Meibomian glands. This lipid layer provides protection against evaporation, binds the tear film to the cornea, and prevents tears from simply pouring out over the lower eyelid onto the face. The middle layer of the tear film is the aqueous layer, which is produced by the lacrimal glands. As its name would suggest, the aqueous layer consists primarily of water, along with important proteins and enzymes that help remove bacteria and cellular waste material, and lubricate the surface of the cornea. The innermost layer of the tear film is the mucin layer, which is is produced by tiny secretory cells in the conjunctiva known as goblet cells. The mucin layer facilitates the spread of the tear film over the cornea.

What Causes Keratoconjunctivitis sicca?

There are several potential causes of KCS in dogs, which include immune disorders that destroy the lacrimal tissue, diseases that affect the conjunctiva and lacrimal tissue, congenital conditions in which the lacrimal tissue fails to develop, medications, traumatic incidents and treatments. The common feature among these causes is that they impair the ability of the tear-secreting tissues in the eye to perform their basic functions, with the end result being the development of "dry eye".

Immune-Mediated Adenitis: The most common cause of KCS is immune-mediated lacrimal adenitis, which means that the body's own immune system is causing abnormal inflammation of the lacrimal glands. The underlying reason why the immune system targets the lacrimal glands for destruction is unknown, but the end result is infiltration of the glands with lymphocytes and the inability to produce the aqueous layer of the term film. There does not appear to be a specific breed predisposition to this condition.

Common Clinical Findings
West Highland White Terriers at Risk
Red, Irritated Eyes
Pawing at Eyes
Ocular Discharge

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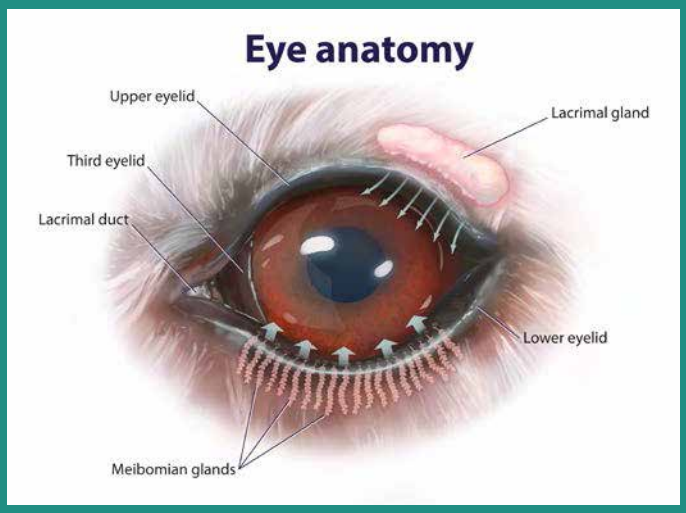

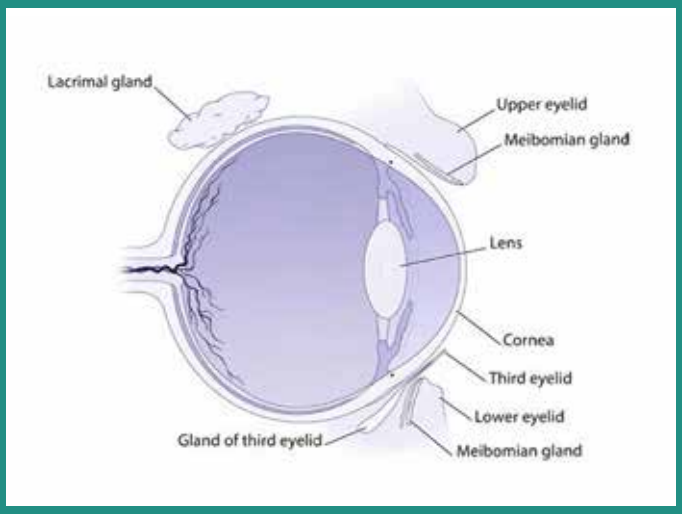

Figure 1A and B - *Two illustrations depicting the important anatomical features of the dog, particularly the locations of the lacrimal and Meibomian glands that are critical to the secretion of the tear film.*

Congenital Acinar Hypoplasia (Congenital Alacrima): As its name implies, this condition is genetic in origin and the term 'alacrima' literally means "no tears." This is an autosomal recessive trait in which the responsible allele is carried on the non-sex determining chromosomes. Thus, if two animals having the recessive trait for alacrima mate, there is a 25% chance that the offspring will inherit the disorder. Breeding dogs that have congenital disorders is problematic, as this practice continues the disease in future offspring. Most breeders monitor the health of litters they have sold, in order to detect the emergence of congenital disorders such as this in litters or breeding stock. Therefore, it is critical that the history and health records of potential breeding pairs are obtained and examined before a puppy at risk of conditions such as this are purchased. There is evidence that Yorkshire Terriers and Bedlington Terriers are overrepresented when compared to reference populations of dogs (Westermeyer et al, 2009).

Drug and anesthesia induced decreases in tear production: Certain drugs/anesthetics can produce either temporary or permanent KCS. A decrease in tear production for up to 24 hours is sometimes noted to occur after anesthesia and surgery, but the inciting cause is unknown. Consequently, it is important for all veterinarians to use a lubricating ointment or fluid to protect eyes during surgery to prevent this temporary decrease in tear production.

There are other drugs whose use have been associated with the development of KCS. These include some of the sulfonamide antibiotics and etodolac, an orally administered nonsteroidal anti-inflammatory drugs that has been used to help relieve pain and inflammation in dogs with osteoarthritis (Klauss et al, 2007). In the latter study, dogs that had received the drug for less than 6 months had a much better chance to complete remission of clinical signs. The investigators advised veterinarians to monitor tear production before and during administration of this drug to ensure that problems can be identified early and drug administration discontinued, if necessary.

Iatrogenic KCS: The term 'iatrogenic' refers to a problem that develops as a result of or associated with a treatment. Consider, for example, a dog that has an abnormal growth involving the gland of the third eyelid (nictitans gland). If this abnormal growth were removed, it could increase the risk that the dog will develop KCS, because that gland is responsible for production of part of the tear film. In fact, this is what happened years ago when a condition caused by inflammation and proliferation of lymphoid tissue near the third eyelid (i.e., "Cherry Eye") was treated by removal the gland. Today, this condition is treated using a combination of medical and surgical treatments instead of removal.

Infectious Diseases: A common viral disease in dogs, canine distemper, is often associated with KCS. Canine distemper is a highly contagious disease that is typically spread via aerosolized respiratory secretions. In most cases, the virus first attacks the respiratory system, and then spreads to the gastrointestinal and nervous systems. When the virus colonizes components of the eye, including the cornea, conjunctiva and the lacrimal glands,

(Continued on page 14)

(Keratoconjunctivitis sicca continued from page 13)

"The common feature among these causes is that they impair the ability of the tear-secreting tissues in the eye to perform their basic functions."

KCS can develop (Gilger, 2009). Consequently, it is extremely important to have all dogs vaccinated against the canine distemper virus.

Metabolic Diseases/Disorders: Tear production has been reported to be reduced in a small number of patients being evaluated for endocrine abnormalities commonly encountered in dogs (Williams et al, 2007). These three conditions were hypothyroidism, diabetes mellitus and hyperadrenocorticism (Cushing's disease). Although the underlying cause or causes for the reduction in tear production were not identified in that clinical study, the investigators suggested that tear production should be measured in dogs with any of these conditions to reduce the chances the damage to the cornea could occur.

Figure 2 - *xamination of a dog's eye using a specialized ophthalmoscope.*

Figure 3 - *An affected eye in a dog with keratoconjunctivitis sicca, characterized by a cloudy cornea and thick ocular discharge.*

Neurologic: Parasympathetic innervation to the lacrimal glands is provided by one of the 12 cranial nerves, namely the facial nerve. Damage to this nerve, either due to disease or trauma, can result in KCS by decreasing the amount of tear film produced. Similarly, damage to the ophthalmic branch of the trigeminal nerve could result in loss of innervation to the lacrimal gland, conjunctiva, and upper eyelids, with the end result being the development of KCS.

How Is Keratoconjunctivitis sicca Diagnosed?

Dogs with KCS are often presented to the veterinarian because they have red/irritated eyes, are pawing at their eyes because they itch and/or hurt, and may have a thick ocular discharge that can range from off-white to green in color. The veterinarian also may notice that the third eyelid is protruded, and that the cornea no longer has its normal shiny appearance *(Figures 2 and 3)*. This latter finding is due to inflammation of the cornea. In advanced cases of disease, there may be evidence of corneal ulceration and pigmentation; corneal scarring may lead to vision loss.

To differentiate KCS from other ocular disorders, the veterinarian will do a comprehensive eye exam that will include a Schirmer tear test, staining of the cornea with fluorescein dye, and evaluation of pressures within the eye for evidence of glaucoma.

Schirmer Tear Test: The Schirmer tear test is a painless diagnostic procedure designed to quantify the amount of tear film produced by the eye. To perform this test, the veterinarian places a thin strip of paper (about an inch long and quarter of an inch wide) just under the dog's eyelid for one minute. This piece of paper has a small scale on it *(Figure 4)*. During the minute, the tear film "wicks" up the paper. At the end of one minute, tear production is quantified by measuring the distance the tear film travelled in the paper. The result is reported in mm/min, with values for normal dogs being >15 mm/min.

(Continued on page 15)

(Keratoconjunctivitis sicca continued from page 14)

Figure 4 - *A packet of standardized Shirmer Tear Test strips that are used to measure tear production.*

Figure 5 - *The eye of a dog with keratoconjunctivitis sicca in which the green fluorescein stain identifies a damaged area of the cornea.*

Application of Fluorescein Stain: Fluorescein is a bright yellow/orange stain that is used to detect corneal ulceration. The veterinarian will place a few drops of the stain in the eye, turn off the exam room lights, and use the ophthalmoscope to determine if corneal ulcers are present *(Figure 5)*. In dogs with KCS, it is not uncommon to also find corneal ulceration because of the chronic irritation.

Examination of Intraocular Pressure: Although changes in intraocular pressure generally do not occur in dogs with KCS, most veterinarians will measure intraocular pressure to rule out another relatively common eye disease, namely glaucoma. Measurement of intraocular pressure is performed in a quick, painless manner using a special handheld device known as a tonometer. Normal intraocular pressure in dogs ranges from 15 to 25 mmHg.

Treatment of Keratoconjunctivitis sicca

There are a variety of treatments for KCS that can be used. These include stimulating the production of tears, replacing the tears, reducing inflammation and controlling bacterial infections. For most dogs with KCS, topical treatments will be required for the life of the animal. Initially, application of topical medications to the eye can be challenging, as some dogs with KCS are painful. Fortunately, with effective management, the level of pain decreases and putting medications in the eyes becomes a routine practice for both dog and owner. Providing rewards as positive reinforcement may help. The following guidelines for deciding when to initiate therapy appear to be reasonable (Best, 2014):

1. Initiate therapy for KCS in all dogs presented with clinical signs of the disease and Schirmer tear test results <5 mm/min.
2. Either initiate therapy for KCS or repeat the Schirmer tear test in one month in breeds predisposed to the disease that have clinical signs of the disease and Schirmer tear test results of 10-15 mm/min.
3. Consider other causes for reduced tear production in dogs presented with clinical signs of the disease and normal Schirmer tear test results.

Stimulating Tear Production: Three drugs are commonly used in an effort to restore tear production in dogs with KCS. Two of these compounds, cyclosporine A and tacrolimus, modulate the immune response that appears to be responsible for the condition in a large number of dogs. They also reduce inflammation, restore production of mucin by goblet cells, and stimulate tear production. These drugs appear to be very effective, positive responses being reported for more than 80% of affected animals (Kaswan et al, 1990; Hendrix et al, 2011). The third compound, pilocarpine, stimulates tear production by interacting with receptors in the lacrimal system. This drug is used when the cause of the condition is determined to be neurogenic in origin (i.e., damage to the nerves involved in tear production).

Replacing Tears: Tear replacement solutions are typically a combination of ingredients that replace one or more components of the tear film. There are three types of solutions, gels and

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(Keratoconjunctivitis sicca continued from page 15)

ointments that are used for this purpose. These include artificial tear solutions that help remove debris and mucus from the surface of the eye. Artificial tear solutions have a relatively short duration of activity, must be reapplied several times a day and are not effective as the sole treatment. Another approach is to use cellulose-based solution and gels that are thicker, last longer and can be applied less often. The most viscous formations, which include lanolin, mineral oil or petrolatum, are used most often for dogs that produce tear film deficient in lipids.

Topical Anti-Bacterial and Anti-Inflammatory Drugs: In some affected animals, there may be a secondary bacterial infection causing the thick, mucopurulent discharge. In these cases, topical ophthalmic anti-bacterial drugs will need to be applied to the eyes 3-4 times daily. These drugs typically include a combination of bacitracin, neomycin and polymyxin. If the conjunctiva are inflamed, many veterinarians also will use topic corticosteroids, such as prednisolone or dexamethasone, to reduce the inflammation. These medications are manufactured as ointments and solutions; your veterinarian will determine which medication is best for your dog.

Surgical Intervention (Parotid Duct Transposition): Some dogs with severe KCS that is unresponsive to medical therapy, may require surgery. To understand the rationale for the surgical procedure used, it first is important to know a bit about the parotid salivary gland that is located behind the jaw and just below the base of the ear. This is the largest salivary gland in the body and produces secretions that aid in chewing and lubricating food and swallowing. Because tears and saliva share similar properties, saliva can be used successfully to treat dogs with severe KCS. The surgical procedure that is performed moves the duct that normally connects the gland with the mouth to a position near the conjunctiva (Figure 6). When this is done, the lubricating and antibacterial secretions from the salivary gland flow onto the surface of the eye. This flow of saliva is intermittent, and increases in response to eating. Veterinarians with experience performing this procedure routinely are most likely to have a successful outcome.

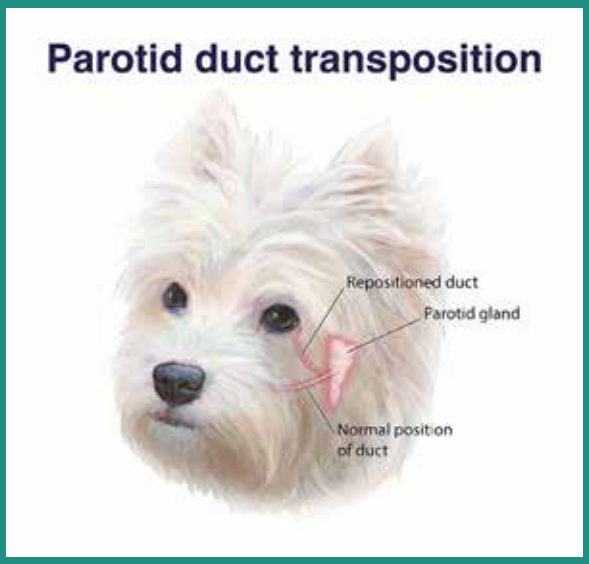

Figure 6 - *An illustration depicting the normal position of the parotid duct where it enters the mouth and its new location adjacent to the eye after the parotid duct transposition surgery has been performed.*

Current Research About Keratoconjunctivitis sicca

The majority of the published studies regarding KCS have centered on its association with other concurrent diseases and on the effectiveness of different treatments. With the increased interest in the effects of diabetes in dogs, the results of a recent study comparing the prevalence of KCS in dogs after treatment of cataracts in dogs with and without diabetes are summarized below. The other two studies selected for review compare the effectiveness of different treatments for the KCS.

Gemensky-Metzler AJ, Sheahan JE, Rajala-Schultz PJ, Wilkie DA, Harrington J. Retrospective study of the prevalence of keratoconjunctivitis sicca in diabetic and nondiabetic dogs after phacoemulsification. Vet Ophthalmol. 2015 Nov;18(6):472-80.

In this study, the occurrence of KCS was compared for 118 diabetic dogs and 117 nondiabetic dogs undergoing a procedure called phacoemulsification for treatment of cataracts. The Schirmer tear test was performed before surgery and several times after surgery for up to one year; a diagnosis of KCS was based on the presence of clinical signs consistent with the disease and Schirmer tear test results < 15 mm/min. The investigators determined that the greatest risk for developing KCS was during the first 2 weeks after surgery, and the animals at greatest risk were small dogs, small diabetic dogs and large dogs with preoperative Schirmer tear test results <22 mm/min. Based on their findings, the investigators suggested that monitoring of tear production and the use of artificial tear supplements immediately after cataract surgery may be warranted for all dogs, but especially for small diabetic dogs.

(Continued on page 17)

(Keratoconjunctivitis sicca continued from page 16)

Chen T, Powell CC. Effect of once daily topical 0.3% naltrexone on tear parameters and corneal sensitivity in dogs with uncontrolled keratoconjunctivitis sicca: a double-masked randomized placebo-controlled clinical trial. Vet Ophthalmol. 2015 Nov;18(6):497-501.

In this study, the investigators evaluated the effectiveness of naltrexone, a drug that normally is given to antagonize the effects of opioids, on tear production and corneal sensitivity in dogs with KCS. The study was based on a previous small study in which two animals had increases in their Schirmer tear test results after being treated with the drug. To eliminate the chance that people involved in the study might be biased if they knew whether or not the drug was being given, they performed this study as a double-masked placebo-controlled trial. This means that the animals either received naltrexone or a commercial saline solution eye wash once daily, without the people involved knowing which was being used until after the study had ended. Sixteen dogs with KCS were involved in the study, and corneal sensitivity and Schirmer tear test results were recorded over 5 weeks. They found no evidence of an increase in tear production or a change in corneal sensitivity, and speculated that this lack of effect may have been due to the chronic nature of the disease in the dogs or the relatively short duration of treatment.

Rhodes M, Heinrich C, Featherstone H, Braus B, Manning S, Cripps PJ, Renwick P. Parotid duct transposition in dogs: a retrospective review of 92 eyes from 1999 to 2009. Vet Ophthalmol. 2012 Jul;15(4):213-22.

Some dogs with KCS fail to respond to medical therapy and develop chronic ocular pain or blindness. In an effort to treat these severely affected dogs, fifty years ago veterinary surgeons began surgically moving the parotid duct to bathe the cornea in saliva. This procedure was widely used until it was determined that cyclosporine was effective in the treatment of KCS. Because relatively few veterinary ophthalmologists now have the training and experience needed to successfully perform the procedure. The investigators in this study consider transposition of the parotid duct a viable technique in the treatment of dogs with severe KCS. The aim of this study was to critically assess the success of this procedure in dogs over a 10-year period. Although there was a 50% complication rate, the overall surgical success rate was 92%, and 90% of owners were satisfied with the outcome.

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Lead, guide and advocate on behalf of Westies.

Develop and communicate to Westie owners, Westie breeders, veterinarians and others who share our challenges.

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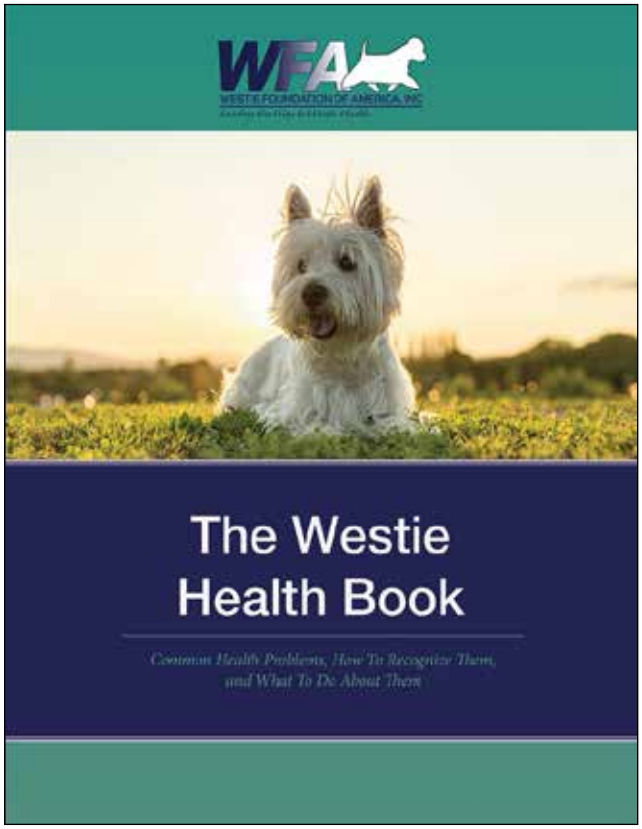

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A printed copy of THE WESTIE HEALTH BOOK provides an easily accessible reference to help ensure your Westie's health. There are up-to-date sections on Westie health, breeding, genetics, common diseases in Westies, complementary and alternative medicine, and sections on each of the health problems affecting our beloved breed, written by the foremost researchers and veterinarians who have the greatest knowledge of our breed.

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Westie Cartoon Caption Contest

Create the winning caption for this Westie cartoon. Please send your caption to bjpinter@msn.com before July 30, 2020. The winner and runner-up will be announced in the next newsletter with their captions.

Create a Caption for this Cartoon

Copy of original watercolour by Ruth Sutcliffe, England

Winning Caption of Last Cartoon!

Donna Rae Summers

"BEST IN SNOW"

WESTIE FOUNDATION OF AMERICA, INC

Leading the Way to Westie Health

OFFICERS

Bebe Pinter, President
428 Hedgecroft Drive
Seabrook, TX 77586
bjpinter@msn.com
(281) 326-3843

Teresa Richardson Barnes, VP – Communications
Independent Counsel
Patient Advocacy & Engagement
338 Greycliff Bluff Drive
St. Louis, MO 63129
TeresaRBarnes@hotmail.com

Marianne Jacobs, VP – Fundraising
4 Agave Court
Ladern Ranch, CA 92694
terriertoys@cox.net

Kay McGuire, DVM, VP – Health
21511 Forest Vista Drive
Humble, TX 77338
kmcscash@aol.com

Susie Stone, Secretary
1202 Fumi Circle
Kettle Falls, WA 99141
sfstone4@outlook.com

Gary Sackett, Treasurer
6440 Sky Pointe Drive, #140-213
Las Vegas, NV 89131
treasurer@westiefoundation.org

Jim McCain, Donor Manager
302 Hemlock Cove
Ball Ground, GA 30107
catercain@gmail.com

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1 Janna Way
Lucas, TX 75002
opeterrpan@aol.com

Dean Nelson, CPA
2520 Resolution Drive
Anchorage, AK 99517
deanwnelson@aol.com

Naomi Brown
2 Ridgecrest Avenue
Fairhaven, MA 02719
ashgateus@comcast.net

Allison Platt
203 N. Slocumb Street
Goldsboro, NC 27530
allisonplatt79@gmail.com

Randy Cantrell
3820 Welwyn Way Drive
Bedford, TX 76021
randycantrell@gmail.com

Mary L. Sahady, CPA
140 Nichols Street
Falls River, MA 02720
mlsahady@gmail.com

Valerie Fadok, DVM, PhD, Diplomate, ACVD
4402 Phil Street
Bellaire, TX 77401
fadokv@aol.com

Anne Sanders
33101 44th Avenue NW
Stanwood, WA 98292
Anne@WestiesNW.com

Stevann Wilson, ESQ
4010 Fountainwood Circle
Georgetown, TX 78633
westie@stevann.com

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