Schirmer tear test, a useful diagnosis tool for the clinician

Teste lacrimal de Schirmer, uma ferramenta diagnóstica útil para o clínico

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ABSTRACT

It was evaluated the Schirmer Tear Test 1 (STT-1) in 100 dogs randomly attended in order to identify its variations and possible relations with the clinical review, disease, breed, age and sex. The STT-1 was accomplished in both eyes in dogs over two years old, females or males. Of these, those whose complaint included ocular clinical signs or those with previously identified ocular disease were excluded from this study. After analysis it were computed 92 dogs (194 eyes), 34 males and 58 females with 7.79 ± 3.7 e 7.76 ± 3.7 years old, respectively. About the breeds, 40.2% were mixed breed, 13.0% Poodle, 6.5% Shihtzu and Basset Hound and 5.4% Pitbull. STT-1 <10mm/min was observed bilaterally in 4.3% of the dogs with mean age 7.4 ± 3.9 years old. Of these, 75% females and 25% males. STT-1 ≥ 10 e ≤ 14 mm/min was observed in 3.2% of the dogs, of these, 66.7% males and 33.3% females, 66.7% mixed breed and 33.3% Teckel. The mean age was 7.6 ± 3.8 years old. About the systemic diseases observed in the animals with STT-1 <10mm/min it were found reproductive apparatus changes(42.8%). It is emphasized the STT-1 in the clinical-surgical veterinary attendance even when the main complaint does not relate the ocular system, mainly in patients over seven years old.

Key-words: dogs, tear film, veterinary ophthalmology, keratoconjunctivitis sicca

RESUMO

Avaliou-se neste estudo o teste lacrimal de Schirmer – tipo 1 (TLS) em 100 cães atendidos aleatoriamente a fim de identificar suas variações e possíveis relações com a resenha clínica, afeição, raça, idade e gênero. O TLS-1 foi realizado em ambos os olhos, em cães com mais de dois anos de idade, fêmeas ou machos. Destes, excluíram-se aqueles cuja queixa incluísse sinais oculares ou os portadores de doença ocular previamente identificada. Após análise, computaram-se 92 cães (194 olhos), 34 machos e 58 fêmeas com 7.79 ± 3.7 e 7.76 ± 3.7 anos de idade, respectivamente. Das raças mais atendidas, 40.2% eram Sem Raça Definida, 13.0% Poodle, 6.5% Shiht-zu e Basset Hound e 5.4% Pitbull. TLS-1 <10mm/min bilateralmente foi observado em 4.3% dos cães com idade média de 7.4 ± 3.9 anos, destes 75% fêmeas e 25% machos. TLS-1 ≥ 10 e ≤ 14 mm/min bilateralmente foi observado em 3.2% dos cães, de destes, 66.7% males e 33.3% females, 66.7% mixed breed e 33.3% Teckel. O mean age was 7.6 ± 3.8 years old. About the systemic diseases observed in the animals with TLS-1 <10mm/min it were found reproductive apparatus changes(42.8%). It is emphasized the TLS-1 in the clinical-surgical veterinary attendance even when the main complaint does not relate the ocular system, mainly in patients over seven years old.

Key-words: dogs, tear film, veterinary ophthalmology, keratoconjunctivitis sicca
observado em 3,2% dos cães, e destes 66,7% machos e 33,3% fêmeas, 66,7,3% Sem Raça Definida e 33,38% Teckel, a idade média foi de 7,6 ± 3,8 anos. Das enfermidades sistêmicas observadas com TLS-1 <10 mm/min destacaram-se alterações envolvendo o aparelho reprodutor (42,8%). Salienta-se a importância do TLS-1 na rotina de atendimento clínico e cirúrgico veterinário, mesmo quando a queixa principal não envolva o sistema ocular, principalmente, em pacientes com mais de sete anos de idade.

Palavras-chave: cão, filme lacrimal, oftalmologia veterinária, ceratoconjuntivite

1 INTRODUCTION

The Schirmer tear test (STT) is a semiquantitative method that measures the amount of the aqueous portion of the tear film, and STT-1 evaluates the basal and tear reflex production being performed in the absence of eyedrops instillation like anesthetics, medications or physiological solution (MAGGS et al., 2013; VERBOVEN et al., 2014). The STT-2 is the basal tear film measurement, for this purpose, instillation of anesthetic eye drops is necessary (MAGGS et al., 2013; VERBOVEN et al., 2014).

In dogs, the STT-1 normal parameter is above 15 mm / minute, below 10 mm / minute is considered positive for keratoconjunctivitis sicca (KCS) and between 10 and 14 mm / minute suspicious (ASTRAUSKAS and CAMARGOS, 2013; MAGGS et al. 2013). The KCS results from lacrimal hypoproduction due to aqueous fraction deficiency and / or by evaporation of this layer (LIMA et al., 2014). The most common causes of KCS include hyperadrenocorticism, hypothyroidism, diabetes mellitus, distemper infection, autoimmune diseases, intoxications (sulfonamide, fenozopyridine and etodolac) (AROCH et al., 2013) nutritional and neurological causes and local radiotherapy (HARTHEY et al., 2006).

The incidence of KCS is high in canine species (LIMA et al., 2014), as well as in humans (BUSNARDO et al., 2013), however, many patients remains undiagnosed or are misdiagnosed, which affects their prognosis. The diagnosis is based on the association of the patient's history, clinical signs and Schirmer test results.

Because of the high number of KCS cases in dogs, this study aimed to verify changes in the STT-1 values in 100 dogs randomly attended to identify its changes and possible relations with the clinical review, disease, breed, age and sex.

2 MATERIALS AND METHODS

This research followed the international guidelines from the Association for Research in Vision and Ophthalmology – ARVO (National Institutes of Health Publications number 85-23: Revised 1985) and was approved and overseen by the Ethics Committee on the Use of Animals from the Franca University (protocol number 019/14).
It were randomly evaluated 100 dogs with ages between two and 18 years old, males and females, castrated and not castrated, with varied weights from the clinical and surgical attendande of the Veterinary Hospital of the University of Franca. Those whose main complaint included ocular signs or those with previously identified eye disease were excluded.

After physical restraint, the measurement of STT-1 was performed between 8 am and 5pm in both eyes with the animal in standing position and without using topical anesthetic by the same veterinary ophthalmologist. It was inserted a small (0.5 cm) piece of graduated filter paper (Tear Flo Diagnostic Test Strips® HUB Pharmaceuticals, Rancho Cucamonga, CA. United States), into the lower fornix of the eye, at the middle portion of lower eyelid for 60 seconds. Direct contact of the filter paper with the evaluator's hands was avoided, because of possible alteration with the results.

Test result was measured in the area of the millimeter filter paper wetted by the tear. Reference value in canine is ≥ 15 mm/minute wetting of the paper; suspicious between 10 – 14 mm/minute; and positive for KCS lower than 9 mm/minute (ASTRAUSKAS and CAMARGOS, 2013; MAGGS et al., 2013). The animals with STT-1 alterations were referred to the Veterinary Ophthalmology sector of the same institution to investigate the possible causes and treatment recommendation.

All tests were performed indoors and under similar temperature and humid conditions, avoiding interference of external factors such as wind and lightness, according to Hartley et al. (2006).

3 RESULTS AND DISCUSSION

From 100 evaluated animals, 40 were males and 60 females. It were excluded eight dogs because two had the main complaint related to the ocular system, two presented mucoid secretion, one presented conjunctival hematoma, one was under glaucoma treatment and another to KCS, and the last because the tutor did not allow the performance of the STT-1.

The low values of STT-1 (<10mm/min) were verified in 4,3% of the dogs, of these, 75% were females and 25% males (Table 1). Alterations in lacrimal production was mainly seen in middle-aged (7,6 ± 3,8 years old) or older dogs, as well as observed by Hartley et al. (2006) and Williams (2008). These authors also affirmed that there are some reports of decreased lacrimal production in older human patients. In dogs, the relation between KCS and senility may be because of reduction of the functional capacity of lacrimal glands and third eyelid (ASTRAUSKAS and CAMARGOS, 2011).
Table 1. Breeds, ages, sex, Schirmer tear test (STT-1)(mm/min) and organ systems or disease of the attendance:

| Number | Breed       | Age | Sex    | STT-1 Right Eye | STT-1 Left Eye | Affected system/disease                  |
|--------|-------------|-----|--------|-----------------|---------------|------------------------------------------|
| 1      | teckel      | 12  | male   | 14              | 14            | Oncology/neurological                    |
| 3      | mixed breed | 6   | female | 10              | 13            | tegumentar                               |
| 4      | poodle      | 5   | female | 20              | 22            | Oral cavity                              |
| 5      | basset hound| 13  | female | 19              | 20            | endocrine                                |
| 6      | mixed breed | 6   | male   | 20              | 18            | locomotor                                |
| 7      | teckel      | 11  | female | 17              | 20            | endocrine                                |
| 8      | shihtzu     | 12  | female | 20              | 18            | locomotor                                |
| 9      | cocker      | 9   | male   | 15              | 12            | Oncology                                  |
| 10     | mixed breed | 12  | female | 20              | 22            | urinary                                  |
| 11     | mixed breed | 5   | male   | 25              | 15            | tegumentar                               |
| 13     | poodle      | 8   | female | 20              | 22            | urinary                                  |
| 16     | mixed breed | 7   | female | 20              | 18            | urinary                                  |
| 17     | poodle      | 15  | female | 0               | 5             | oncology/reproductive/cardiorespiratory  |
| 18     | labrador    | 10  | female | 18              | 19            | neurological/locomotor                   |
| 19     | mixed breed | 12  | female | 18              | 25            | cardiorespiratory                        |
| 20     | mixed breed | 3   | female | 18              | 22            | oncology                                 |
| 21     | poodle      | 4   | female | 0               | 14            | reproductive                             |
| 22     | shihtzu     | 2   | female | 8               | 14            | reproductive                             |
| 24     | basset hound| 5   | female | 24              | 20            | tegumentar                               |
| 25     | basset hound| 14  | female | 15              | 14            | oncology/cardiorespiratory               |
| 26     | poodle      | 14  | female | 18              | 22            | locomotor/cardiorespiratory              |
| 27     | mixed breed | 8   | male   | 18              | 22            | Oral cavity                              |
| 28     | basset hound| 13  | female | 16              | 15            | locomotor/neurological                   |
| 29     | shihtzu     | 8   | male   | 20              | 23            | Oral cavity                              |
| 30     | mixed breed | 4   | female | 22              | 19            | neurological                              |
| 31     | pitbull     | 10  | male   | 20              | 22            | tegumentar                               |
| 32     | mixed breed | 10  | male   | 14              | 5             | oncology                                 |
| 33     | mixed breed | 2   | female | 20              | 22            | tegumentar                               |
| 34     | pitbull     | 11  | female | 20              | 18            | oncology                                 |
| 35     | mixed breed | 5   | female | 25              | 20            | tegumentar                               |
| 36     | teckel      | 4   | female | 20              | 23            | tegumentar                               |
| 37     | pitbull     | 8   | female | 24              | 23            | auditory                                 |
| 38     | pinscher    | 4   | male   | 25              | 30            | tegumentar                               |
| 39     | rottweiler  | 4   | female | 18              | 20            | oncology                                 |
| 40     | mixed breed | 13  | female | 20              | 18            | oncology                                 |
| 41     | boxer       | 7   | male   | 22              | 18            | locomotor                                |
| 42     | border collie| 8   | female | 18              | 20            | locomotor                                |
| 43     | mixed breed | 3   | female | 23              | 18            | auditory                                 |
| 44     | pastor alemão | 4   | female | 20              | 25            | auditory                                 |
| No. | Breed          | Age | Sex | Diagnosis                          |
|-----|----------------|-----|-----|------------------------------------|
| 45  | poodle         | 12  | female | 18 | 20 | oncology                           |
| 46  | poodle         | 11  | male | 28 | 23 | locomotor/oncology                 |
| 47  | pitbull        | 5   | male | 17 | 28 | locomotor                           |
| 50  | mixed breed    | 9   | male | 19 | 23 | urinary/cardiorespiratory          |
| 51  | mixed breed    | 2   | male | 23 | 25 | reproductive?                      |
| 52  | mixed breed    | 11  | female | 18 | 19 | Oral cavity                        |
| 53  | mixed breed    | 5   | male | 18 | 10 | infectious/parasitary disease      |
| 54  | mixed breed    | 7   | female | 30 | 25 | neurological                        |
| 55  | mixed breed    | 5   | female | 18 | 25 | neurological                        |
| 56  | shihtzu        | 4   | male | 25 | 13 | auditory                            |
| 57  | shihtzu        | 4   | male | 25 | 20 | general inspection                 |
| 58  | poodle         | 15  | female | 20 | 18 | auditory                            |
| 59  | mixed breed    | 4   | female | 20 | 20 | reproductive                        |
| 60  | mixed breed    | 5   | female | 16 | 25 | tegumentar                          |
| 62  | pinscher       | 11  | male | 15 | 16 | soft tissue                         |
| 63  | poodle         | 11  | male | 23 | 17 | locomotor                           |
| 64  | teckel         | 8   | female | 12 | 23 | cardiorespiratory/locomotor        |
| 65  | rottweiler     | 8   | male | 4  | 9  | locomotor                           |
| 66  | mixed breed    | 12  | female | 15 | 16 | Reproductive/cardiorespiratory     |
| 67  | fila brasileiro| 6   | female | 5  | 0  | auditory                            |
| 68  | mixed breed    | 13  | female | 15 | 20 | oncology                            |
| 69  | mixed breed    | 5   | female | 24 | 28 | Reproductive?                      |
| 70  | rottweiler     | 8   | female | 15 | 14 | oncology                            |
| 71  | mixed breed    | 5   | female | 16 | 19 | locomotor                           |
| 72  | mixed breed    | 6   | female | 17 | 20 | soft tissue                         |
| 73  | labrador       | 12  | male | 20 | 29 | oncology                            |
| 74  | fox terrier    | 4   | male | 18 | 15 | locomotor                           |
| 75  | mixed breed    | 6   | female | 18 | 24 | infectious/parasitary disease      |
| 76  | pug            | 8   | female | 20 | 18 | oncology                            |
| 77  | mixed breed    | 4   | female | 22 | 24 | reproductive                        |
| 78  | basset hound   | 6   | male | 18 | 20 | neurological                        |
| 79  | poodle         | 9   | female | 20 | 24 | endocrine                           |
| 80  | mixed breed    | 2   | female | 18 | 20 | auditory                            |
| 81  | pointer        | 7   | female | 24 | 23 | endocrine                           |
| 82  | poodle         | 5   | male | 12 | 16 | neurological/locomotor             |
| 83  | mixed breed    | 4   | female | 13 | 24 | neurological                        |
| 84  | mixed breed    | 12  | male | 19 | 25 | cardiorespiratory                  |
| 85  | labrador       | 11  | male | 20 | 18 | locomotor                           |
| 86  | blue heller    | 3   | female | 21 | 26 | infectious/parasitary disease      |
| 87  | shihtzu        | 2   | female | 17 | 19 | endocrine                           |
| 88  | mixed breed    | 5   | male | 20 | 22 | auditory                            |
| 89  | cocker spaniel | 18  | male | 20 | 18 | oncology                            |
The KCS incidence in the canine species is high (LIMA et al., 2014) as well as in humans (BUSNARDO et al., 2013), however, countless patients are wrongly diagnosed undiagnosed or misdiagnosed which significantly disfavors the prognosis. The STT-1 has been considered for more than 30 years as the standard semi-quantitative diagnosis, for being practice, minimal invasive, quickly, and low cost (BROADWATER et al., 2010). In this study, we selected the standardized commercial label for schirmer test strips, because type, width and thickness of the material could interfere in absorption, thus affecting the results of the lacrimal genesis (LAUS et al., 1995; VERBOVEN et al., 2014).

One dog was excessive reluctant about the physical restraint and just one sample of the STT-1 was collected. This patient was excluded because Broadwater et al. (2010) stated that stress may cause sympathetic stimulation and temporarily minimize the tear production, interfering in the obtained results during the experimentation.

The criteria of inclusion of adult animals in this study was based on other report recorded by Broadwater et al. (2010), in which they described that tissues and ocular attachments of puppies are not fully developed during the first weeks of life, occurring significant decrease of lacrimal production. Furthermore, Verboven et al. (2014) also point out that the eye is immature at birth, making it impossible to evaluate in a proper ophthalmologic exam.

All animals in the present study were seen during the day, that is, between 8 and 17 hours, as according to Giannetto et al. (2009), in dogs, observed that dogs showed more STT-1 alterations during nocturnal phase when compared to diurnal phase with an increase of 2.31 mm/minute between them, suggesting the circadian rhythms in tear production.

Lagoftalmia is frequently observed in brachycephalic dogs and it disfavours the ocular surface lubrication besides there is a precocious evaporation of the tear film, leading to corneal dehydration, mainly in its central region (WILLIAMS, 2008). Despite only 8.7% of all dogs of this study are

|   |   |   |   |   |   |
|---|---|---|---|---|---|
|   |   |   |   |   |   |
| 90 | mixed breed | 7 | female | 22 | auditory |
| 91 | pinscher | 14 | male | 20 | locomotor |
| 92 | poodle | 7 | female | 24 | oral cavity |
| 93 | labrador | 9 | male | 20 | tegumentar |
| 94 | yorkshire | 5 | male | 20 | tegumentar |
| 95 | mixed breed | 12 | male | 18 | oral cavity |
| 96 | basset hound | 12 | male | 14 | cardiorespiratory |
| 97 | yorkshire | 7 | female | 9 | oral cavity |
| 98 | mixed breed | 10 | female | 8 | reproductive |
| 99 | mixed breed | 5 | male | 14 | infectious/parasitary disease |
| 100 | pitbull | 5 | female | 20 | reproductive |
brachycephalic breeds like Shihtzu (75%), Boxer (12.5%) and Pug (12.5%) it was observed that 33.3% of the Shihtzus presented STT-1 below 15mm/min.

The STT-1 alterations observed in Yorkshire’s breed, congenital acinar hypoplasia was not ruled out, although infrequent in the canine species, it affects miniature breeds, especially females (GIULIANO and MOORE, 2007).

Despite Astrauskas and Camargos (2011) and Lima et al. (2014) reported that the most dogs with KCS have bilateral involvement, it was not observed in this study this relationship, because the bilateral affection occurred in 4.9% whilst unilateral affection was observed in 7.6% of the dogs.

Among the neurological disorders observed, distemper was the most common alteration. Distemper may cause temporarily or permanent KCS (MARTINS et al., 2009), one of the proposed mechanism of action is to promote conjunctival adenitis, characterized by mononuclear and neutrophilic inflammatory infiltrate and degenerative alterations in glandular tissue leading to lacrimal reduction (RIBEIRO et al., 2008). Still Aroch et al. (2013) explained that 50-70% of the infection are subclinical, corroborating the results of the present study which had low tear production and no ocular clinical signs manifestation.

This study also observed two dogs affected by inflammatory disease of the ear with one female and male dog affected bilateral and unilateral, respectively, with KCS. Accordingly, to Stades et al. (1999) inflammatory diseases of the ear can promote sympathetic alterations of the lacrimal glands leading to KCS.

Endocrine diseases like diabetes mellitus, hyperadrenocorticism and hypothyroidism, significantly decrease the lacrimal production both in dogs and humans (WILLIAMS et al., 2007; RIBEIRO et al., 2008). In this study the dogs identified with endocrine disorders did not present STT-1 less than 15 mm/min.

Animals with altered STT-1, no breed predisposition to KCS and no systemic illness associated to reduction of lacrimal production, probably had atrophy of the lacrimal glands secondary to senility, corroborating with descriptions of Astrauskas and Camargos (2011). Moreover, any factor that could destabilize the tear film and generates an increase in the evaporation of the aqueous layer may also contribute to the onset of KCS, such as direct contact with air conditioner, fans, the wind impact during car rides, use of dryers after baths, exposure to irritating products such as shampoos and perfumes and environmental pollution or low humidity (LAUS et al., 1995).

**4 CONCLUSIONS**

According to the applied methodology and its results it was concluded that the STT-1 accomplishment in the clinical and surgical attendance routine is important mainly in elderly dogs,
even that ocular clinical signs are absent, once tear production decreasing may be related to systemic diseases and breed predisposition.

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