

# Grading Scheme and Treatment Protocols for Chronic Superficial Keratitis in Dogs

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## ABSTRACT

A retrospective study of 53 dogs diagnosed with chronic superficial keratitis (CSK) was performed, allowing the creation of a grading scheme for the extension of the disease. Three different treatment protocols were prescribed and response to treatment and possible risk factors were analyzed. Every patient underwent a complete ophthalmic exam. Based on the extent of corneal lesions, CSK was classified in three stages: initial (Stage I), moderate (Stage II) and advanced (Stage III). Vision impairment was evaluated. Initial treatment consisted on topical cyclosporine A 2%, or combination with topical corticosteroids. In more advance cases a four week cycle of oral prednisolone was also added to the prescription. Nevertheless, the approach was conditioned by the general health of the patient or presence of other ophthalmic diseases. Hemoparasite infection as a possible risk factor for disease rapid progression was analyzed. Descriptive statistics were calculated and  $p < 0.05$  was considered statistically significant.

In the studied population middle-aged dogs (4-7 years old) were the most affected, with statistically significant differences between age groups ( $p < 0,01$ ). Seventy-six percent were

German Shepherds and its crosses, 11% mixed breed dogs, 6% Belgian Shepherds and its crosses, 2% Siberian Husky and 2% Portuguese Fila de S. Miguel. Sexual predisposition was not found ( $p=0,29$ ). In 94% of the cases the disease was bilateral. Regarding lesion extent, 23% of the patients were in stage I, 30% in stage II and 47% in stage III of the disease. Vision was considered unaffected in 38% of the patients, affected in 45%, while 17% were considered blind.

Based on the extent of the corneal lesions, a grading scheme for the disease considering three stages of CSK was proposed, which is of value to classify the patients on initial presentation, helping in the choice of a treatment protocol and evaluate their evolution. Results of this study may be of help to both veterinary ophthalmologists and general clinicians.

## INTRODUCTION

Chronic superficial keratitis (CSK), also known as Pannus or Überreiter's syndrome, is a progressive, inflammatory, and potentially blinding disease that affects the canine cornea [1]. It is characterized by the infiltration of the epithelium and superficial corneal stroma with plasma cells and lymphocytes, neovascularization, granulation tissue and pigment [2]. Normally the lesions of CSK start at the temporal inferior limbus and progress centrally. With time, corneal neovascularization also affects nasal inferior limbus and extends centrally. The superior portion of the cornea usually remains unaffected until late in the disease. Eventually, the entire cornea may become vascularized, pigmented, and scarred [1].

Although the cause of CSK has not been established yet, it is believed to be an immune-mediated disease in which UV-radiation is one important factor in the potentiation of the symptoms [3]. This disease is relatively common in Portugal, probably due to its Mediterranean climate and high solar incidence. This study aimed to characterize the studied population, clinical characteristics of the disease, propose a grading scheme and adequate therapeutic protocols according to the severity of CSK, clinical outcomes and owners' compliance. It also intended to assess possible risk factors, the need for complementary diagnostic tests and the frequency with which concomitant ocular or systemic diseases were diagnosed.

## MATERIAL E METHODS

A 10-year retrospective study about CSK in domestic dogs was carried out (2002-2012) that included 53 cases that presented to the Ophthalmology Department of the Teaching Hospital at the Veterinary Faculty of Lisbon University and were diagnosed with CSK. All patients underwent a complete ophthalmic examination including: evaluation of menace response and ophthalmic reflexes (palpebral, corneal and pupillary light reflexes); Schirmer I tear test; Slit-lamp Biomicroscopy (SL-15 Portable Slit Lamp®, Kowa, Tokyo, Japan) and applanation tonometry (Tonopen®, Medtronic Solan, North Jacksonville, U.S.A.).

Whenever possible, direct (Welch Allyn® Direct Ophthalmoscope, New York, USA) or indirect (Welch Allyn® Indirect Ophthalmoscope, New York, USA) funduscopy was performed.

Some of the dogs included in this study performed additionally complementary diagnostic tests, such as ocular cytology and detection of concomitant systemic diseases that could potentially worsen ocular symptoms.

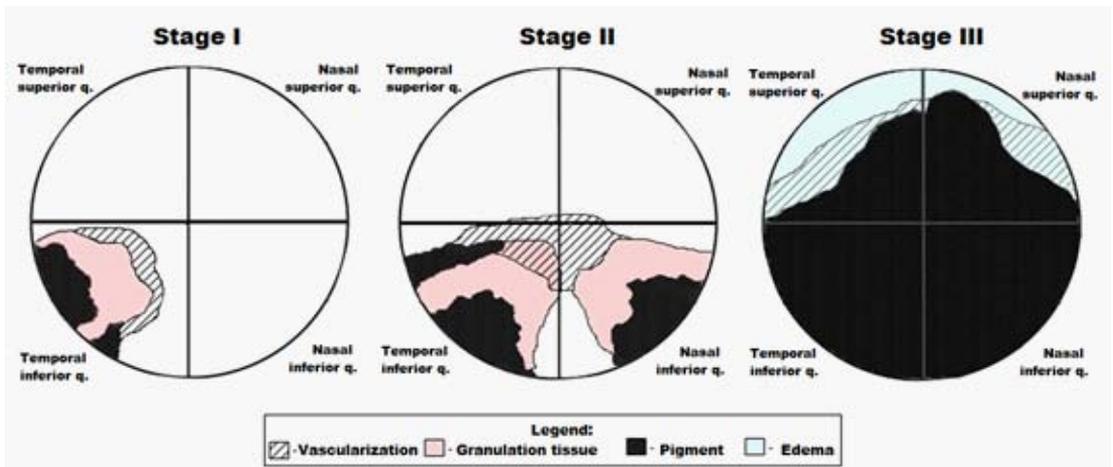
Statistical analysis was performed to:

- Characterize the study sample in terms of gender, breed and age at initial consultation. Concerning the gender, a second analysis was performed, excluding patients belonging to the Military Forces, to avoid bias in the results, since they were all male (n=7). The corrected sample size was n=45;
- Characterize ophthalmic lesions - uni or bilateral, CSK classification, presence of corneal edema and statistical association between this clinical manifestation and CSK classification, presence of other concomitant ophthalmic conditions, namely depigmentation of the nictitating membrane, corneal dystrophy and others;
- Assessing visual capacity - classified as normal, compromised or absent (see 3.1) and analyze the statistical relationship between the CSK stage and visual capacity;
- Evaluation of frequency of further diagnostic exams (ocular cytology and investigation of infection by *Leishmania spp.*, *Ehrlichia canis*, *Rickettsia conorii* and *Babesia Canis*) and their results;
- To describe therapeutic options - descriptive analysis and its relation with CSK stage.
- Medical treatment - frequency of prescription of different medical therapeutic approaches (listed in 3.2), as well as their relation to the CSK stage (n=53). The therapeutic success was also evaluated (in this analysis, we only compared results from patients that were reassessed up to 3 months after initial consultation) and their relation to owners' compliance (n=21).
- Surgical treatment - relative frequency with which this option was proposed versus performed, as well as the therapeutic result.

## Classification of Ophthalmic Lesions and Visual Capacity

In this study, a classification of CSK was proposed including three stages, depending exclusively on the extent of corneal lesions. In stages I, II and III, the lesions were considered, respectively, initial, moderate and advanced.

The lesions were classified as stage I when only one quadrant of the cornea was affected, moderate lesions (stage II) when there were two affected quadrants, and advanced lesions (stage III) when there were more than two quadrants affected (Figure 1).



**Figure 1:** Schematic drawing of the right eye with examples of corneal lesions in the different stages of CSK: stage I <1 quadrant affected; stage II with 1 to 2 affected quadrants; stage III >2 affected quadrants.

This characterization is independent of the corneal lesion, which may be neovascularization, granulation tissue, pigment and / or corneal edema. Since most of the times lesions are asymmetrical, we characterize CSK stage considering the most severely affected eye.

The visual capacity of the patients was classified as normal, compromised or absent, according to the criteria shown in (Table 1).

**Table 1:** Criteria for assessing patients' visual capacity.

Visual capacity	Corneal lesions	Pupillary light reflexes	Menace response
Normal	They do not affect the patient's axis of vision (corresponding to the pupillary opening)	Normal	Normal
Compromised	It partially covers the pupillary opening, obstructing part of the patient's axis of vision	Normal	Normal
Absent	Corneal opacity totally covers the patient's axis of vision	Normal / Not evaluable	Decreased or absent

## Medical Treatment of CSK

For descriptive analysis of the medical treatment protocol, three different therapeutic approaches were considered for CSK:

- Monotherapy with topical cyclosporin A;
- Combination therapy with topical cyclosporin A and topical corticosteroid;
- Combined therapy with topical cyclosporin A, topical corticosteroid and oral systemic corticosteroid.

The choice of the approach depended, essentially, on the extent and severity of CSK lesions, and was conditioned by the general health of the patient and the existence of concomitant diseases.

Ophthalmic ointment of cyclosporine A was prescribed at concentrations of 0.2% or 2%. Topical prednisolone was prescribed as an ophthalmic ointment to increase the time of contact between medication and cornea. Prednisolone was the systemic corticosteroid of choice.

The frequency of ointment applications (once or twice a day) was not taken into account for statistical purposes.

When used for CSK treatment, oral prednisolone was prescribed according to the following therapeutic protocol: 0.5-1mg/kg BID, 8 days + 0.5-1mg/kg SID, 8 days + 0.5-0.25mg/kg SID, 8 days + 0.5-0.25mg/kg QUOD, 8 days.

## STATISTICAL ANALYSIS

In this study, a database was initially created through the Excel® program. R© version 2.13.0 program for Windows (R Development Core Team, 2011) and its extension, R Commander© version 1.6-4 was used for data analysis.

Descriptive statistics of quantitative variables (mean ± standard deviation) and relative and absolute frequencies of several categorical variables (eg: gender, breeds, age groups, CSK stages, etc.) were performed.

The comparison of categorical variables (gender, age groups) was performed using the chi- -square test.

Fisher exact test was used to identify statistical associations between categorical variables (e.g. presence of edema versus classification of CSK, visual capacity versus CSK stage and owners' compliance versus treatment outcome).

For all data analyzes, a 95% confidence level interval was considered and therefore all values of  $p < 0.05$  were considered as statistically significant.

## RESULTS

### Characterization of the Sample

In the studied sample, the German Shepherd breed (66%) and its crosses presented a higher prevalence, with 77.4% of the cases (41/53). CSK was also diagnosed in mixed breeds dogs (11,3%), Belgian Shepherds and its crosses (6%), Siberian Husky (2%), São Miguel Cattle Dog (Portuguese breed) (2%) and in a Portuguese Pointer cross (2%).

At the initial consultation, the patients had a mean age of  $6 \pm 2.3$  years, with a minimum of 2 years and a maximum of 11 years.

When evaluated by age groups, 11.3% of the sample was less than 4 years old, 62.3% were between 4 and 7 years old, and 26.4% of the patients were older than 7 years at diagnosis. In this analysis there were statistically significant differences ( $p < 0.01$ ), confirming that CSK was more often diagnosed in patients between 4 and 7 years old.

Regarding gender, 64.2% (34/53) were males and 35.8% were females (19/53), with a statistically significant difference between genders ( $p < 0.05$ ). However, when excluding from the analysis the patients belonging to the Military Forces (all males, due to male preference for these tasks), 57.8% (26/45) were males and 42.2% (19/45) were females; with this analysis we can no longer identify statistically significant differences between groups ( $p = 0.29$ ).

## Characterization of Ophthalmic Lesions

In the studied sample, lesions occurred in both eyes in 94.3% (50/53) of the patients and were unilateral in 5.7% (3/53).

The CSK was divided into three stages according exclusively to the extent of the lesions. In 22.6% (12/53) of the cases the CSK was classified as stage I, in 30.2% (16/53) as stage II and 47.2% (25/53) as stage III.



Left eye of a patient with CSK classified as stage I.

Right eye of a patient with CSK classified as stage II.

Left eye of a patient with CSK classified as stage III.

**Figure 2:** Ocular photographs of patients classified in the three stages of CSK.

Nevertheless this classification doesn't take into account different types of tissue (neovascularization, granulation tissue and pigment), which may justify different responses to the treatment and also demonstrate the chronicity of the process.



**Figure 3:** Photographs of both eyes of a patient with more acute evolution of CSK. Note the extensive deposition of granulation tissue in both corneas. CSK was classified as stage III.



**Figure 4:** Photographs of both eyes of a patient with more chronic evolution of CSK. Note the heavily deposition of pigment in both corneas. CSK was also classified as stage III.

Corneal edema was present in 26.4% of the cases (14/53). When the stage of CSK was related to the presence of corneal edema, it was possible to verify that this edema was detectable only in the CSK stages II and III, mainly in the advanced lesions (stage III). A statistically significant association was observed between the two variables ( $p < 0.01$ ).

The frequency of diagnoses of other ocular diseases concomitant with CSK in the studied sample was evaluated. The depigmentation of nictitating membrane appeared in 71.7% (38/53) of the patients. Corneal dystrophy was observed in 20.8% of the patients (11/53), from which 11.3% (6/53) were diagnosed at the initial consultation, and the rest subsequently developed corneal dystrophy.

The presence of other ocular diseases occurred in 8 patients (15.1%). Each presented one of the following diseases: glaucoma, uveitis, keratoconjunctivitis sicca, corneal ulcer, cataracts, age-related lenticular sclerosis, vitreitis and chorioretinitis lesions.

## Assessment of Vision Capacity

It was determined that visual capacity was normal in 37.7% of the patients, compromised in 45.3% and absent in 17%.

Since the extension of the lesions is an obstacle to vision, the relation between the visual capacity and the CSK stages was evaluated and a statistically significant association between the two variables was identified ( $p < 0.001$ ).

## Complementary Diagnostic Exams

Corneal cytology was performed in 3 of the patients (5,7%), and the results were: inconclusive in one case (cytology without enough cells); compatible with CSK in another case (identification of inflammatory cells, but no plasma cells) and diagnostic in the third case (plasma cells identified).

Of the 53 cases studied, 13.2% performed screening for Leishmaniosis and hemoparasites. In 11.3% of the cases screening was proposed but owners did not allow it. The remaining 75.5% were not advised to do any screening for concomitant diseases.

Of the seven patients tested for concomitant diseases, five (71.4%) were infected with at least one hemoparasite: *Rickettsia conorii* infection was the most frequent (57.1% in 4/7), followed by infection with *Erichiacanis* (29.6% in 2/7) and *Babesiacanis* (14.3% in 1/7). None of the cases were positive for Leishmaniosis, with only a suspicious result (14.3% in 1/7), but the patient did not repeat the screening to confirm the outcome.

## Treatment of CSK

### Medical Treatment

As previously described, three therapeutic approaches for CSK were considered in the initial consultation:

- Monotherapy with topical cyclosporin A (first approach), which was prescribed in only 5.6% (3/53) of the cases;
- Combination therapy with topical cyclosporin A and topical corticosteroid (second approach) prescribed in 39.6% (21/53) of the patients;
- And combined therapy with topical cyclosporin A, topical corticosteroid and oral systemic corticosteroid (third approach), prescribed in the majority of cases (52.8% in 28/53).

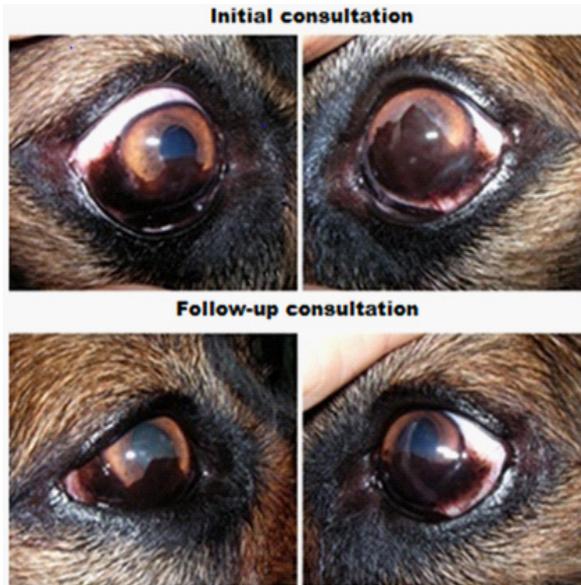
On patients with CSK stage I, the second approach was the most common (9/11), while the first approach was only chosen in two cases (2/11). In patients with CSK stage II, both second (8/16) and third (8/16) approaches were chosen. In patients with CSK stage III, the vast majority of cases required a more intensive medical approach (third approach) (20/25); some of these advanced cases received only topical treatment for medical reasons (5/25).

### Clinical evolution up to three months after the initial consultation

The minimum follow-up period was 15 days, and the maximum period was 3 and half years (n=28).

For the present analysis, the time interval considered acceptable for comparison of results was 3 months after initial consultation (n=21).

In the first three months after initial consultation, all patients improved or maintained the following parameters: clinical signs, classification of CSK stage and visual capacity.



OD and OS, respectively, in the initial consultation. CSK classified as stage III (OS with pigmented keratitis in more than 2 quadrants) and visual impairment.

OD and OS, respectively, at the follow - up visit (2 months after initial consultation). Clinical improvements were achieved: subtle in OD but evident in OS. In OS pigment deposition only occupies two corneal quadrants. Improved CSK classification (for stage II). Maintained visual impairment.

**Figure 5:** Compilation of a patient's ocular photographs at the initial consultation and follow-up visit (performed two months after the initial consultation).

Thus, it was concluded that 90.5% had a positive clinical outcome in the follow-up consultation(s), while 42.9% and 33.3% of the patients improved CSK stage and visual capacity, respectively.

When asked about their compliance, 81.0% (19/21) of the owners stated that they had correctly administered all the prescribed therapy. The others admitted that they had only partially complied.

The analysis identified a statistically significant association between improvement in clinical signs and owners' compliance ( $p < 0.05$ ). However, the same did not occur with changes in visual capacity ( $p = 1$ ) and CSK stage classification ( $p = 0.60$ ).

## Surgical Treatment

Five patients (9.4%) were considered possible surgical candidates, but only one patient underwent superficial keratectomy (1.9%).

The patient submitted to superficial keratectomy showed evident clinical improvements 15 days after surgery. Despite good owner compliance, four months after superficial keratectomy, pigmented keratitis recurred, but it was possible to preserve patient's vision.

## DISCUSSION

Based on the extent of the corneal lesions, a grading scheme for the progression of the disease considering three stages of CSK was proposed in this study, which is of value to classify the patients on initial presentation, help in the selection of an adequate treatment protocol and evaluate their evolution.

Breed predilection for development of CSK among German Shepherd Dogs has already been recognized [2-5]. In a study by Slatter *et al.* [2], this breed represented 82% of the sample. In the present study, the German Shepherd Dogs and its crosses represented 77.4% of the sample.

Despite the strong predisposition of the German Shepherd breed, there are other breeds prone to develop CSK, such as the Belgian Shepherd and the Siberian Husky [1], which are also represented in the studied sample. Results of the characterization of the studied sample are in agreement with the literature.

Yet, CSK can develop in any breed [2,4]. Indeed, in the studied sample, CSK has been diagnosed in several mix breed dogs, in a Portuguese Pointer crossbreed in another Portuguese breed called São Miguel Cattle Dog.

CSK occurs more frequently in middle-aged animals [2,3]. According to Chavkin *et al.* [3] dogs between 4 and 7 years old were 2.36 times more likely to present with the disease than dogs less than 4 years old.

In the present study, following the same age-group stratification, dogs 4 to 7 years old were the most affected (62.3%), with statistically significant differences between age-groups ( $p > 0,01$ ).

Concerning gender, most authors agree that there is no gender predilection on CSK [4]. However, contradictory results have been published in some studies regarding gender predisposition [2,3,5].

In the present study, 64.3% of the 53 patients included in the study were males. When an additional gender analysis was carried out excluding dogs from the Military Forces, in order to avoid bias in results, the male percentage dropped to 57.8%, resulting in no statistically significant difference between gender distributions.

So, with this additional analysis, and in agreement with most authors [2,4], there seems to be no sexual predisposition in CSK.

In the present study, 94.3% of the patients had bilateral CSK lesions. These results were similar to those described in the literature, which states that 93% of the cases are bilateral, although asymmetrical [4].

The CSK classification proposed in the present study is useful for assessing the extension of the lesions, allowing a notion of the severity of the disease and measuring its clinical evolution.

In almost half of the patients (47.2%), CSK was classified in stage III at the initial consultation. This high percentage of patients with advanced CSK is in most cases justified by the delay of owners in taking their animals to specialized consultations. For the same reasons, only 22.6% of the cases were classified as stage I.

Although the classification of the CSK in stages tries to evidence the severity of the lesions, it only took into account their extent. Nevertheless, the appearance of different types of tissue (neovascularization, granulation tissue and pigment) may justify different responses to the treatment and also demonstrate the chronicity of the process.

In the early stages of CSK, neovascularization and corneal infiltration with granulation tissue arise [6]. The presence of granulation tissue may even prevent the patient's eyesight, but it can be easily reverted through medical therapy. The development of scarred tissue with pigment in the cornea occurs in later stages of the disease, evidencing chronic processes. Because it is more difficult to revert medically, corneal lesions with heavily pigment deposition are considered more serious [1,6].

CSK is also characterized by the presence of corneal edema, which occurs due to the presence of neovascularization [1]. Although it is not detectable in all patients, in this study it was possible to prove a statistically significant association between detectable corneal edema and the stage of CSK, with corneal edema being perceptible in more advanced CSK stages. To the best of our knowledge this is the first time this association is recognized.

The presence of ocular diseases concomitant with CSK is possible and has therefore been analyzed in the present study. We identified corneal lipid dystrophy, depigmentation of the nictitating membrane glaucoma, uveitis, corneal ulcer, keratoconjunctivitis sicca, cataracts, age-related lenticular sclerosis, vitreitis or chorioretinitis lesions.

The ocular diseases most frequently associated with CSK were corneal lipid dystrophy and depigmentation of the nictitating membrane [2,7,8].

It is reported that in chronic cases lipid deposition in the corneal stroma is common to complicate CSK symptoms [2,8]. In the present study, we found corneal lipid dystrophy in 20.8% of patients considering initial and follow-up visits.

In depigmentation of the nictitating membrane, the third eyelid can appear inflamed, grey, distorted, with loss of pigment and the free edge can appear pink and scalloped, which is associated

with plasma cell infiltration [6]. Yet, this is rarely of significance except in diagnosis [8]. Martin [7] reported that this association occurred in about 10% of dogs with CSK. However, in this study, the prevalence of depigmentation of nictitating membrane was much higher, occurring in 71.7% of the cases.

The majority of the patients (45.3%) had compromised vision at the initial consultation and 17% of the patients were considered blind. The statistical association found between visual ability and CSK stages confirms that it is the very extent of CSK lesions that constitutes an obstacle to vision, although this may be reversible with treatment [1].

In most cases, breed and ophthalmologic examination (by the typical appearance and location of the lesions) allow the presumptive diagnosis of CSK. In atypical cases, cytology allows for the diagnosis [1,9]. In the present study, only three of the patients were subjected to an ocular cytology - one of the exams was inconclusive due to insufficient collection of cells; another was compatible with CSK, despite the absence of plasma cells and only in the third case the presence of plasma cells was diagnostic for CSK. Thus, it is considered that ocular cytology is dispensable in the diagnosis of CSK, since it is not always conclusive and the typical clinical signs are usually enough to obtain it.

To date, no causal organisms have been demonstrated for CSK [10,11], but in the present study it is proposed that concomitant infections with hemoparasites or *Leishmania sp.* are aggravating factors of CSK. Although the eyeball is considered an immunologically privileged site [4], it is often affected by ocular repercussions of systemic diseases.

According to Bistner [12], the eyeball is susceptible to the development of immune-mediated disease. Indeed, the most accepted assumption of the origin of CSK describes the process as an immune-mediated response [3,13].

The detection of *Leishmania sp.*, *Ehrlichia canis*, *Rickettsia conorii* and *Babesia canis* were accomplished since canine leishmaniosis is endemic in Portugal [14] and canine ehrlichiosis, rickettsiosis and babesiosis are the hemoparasites more frequently diagnosed in our Hospital [15].

These infections may trigger a cell-mediated inflammatory reaction, not only in the uvea, but also in the corneal-scleral limbus. Due to the immune-mediated characteristics of CSK, the presence of ocular inflammation may be a triggering or aggravating factor of CSK in animals susceptible to developing the disease.

Of the seven patients who performed the recommended screening, five were positive for one or more agents.

To date, no studies have been found that refer to the association between CSK and leishmaniosis or canine hemoparasitosis, this being the first time this hypothesis has been raised. In the future,

it would be interesting to study the hypothesis that infection with some of these pathogens that often cause intraocular inflammation may be a triggering and/or aggravating factor for CSK.

In order to analyze the medical approaches, only the specific medical treatment for CSK and the prescription at initial consultation were considered.

In most patients, the most intensive therapy (third approach) was prescribed at the initial consultation. Since moderate to advanced lesions prevailed in the study sample and clinical improvements should be evident within a minimum period of 3 to 4 weeks after initiation of treatment [8], more intensive treatments were required.

The therapeutic approach applied depended essentially on the severity and extent of CSK lesions, and therefore the choice of therapeutic approaches according to the stage of CSK has been analyzed. The treatment approach can still be conditioned by the general health of the patient and the existence of concomitant diseases that may contraindicate the use of some medications, so the prescription of more aggressive therapies was decided on a case-by-case basis. Nevertheless, it was possible to observe the tendency to choose more intensive treatments as the lesion extension increased.

In the treatment of patients with stage I CSK, only topical therapy was used, mainly the second approach. In patients with stage II CSK, combination therapies were always the option. In half of these cases, more aggressive therapy with systemic oral corticosteroid was prescribed for faster elimination of granulation tissue and consequently more significant and rapid improvements in the initial phase of treatment.

Though it would be expected that patients with CSK grade III would be treated exclusively with the most aggressive therapy (third approach), this was only observed in 80% of the cases (20/25); in the remaining patients only topical treatment was prescribed for clinical reasons due to contraindications for the use of systemic corticosteroids.

To evaluate the therapeutic response, it was necessary to create a temporal criterion to perform the analysis, to have comparable results. It should be noted that in the first three months after initial consultation, no patient worsened CSK symptomatology, visual capacity or CSK stage.

Concerning the clinical results, the great majority of patients (90.5%) included in the analysis showed of the lesions three months after initial consultation.

However, when the visual capacity evolution and CSK classification were evaluated, there were only improvements in 33.3% and 42.9% of the patients, respectively. This happened because not all clinical improvements were sufficient to change CSK stage and visual assessment. In addition, patients who have been evaluated with normal visual capacity and / or stage I CSK could not improve these ratings.

It must be explained to the owner that life-long therapy is necessary [8]. In fact, owners' compliance is critical to CSK's therapeutic success and control.

The vast majority of owners (81% in 17/21) said they had administered all medical therapy correctly during the first 3 months after initial consultation.

When the statistical association between evolution of clinical signs (during the period considered) and owners' compliance was evaluated, a statistical association was confirmed between the two variables. It was concluded that therapeutic success depended on the owners' compliance.

However, when all follow-up visits were evaluated, there was a trend towards increased non-adherence to therapy as time progressed. These cases indicate that, although CSK is a disease requiring low dose treatment for the rest of the animal's life, many owners eventually neglect long-term treatment of CSK. That can lead to severe flare-ups and some dogs can go blind as a result [9].

In the studied sample, corneal surface keratectomy was considered a possible therapeutic approach in five patients. All of them were classified as CSK stage III with heavily deposition of pigment in the four quadrants of the cornea and visual capacity compromised or absent. However, only one patient underwent surgery.

Surgical success in this patient submitted to superficial keratectomy was achieved 15 days after surgery, with evident clinical improvement. However, despite medical treatment obedience, corneal lesions recurred four months after superficial keratectomy. Thus, according to Turner [9], surgery should only be used as a last resort in cases with severe corneal pigmentation, since the pigment is very slow to clear with topical medication.

In conclusion, in this study, based on the extent of the corneal lesions, a grading scheme for the disease considering three stages of CSK is proposed. This may be of value to classify the patients on initial presentation, help in the choice of a treatment protocol and evaluate their evolution. Results of this study may be of help to both veterinary ophthalmologists and general clinicians.

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