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COMPARISON OF OUTCOMES IN CATARACTOUS EYES OF DOGS UNDERGOING PHACOEMULSIFICATION VERSUS EYES NOT UNDERGOING SURGERY

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Abstract

Objective.—To compare outcomes of surgical intervention and non-surgical management of canine cataracts.

Methods.—Records of patients examined for cataracts from January 2007-February 2018 were divided into 2 groups: non-surgical and surgical. The non-surgical group was further sub-divided based on whether the decision not to pursue surgery was elected by owners, or based on ophthalmologist's advice. Inclusion criteria included 6 months of follow-up. Success in the non-surgical group was defined as a comfortable (non-inflamed, non-glaucomatous) eye, and success in the surgical group additionally required vision. Time-to-failure (complications) was assessed with Cox proportional hazards models.

Results.—72 eyes (41 dogs) were included in the non-surgical group, and 126 eyes (67 dogs) were surgically treated. There was no difference in gender or age; however, the surgical group had significantly more diabetic eyes (56.3% vs 15.3%; $P < 0.001$), and patient eyes with longer follow up times (median 37.6 months vs 22.1 months; $P < 0.001$) than the non-surgical group. There was no statistically significant difference in complication rates between the non-surgical group (15/72 [20.8%]) and the surgical group (23/126 [18.3%]; HR: 2.22 [0.97, 5.0]; $P = 0.060$). However, the complication rate in the ophthalmologist-led non-surgical group was significantly greater than in the owner-led non-surgical group ($p = 0.019$), and the surgical group ($p = 0.002$).

Conclusions.—When using relevant outcomes, whether or not a cataractous eye has surgery does not affect long term complications; additionally, non-surgical eyes which are poor surgical candidates have a higher complication rate than eyes deemed suitable for phacoemulsification for which owners elected not to pursue cataract surgery.

Keywords

cataracts; phacoemulsification; success rate

Introduction

Cataracts are a common ocular condition in canine patients and currently the only effective treatment to restore vision is surgical extraction with intraocular lens implantation.¹ However, there are many potentially painful and blinding complications of phacoemulsification surgery, including retinal detachment, glaucoma, and ocular surface diseases.^{1–4} Multiple studies have examined the outcome of phacoemulsification in dogs. In 1990, Davidson et al. reported an 85.7% success rate for bilateral cataract extraction in the short-term (4–6 weeks) that decreased to 69.4% at 3–9 months.⁵ Another study published in 2006 reported that after phacoemulsification, 12.41% (36/290) of eyes developed glaucoma and 15.5% (45/290) of eyes were blind, with follow-up ranging widely from 3 months to 4.75 years.⁴ Klein et al. (2011) reported an 82.7% success rate post-operatively with a follow-up time ranging widely from just 6 days to 1010 days.⁶ Newbold et al. in a study that examined differences in outcomes between Boston terriers and non-Boston terriers, found an overall success rate of 80–90% at one year across both groups. At two years, however, the success rate fell to 65% and 80%.⁷ Across studies, the most common causes of failure after phacoemulsification surgery are glaucoma^{3,7,8} and retinal detachment,^{4,9,10} with other less commonly reported complications including ocular surface diseases¹¹ and endophthalmitis.^{12, 13}

Given the severity of these possible complications and the demands of post-operative care, it is critical for ophthalmologists to have an open and detailed conversation with clients about canine cataract surgery as an elective procedure. In 2006, Appel et al. conducted a study to assess client satisfaction with the outcome of cataract surgery in their dogs. Eighty-one percent (88/108) clients surveyed indicated that they would have their dogs undergo cataract surgery again. The study also revealed that dissatisfied clients were significantly more likely to believe that the pre-operative conversation of risks and benefits was inadequate.¹⁴

A common topic owners want to discuss during these pre-operative conversations involves the outcome of dogs who do not receive cataract surgery. To address this question, a study performed in 2011 by Lim et al. compared the occurrence of treatment failure in eyes that underwent phacoemulsification to those that only received topical medications or no medical or surgical intervention. With a median follow-up time of 2.3 years, the authors found that those eyes in the medical management group had a 4 times higher failure rate than those eyes that underwent phacoemulsification.¹⁵ Given these findings, the objective of our study was to examine the success of phacoemulsification compared to medical management of cataracts within the population of canine patients of the Comparative Ophthalmology service at the University of Wisconsin-Madison.

Materials and Methods

Case Selection

Medical records of dogs diagnosed with cataracts between January 2007–February 2018 by the Comparative Ophthalmology service at the University of Wisconsin-Madison were retrieved and reviewed. Criteria for inclusion in the study were: a complete ophthalmic examination performed by or under the supervision of an ACVO Diplomate; a diagnosis of

incipient, incomplete, complete, or resorbing cataracts; and a follow-up period of at least 6 months. Patients were excluded if lens luxation or subluxation, retinal detachment, glaucoma, or persistent hyperplastic vitreous/tunica vasculosa lentis were diagnosed at initial exam. Glaucoma was defined as an intraocular pressure persistently greater than 25mmHg, with characteristic optic nerve and/or retinal abnormalities (if possible to examine).

The patients were initially divided by eye into two main groups: The surgical group included eyes that underwent phacoemulsification with or without intraocular lens implantation; the non-surgical group were those eyes that received either no therapy or topical anti-inflammatory medication. Cases that had surgery within 6 months of the first visit were included in the surgical group, and cases in which the owners elected cataract surgery after 6 months were excluded. For some analyses, the non-surgical group was further subdivided into those eyes considered to be good candidates by the ophthalmologist but for which the owners elected not to pursue surgery (owner-led), and those eyes considered to be poor candidates for surgery (ophthalmologist-led). Poor candidates for surgery had severe uveitis, extensive synechiae, or corneal disease in the visual axis, and the attending ophthalmologist indicated the eye was a poor candidate for surgery in the medical record.

Information collected from the records for both groups were signalment, whether the patient was diabetic, length of follow-up, the stage of cataract, and co-existing ocular abnormalities noted on initial exam. Ophthalmic abnormalities were defined as: **ocular surface disease** (conjunctival hyperemia, tear film deficiencies, pigmentary keratitis and extensive scarring); **uveitis** (mild if less than 2+ flare and/or cell, or severe if >2+ flare and/or cell, synechiae, keratic precipitates, or extensive pigment dispersion and deposition in the anterior segment were present)¹⁶; **glaucoma** (defined as an intraocular pressure of greater than 25mmHg with consistent optic nerve and/or retinal changes if visible), and **retinal abnormalities**, such as retinal detachment or degeneration. Success within the non-surgical group was defined as a comfortable, non-inflamed, non-glaucomatous eye, and success in the surgical group additionally required vision, which was evaluated via a menace response and navigation behavior. Post-operative ocular hypertension was defined as a post-operative IOP > 25mmHg within the first month after surgery with no changes in the optic nerve or retina and record of discontinuation of anti-glaucoma medications with IOP below 25mmHg; these cases were not considered glaucoma.

Statistical Analysis

Characteristics between groups were compared, with eye as the unit of analysis, using chi-square tests, t-tests, or Wilcoxon rank sum tests when appropriate for the characteristic's statistical distribution. Characteristic analysis was also examined controlling for a cluster effect of dog, however results were similar and therefore the simpler analysis is reported for ease of interpretation. Time-to-failure (complication) between non-surgical vs surgical groups were compared using Cox proportional hazards (Cox PH) survival model with dog as a cluster effect to account for some dogs with data from both eyes. Age, diabetic status, and neutered status were included as covariates in the Cox PH model. Similar models were used

for comparing time-to-failure (complications) between sub-groups. P-values < 0.05 were considered significant. Statistical analyses were conducted using R version 3.5.1.¹⁷

Results

Eight hundred fifty unique patients were evaluated by the UW Ophthalmology service for cataracts between January 2007 and October 2017. The most common reason patients were excluded was due to insufficient follow-up time, and 2 dogs were excluded due to electing cataract surgery more than 6 months after initial examination. Ultimately, 100 dogs were included in the study and 198 eyes met the inclusion criteria. One hundred twenty-six eyes (67 dogs) were included in the surgical group, and 72 eyes (41 dogs) were included in the non-surgical group. Eight dogs (8.0%) had each eye in different groups. Age, eye affected, gender or neuter status of the patients did not differ significantly between groups. The surgical group included more diabetics than the non-surgical group (56.3% vs. 15.3%; $P<0.001$) and had longer follow-up time (median 37.6 months vs. 22.1 months; $P<0.001$; Table 1).

Overall, there was no statistically significant difference in complication rates in the non-surgical group compared to the surgical group when controlled for neuter status, diabetic status, and age (non-surgical group: 15/72 (20.8%); surgical group: 23/126 (18.3%); Hazard Ratio (HR) [95% CI]: 2.22 [0.97, 5.0]; $P=0.060$). Based on examiner notes in the medical record, the non-surgical group was then further divided into those eyes that did not receive surgery as a result of the clinician's recommendation (42 eyes; ophthalmologist-led) or because the owner elected not to pursue phacoemulsification despite the eye being assessed as a good candidate for surgery (30 eyes; owner-led). Reasons for clinicians discouraging surgery included patients that retained good functional vision, and those with ocular abnormalities such as lens-induced uveitis, ocular surface disease, or retinal degeneration.

The complication rate for eyes in the ophthalmologist-led non-surgical group (14/42 [33.3%]) was significantly higher than the complication rate for eyes treated by phacoemulsification (23/126 [18.3%]; HR: 3.72 [1.63, 8.50]; $P = 0.002$). The complication rate of 33% in the ophthalmologist-led non-surgical group was also significantly higher than the complication rate of 3.3% (1/30) in the owner-led non-surgical group (HR: 10.5 [1.48, 74.8]; $P=0.019$; Fig. 1). The causes of the complications within the three groups varied (Table 2). The main causes of complications were glaucoma, ocular surface disease and retinal detachment.

In the non-surgical group, the effect of prescribing a topical anti-inflammatory medication on complication rate was also examined. Fifty-four out of 72 (75.0%) eyes were prescribed an anti-inflammatory medication. Of those 54 eyes, 10 (18.5%) went on to have complications, while 5 of the 18 (27.8%) eyes not on medication failed. These complication rates were not statistically significantly different (HR: 0.66 [0.23, 1.86; $P=0.429$). We also examined the possible association between cataract status and time-to-complication across both groups. There were 70 (35.4%) eyes with an incipient or incomplete cataract, 82 (41.4%) with an intumescent or complete cataract, and 46 (23.2%) with a resorbing cataract. Complication rates in these three groups were 11.4%, 19.5%, and 30.4% respectively.

However, after controlling for covariates, these complication rates were not significantly different (using incipient/incomplete as the reference group: HR for intumescent/complete = 1.76 [0.63, 4.90]; $p=0.277$, HR for resorbing = 1.92 [0.63, 5.84]; $p=0.248$).

Discussion:

Our initial analysis found no difference in complication rates between eyes that underwent surgery and eyes that did not, when complications were defined as glaucoma, severe inflammation, ocular surface disease, lens instability, or retinal disease in non-surgical eyes, and additionally the loss of vision in surgical eyes. As the majority (54/72, 75%) of the non-surgical group were on anti-inflammatory medications, our non-surgical group was relatively comparable to the medical treatment group in Lim et al.¹⁵ The difference in complication rates between our two groups was lower than the HR of dogs receiving medical treatment versus surgical treatment in this earlier study (HR: 4.0 [1.0, 15¹⁵]) with a HR of 2.22 [0.97, 5.0] for complication in non-surgical eyes in the present study.

In our experience, we considered that the high complication rate previously noted in non-operated eyes was unusual and could be related to factors influencing the decision whether or not to pursue cataract surgery. Therefore, in order to better define the population that did not undergo phacoemulsification, we separated the non-surgical patients into two sub-groups: those that did not undergo surgery because the owner elected not to (owner-led) and those that the ophthalmologist considered to be poor candidates for surgery (ophthalmologist-led). When comparing the outcomes for each non-surgical sub-group separately with the surgical group, those eyes in the ophthalmologist-led group had a HR 3.7 times higher than the HR for those eyes that underwent phacoemulsification and a HR of 10.5 when compared to eyes that were considered good candidates for surgery. Thus, these poor candidates appear to be driving the complications that we and others have identified in non-surgical patients. While it is possible that these poor surgical candidates may have had a successful outcome had they undergone surgery, this study was not adequately powered or designed to address this question. Therefore, if an eye is a good candidate for phacoemulsification, but the owner does not want to pursue surgery, our data suggest that it is less likely that these eyes will develop painful complications than might be suggested by earlier reported outcomes. Ophthalmologists can use this information during the pre-operative conversation to appease an owner's concerns if their pet is a good candidate, but they are unable or reluctant to pursue surgery due to financial constraints or concerns regarding demands of post-operative management.

In contrast to the Lim et al. study,¹⁵ the present study identified no significant difference in outcomes of eyes in the non-surgical group that were treated with topical anti-inflammatory medication and those that were not. Possible reasons for the conflicting results of the two studies may be due to the smaller sample size of eyes with no treatment ($n=8$) in the Lim et al. study, and that none of these 8 cases were considered successes, thus making estimation of HRs when compared to other groups less reliable, as seen by a wide CI range (10 to 403) in that study. Another possible reason for differing results between the two studies is the fact that owner compliance is involved in administering the medications, which was not assessed in either the Lim study¹⁵ or this study.

Limitations of the present study include the large number of patients that were excluded from the study as they did not meet requirements for a minimum 6-month follow-up period, and the relatively short duration of this follow-up time. However, of the patients that met the inclusion criteria with 6 months of follow-up, the majority in both groups (87% in the surgery group, 77% in non-surgery group) actually had a follow-up time greater than one year. In interpreting follow-up data, based on a previous study, it must be acknowledged that owners who are dissatisfied with the outcome of surgery may be less likely to return for recheck examinations.¹⁴ Therefore, it is possible that the complication rate of surgical patients may actually be higher than our results suggest. Due to the retrospective nature of the study, the factors involved in an ophthalmologist's recommendation against surgery were not pre-defined or based on specific criteria prior to the study. As such, it is possible that the assessment made by the ophthalmologists in this study may differ from that of other ophthalmologists, and the results of this study may not translate to other practices/institutions. Furthermore, vision was usually evaluated via a menace response and a patient's navigation abilities in the examination room as documented by notes in the medical record, but a standardized method of testing would be preferable. A prospective study that strictly defined poor surgical candidates and provided a uniform method for vision evaluation, whether assessed by the owner, e.g. using the Canine Visual Function Instrument¹⁸ along with structured assessment by the ophthalmologist, or assessed by objective testing of visual behavior, may provide more broadly applicable results.^{19,20,21}

Surgery is currently the only way to restore vision in patients with cataracts.¹ However, the surgical complications, cost, and demanding post-operative care regimens often make an owner's decision to pursue cataract surgery difficult. During the decision-making process, owners often want to know how their pet will do if surgery is not performed. This study suggests that, with the important exception of vision, clinically relevant outcomes are similar between eyes that receive surgery and eyes that do not. However, in eyes that are considered poor candidates for cataract surgery, owners should be prepared for further complications, regardless of whether surgery is pursued.

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Figure 1:

Kaplan Meier survival curve depicting success rates over time curves among the three groups. The surgical group had significantly better outcomes than the ophthalmologist-led non-surgical group (HR: 3.70 [0.12 – 0.61]; $P=0.002$), as did the the owner-led group (HR: 11.1 [0.01 – 0.67; $P=0.019$).

Table 1:

Characteristics of patients among the non-surgical and surgical groups. There was no statistical difference in the affected eye, gender, neuter status or age of the patients between the two groups. The surgical group included significantly more diabetic patients and patients with longer follow-up times than the non-surgical group.

Characteristic	Non-Surgical (n=72)	Surgical (n=126)	P-value
Eye - Left	38 (52.8%)	61 (48.4%)	0.658
Gender - Female	34 (47.2%)	46 (36.5%)	0.184
Neutered – Yes	66 (91.7%)	124 (98.4%)	0.028
Diabetic - Yes	11 (15.3%)	71 (56.3%)	< 0.001
Age - year	7.7 (4.2)	7.6 (2.8)	0.784
Follow up - months	22.1 (11.3 – 31.3)	37.6 (17.8 – 55.8)	< 0.001

Table 2.

Complications among the patients in the surgical group, and the two sub-groups of the non-surgical group (ophthalmologist-led and owner-led).

	Ophthalmologist-Led n=42	Owner-Led n=30	Surgical n=126
Glaucoma	2		11
Ocular surface disease	4	1	5
Retinal degeneration	1		
Retinal detachment	2		7
Lens instability	1		
Concurrent ocular surface disease, uveitis and glaucoma	2		
Severe uveitis	2		
Total Failures	14	1	23