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Long-term systemic antibiotics and surgical treatment can be an effective treatment option for retrobulbar abscesses in rabbits (*Oryctolagus cuniculus*): 21 cases (2011–2022)

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OBJECTIVE
To characterize the epidemiologic features of rabbits with retrobulbar abscesses, including the clinical signs, diagnosis, treatment, and outcome.

ANIMALS
21 client-owned rabbits.

METHODS
The medical record database of a veterinary teaching hospital was searched from 2011 to 2022 for records of rabbits diagnosed with retrobulbar abscesses by CT. Data reviewed included age, breed, presenting complaint, association with an odontogenic infection, aerobic and anaerobic culture results, treatment, and outcome.

RESULTS
The primary presenting complaint was exophthalmos (19/21 [90%]). Most cases (15/21 [71%]) were associated with an odontogenic infection. Dental disease, not associated with a retrobulbar abscess (14/21 [67%]), was a common comorbidity on CT. The most common aerobic and anaerobic isolates were *Streptococcus intermedius* (5/12 [42%]) and *Fusobacterium nucleatum* (2/12 [17%]), respectively. Surgical treatment combined with long-term systemic antibiotic therapy was performed in 9 of 21 (43%) cases. It included intraoral tooth extraction (4/9 [44%]) versus extraoral peribulbar abscess lancing with either abscess packing with antibiotic-soaked gauze (3/9 [33%]) or surgical abscess debridement (2/9 [22%]). Resolution of the clinical signs with no recurrence for at least 6 months occurred in 7 of 9 (78%) surgically treated cases. Medical treatment with long-term systemic antibiotic therapy was performed in 4 of 21 (19%) cases, and 3 of 4 (75%) resolved. Due to poor prognosis or financial concerns, euthanasia was performed or recommended in 8 of 21 (38%) cases.

CLINICAL RELEVANCE
On the basis of the data from this study, retrobulbar abscesses in rabbits carry a guarded prognosis. When intraoral and extraoral surgical treatment options combined with systemic antibiotic therapy were used, it resolved clinical disease in most cases.

Keywords: rabbit, tooth, infection, abscess, retrobulbar

Rabbits are frequently diagnosed with dental disease due to their aradicular, hypsodont, and elodont dentition.[1] Dental disease in rabbits is characterized by clinical or reserve crown elongation, malocclusion, and the formation of dental spurs.[1,2] Periapical odontogenic infections are a common sequela to dental disease in rabbits and are defined as abscess formation in the periapical region of the tooth.[1–3] If the periapical abscess is associated with maxillary teeth, the alveolar bulla, reserve crown, and apices of the maxillary third premolar (108 and 208) and 3 molar teeth (109 to 111 and 209 to 211) can be affected.[4] Subsequently, the infection can spread to the retrobulbar area. This can be characterized by unilateral exophthalmos, a facial mass, or no palpable abnormalities.[1,2]

Clinical signs of retrobulbar abscessation include predominantly unilateral exophthalmos, but rabbits can display more generalized signs of lethargy, hyporexia,

facial masses, weight loss, gastrointestinal disease, ocular or nasal discharge, or problems chewing or swallowing.[5–7] Diagnostic imaging is recommended to diagnose retrobulbar abscesses, and the preferred method is CT.[2,8] Radiographs can be performed but require several oblique views and may not provide complete information.[8] Ultrasound has also been reported as a suitable method to diagnose retrobulbar abscesses in rabbits.[7] Less common differentials for a space-occupying mass behind the eye in rabbits can include neoplasia, hematoma, or parasitic cysts.[5,9,10] Therefore, obtaining a fine-needle aspirate sample for cytological evaluation and bacterial culture is recommended to confirm the diagnosis, if feasible.[7,8]

In dogs, retrobulbar abscesses are reported, but the underlying etiology is often unknown and frequently considered idiopathic, with other differentials including tooth root abscess, foreign body, and trauma.[11] The primary treatment recommendation for canine retrobulbar abscesses includes systemic broad-spectrum antibiotics and intraoral mucosal incision and drainage without tooth extraction.[11] This protocol improves the animal's general condition and, in most cases, heals rapidly with no complications.[11] In rabbits, however, retrobulbar abscesses are more challenging to treat than other companion animals due to their thick caseous abscess material and alveolar bulla anatomy.[2] Information on the treatment and outcome of rabbits with retrobulbar odontogenic abscesses is currently limited.[6,7] Reported treatment approaches include long-term systemic antibiotic treatment in conjunction with an intraoral or extraoral surgical approach or both.[6–8] Intraoral techniques include a blind or stomatoscopy-guided approach to remove the affected teeth and create a draining tract.[6–8] Extraoral approaches described are either a peribulbar facial mass incision with flushing and closure,[12] marsupialization of the abscess capsule,[7] or partial ostectomy of the zygomatic arch with lavage of the alveolar bulla.[8] Enucleation of the globe is not recommended as part of the therapeutic protocol for retrobulbar abscesses, unless the eye is painful or irreversibly blind.[13] It has been suggested anecdotally that even with aggressive surgical and medical management, the prognosis for recovery is usually guarded and recurrence can be common.[2,7]

Although retrobulbar abscesses are commonly diagnosed in pet rabbits, there is currently limited information on the epidemiology and treatment outcome in a population of client-owned rabbits. The purpose of this study was to retrospectively report the clinical signs, diagnosis, treatment, and outcome of client-owned rabbits with retrobulbar abscesses diagnosed at a university veterinary referral and teaching hospital.

Methods

Rabbit medical records were reviewed by the same author (IL) using an electronic medical record system (VetStar; Advanced Technology Corp) at University of Wisconsin-Madison Veterinary Medical Teaching Hospital. Medical records for review were available for the period of January 1, 2011, to July 31, 2022, and all medical records of rabbits that were presented in this period and had the term "abscess" included in their medical record were initially reviewed. Cases were eligible for inclusion only if the CT scan was reviewed by a board-certified radiologist whose findings and interpretation were consistent with a retrobulbar abscess. Retrobulbar abscesses were defined as a fluid to soft tissue attenuating material arising from either the retrobulbar region or the apical aspect of a tooth and causing globe displacement.

Other data extracted from the medical record included age at diagnosis, sex, presenting complaint and physical exam findings, abscess location (oral quadrant affected), whether the abscess was associated with radiographically evident periapical infection if aerobic and/or anaerobic cultures were performed, whether the patient had received antibiotics before culture, treatment recommendations (surgical vs medical vs euthanasia), and outcome. Efforts were made to obtain follow-up information from the owner and referring veterinarian through email and phone.

Results

Signalment

A total of 1,886 rabbits were presented to the hospital between January 1, 2011, and July 31, 2022. Of those rabbits, 21 (1.1%) were diagnosed with retrobulbar abscesses via CT. Age ranged from 18 to 138 months (median, 51 months). Body weight ranged from 0.9 to 3.5 kg (median, 2.1 kg). Eleven of 21 (52%) were male, and 10 of 21 (48%) were female. A breed was not recorded in the record in 5 of 21 (24%) cases, 5 of 21 (24%) were lop-eared breeds, 3 of 21 (14%) were Netherland dwarf, 3 of 21 (14%) were Dutch rabbits, 2 of 21 (9%) were mini rex, 2 of 21 (9%) were lionhead, and 1 of 21 (5%) was harlequin breed.

Presenting complaints and clinical signs associated with retrobulbar abscesses included unilateral exophthalmos ipsilateral to the abscess in 19 of 21 (90%) cases **(Figure 1)**, elevated unilateral third eyelid ipsilateral to the abscess (14/21 [67%]), facial mass (11/21 [52%]), unilateral or bilateral ocular discharge and conjunctivitis (4/21 [19%]), and anorexia/hyporexia (4/21 [19%]).

Diagnosis

On the basis of CT, 15 of 21 (71%) cases with a retrobulbar abscess were associated with an odontogenic infection, while 6 of 21 (29%) had no identifiable cause on CT. Of the confirmed odontogenic abscesses, 13 of 15 (87%) were associated with the maxillary quadrants, while 2 of 15 (13%) were associated with the mandibular quadrant. The mandibular abscesses arose from a mandibular apical abscess and extended dorsally, medial to the ipsilateral zygomatic arch, to the ventral portion of the ipsilateral retrobulbar space. Maxillary teeth affected included 106 (2/15 [13%]), 111 (2/15 [13%]), 210 (2/15 [13%]), as well as 1 (7%) case each associated with 107, 108, 110, 207, 209, and 211. A single case (7%) involved teeth 108 to 111. Mandibular teeth affected were identified in both cases as 311

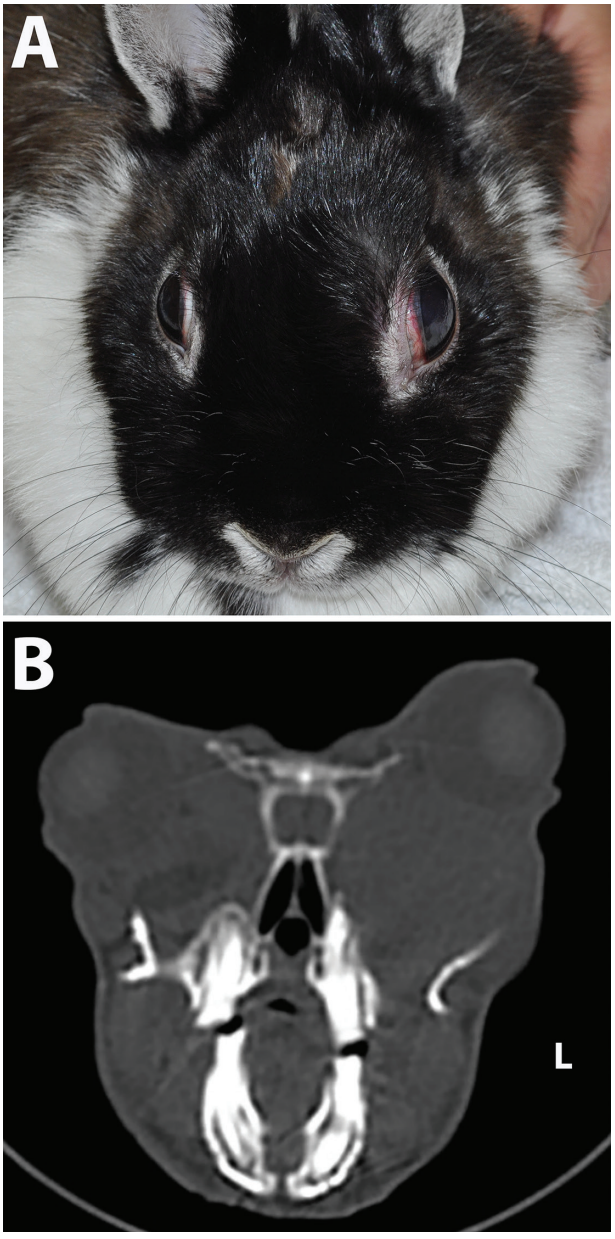

Figure 1—A—Unilateral exophthalmos of the left eye, secondary to an odontogenic retrobulbar abscess, in a domestic rabbit. B—Transverse CT (bone window) of a rabbit head, showing a large left-sided odontogenic retrobulbar abscess displacing the left globe. Lysis of the alveolar bone at the apex of the left maxillary cheek tooth and apical cheek tooth elongation are also visible.

(2/15 [13%]). All patients (15/15 [100%]) diagnosed with an odontogenic abscess had lytic or alveolar bony changes at the level of the affected teeth. Concurrent CT findings not associated with the retrobulbar abscess included dental malocclusion (8/21 [38%]), dental points (8/21 [38%]), periodontal disease (7/21 [33%]), osteomyelitis (7/21 [33%]), mandibular lymphadenopathy (6/21 [28%]), otitis media (5/21 [24%]), rhinitis (5/21 [24%]), and apical odontogenic abscesses at different locations (1/21 [5%]).

Fine-needle aspiration of the suspected retrobulbar abscess was performed in 7 of 21 (33%) cases. Of these cases, 6 of 7 (86%) confirmed the diagnosis, while the sample was nondiagnostic in 1 of 7 (14%) cases. Another 7 of 21 (33%) patients had samples for bacterial cultures collected during surgical exploration and were subsequently treated.

Bacterial culture

Bacterial cultures (aerobic, anaerobic, or both) were performed in 11 of 21 (52%) cases, all of which were not euthanized, and samples were collected either by fine-needle aspiration or during surgical exploration. Of the 11 patients with a culture performed, 8 of 11 (73%) received antibiotics (oral, injectable, or a combination of both) at the time of sample collection. Aerobic and anaerobic cultures were performed in 7 of 11 (64%) cases and solely aerobic cultures in 4 of 11 (36%) cases. All cases that had aerobic and anaerobic cultures performed had growth on aerobic culture. No growth on aerobic culture was reported in 1 of 11 (9%), and the patient was receiving systemic antibiotics at the time of sampling. No growth on anaerobic culture was reported in 4 of 7 (57%) cases, with 2 of these cases having received antibiotics effective against anaerobes at the time of sampling.

Bacterial isolates (12 total, 9 aerobic and 3 anaerobic) included *Streptococcus intermedius* (5/12 [42%]), α-hemolytic *Streptococcus* spp (2/12 [17%]), *Fusobacterium nucleatum* (2/12 [17%]), *Actinobacillus capsulatus* (1/12 [8%]), *Escherichia coli* (1/12 [8%]), and *Clostridium aidenense* (1/12 [8%]). Susceptibility information was reported for 3 of 9 (33%) aerobic isolates. Data were collected only for the first culture in each case.

Treatment

Humane euthanasia was performed in 7 of 21 (33%) cases within 7 days of presentation due to poor prognosis discussed based on the severity of the disease, severe comorbidities, or rapidly worsening clinical signs and less so due to financial concerns. A single case (1/21 [5%]) was sent home against medical advice due to poor prognosis.

Treatment recommendations other than euthanasia included medical management with long-term antibiotics or a combination of long-term systemic antibiotics and surgical intervention **(Figure 2)**. Long-term systemic antibiotic therapy as the sole treatment was initiated in 4 of 21 (19%) cases. Antibiotics were prescribed for at least 4-week courses and most frequently included procaine-penicillin G injections, azithromycin, metronidazole, enrofloxacin, or a combination. Of these cases, 3 of 4 (75%) had complete resolution, which was based on either repeat CT scans (2/3 [67%]) or clinical exam findings (1/3 [33%]). Disease-free time was 696 days (1.9 years), 1,603 days (4.4 years), and 2,784 days (7.6 years). In 1 of 4 (25%) cases, the retrobulbar abscess did not resolve, and this animal had a survival time of 293 days. In the 3 of 4 cases that resolved with medical treatment alone, no apparent odontogenic underlying cause was identified on CT. The single case that did not resolve was associated with an odontogenic abscess. In this case,

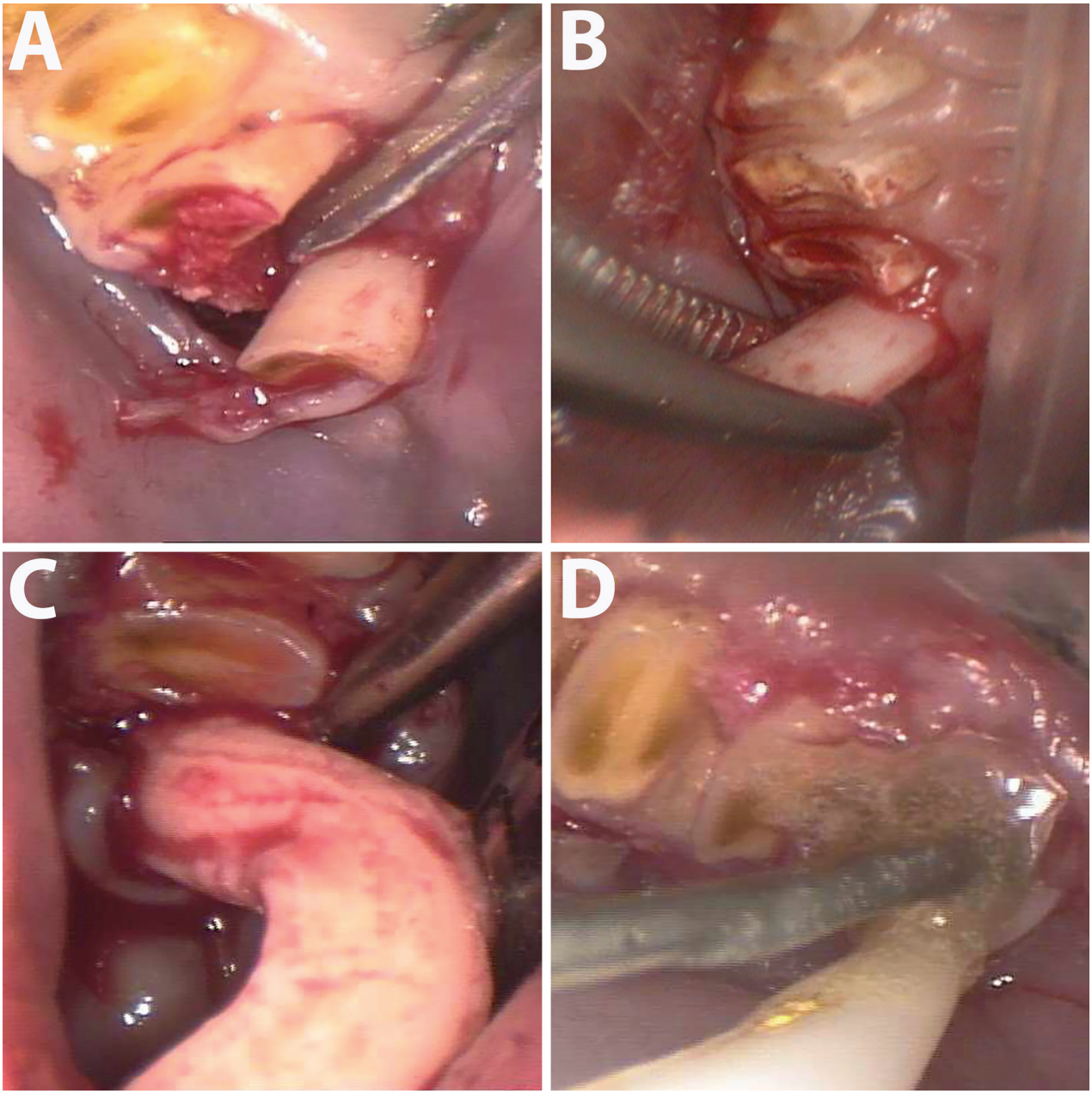

Figure 2—Treatment of a right-sided odontogenic retrobulbar abscess in a rabbit through an intraoral approach. Luxation (A) and extraction (B) of the second molar (110) of the right maxillary quadrant to access the retrobulbar abscess. Drainage of thick purulent abscess content through the extraction site by applying pressure on the globe (C). Sealing of the extraction site using a polymer gel containing doxycycline to prevent impaction and infection of the extraction site and retrobulbar space with material from the oral cavity (D).

surgical intervention was recommended but not pursued due to financial constraints.

Surgical treatments were performed in 9 of 21 (43%) cases and always combined with long-term systemic antibiotic therapy, including procaine penicillin G, ceftiofur crystalline-free acid, metronidazole, enrofloxacin, azithromycin, or a combination. Intraoral surgical treatments by means of maxillary cheek tooth extraction and abscess drainage were performed in 4 of 9 (44%) cases. In all these cases, the extraction site was sealed with doxycycline hyclate–containing polymer gel (Doxirobe Gel). Three of 4 (75%) were resolved based on clinical signs. Disease-free time following abscess resolution was 180 days, 231 days, and 1,356 days (3.7 years). One case had no follow-up. Extraoral surgical treatment via a peribulbar approach to allow for access to the retrobulbar abscess was performed in 5 of 9 (56%) cases (all of which had palpable facial masses). Of these cases, 3 of 5 (60%) received repeated antibiotic-soaked gauze packings, while 2 of 5 (40%) were lanced and debrided with no packing. In the cases that received gauze packings, the gauze was replaced every 7 days for 4 to 5 packings and ampicillin or ceftazidime was used **(Figure 3)**.

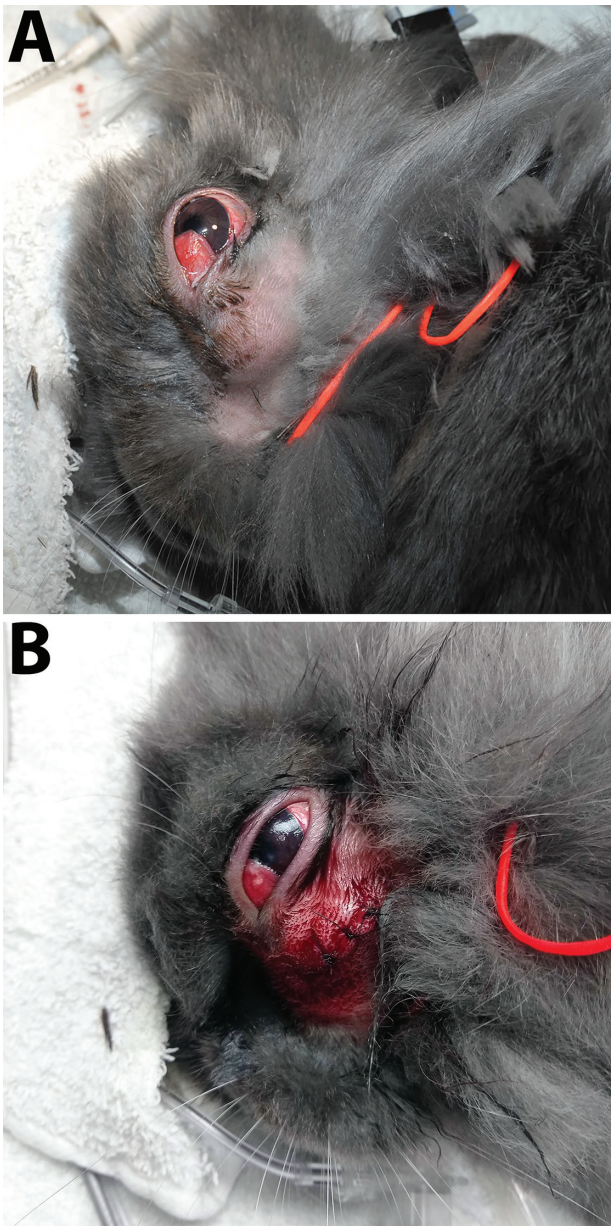

Figure 3—A—Left-sided exophthalmos with third eyelid protrusion and ipsilateral maxillary facial swelling secondary to an odontogenic retrobulbar abscess in a domestic rabbit. B—Postsurgical photo following lancing and draining of the abscess via the extraoral peribulbar approach and placement of antibiotic-soaked gauze in the abscess cavity.

All 3 packing cases were resolved clinically. Disease-free time following abscess resolution was 389 days, 1,720 days (4.7 years and still alive as of data collection), and 419 days (still alive as of data collection). In the cases that were lanced and debrided, one of these cases resolved (disease-free time, 2,312 days [6.3 years]), while another did not.

Discussion

This study analyzed epidemiologic data from 21 rabbits diagnosed with retrobulbar abscesses and found that abscesses treated with a combination of long-term systemic antibiotics and surgical treatment can be an effective treatment option. This finding is consistent with a case series in 7 rabbits, which underwent surgical and medical treatment for retrobulbar abscesses and responded favorably.[7] Although dental extraction has been previously reported as a successful treatment option for rabbits with retrobulbar abscesses,[6,7] it is not currently the recommended treatment for canines.[11] In dogs, creating an intraoral mucosal incision is appropriate to allow for drainage without tooth extraction.[11] This is not feasible in rabbits due to their caseous abscess material. Instead, complete tooth extraction is recommended to remove the diseased tooth, allow for a draining tract, and obtain a sample for culture.[6,12] After tooth extraction and expression of the purulent material, it is recommended to pack the site with antibiotic polymer gel rather than leaving a draining tract to prevent impaction with food material and secondary infection.[2,6]

Common surgical risks associated with tooth extraction include incomplete extraction or hemorrhage, which did not occur in any of the reported cases in this current study.[2] Due to rabbits' unique dental anatomy, there is also a concern for inappropriate occlusion of the corresponding tooth following extraction.[2] However, none of the rabbits that received dental extractions needed further dental care or reported any mastication issues in the follow-up period.

Another surgical approach described in this study is an extraoral abscess packing technique using antibiotic-soaked gauze. This technique has been reported to treat odontogenic abscesses in other locations successfully but not retrobulbar abscesses, to the authors' knowledge.[14] Combined with long-term systemic antibiotics, this provided resolution in all cases and should be considered a viable treatment option for rabbits with palpable facial masses associated with a retrobulbar abscess.

Retrobulbar abscesses in rabbits have been reported anecdotally to carry a guarded prognosis,[5,7,12] and more than a quarter of cases in the present study were euthanized. A common underlying reason for euthanasia was the development of neurologic signs or severe, systemic, or localized comorbidities disease rather than financial constraints. While inappropriate to recommend euthanasia solely on the basis of clinical signs, it should be considered for patients that have retrobulbar abscesses and concurrent nonrelated systemic disease.

Several cases received long-term antibiotics as their sole treatment. The resolved cases did not have an odontogenic abscess identified on CT as the origin for their retrobulbar abscess. These cases were treated with broad-spectrum antibiotics effective against anaerobes for at least 4 weeks. The single case that did not resolve was associated with an odontogenic infection. While more prospective research is needed about the link between odontogenic infections and retrobulbar abscesses and surgical versus medical management, it is hypothesized that the cases that received long-term broad-spectrum antibiotics may

have resolved due to their lack of radiographically-evident association with an odontogenic infection.

Bacterial cultures in cases of confirmed odontogenic infection demonstrated polymicrobial aerobic and anaerobic infections. Previous studies examining bacterial isolates and antimicrobial susceptibilities from odontogenic abscesses in rabbits have demonstrated mixed infections, but a larger percentage of isolates were anaerobic bacteria.[14–16] The predominant isolate in this study was *Streptococcus* spp, which are aerobic, gram-positive cocci. This finding is in contrast to a case series of rabbits with retrobulbar abscesses in which *Pasteurella multocida*, *Staphylococcus aureus*, and *Pseudomonas* spp were isolated.[7] In the present study, more than half of the anaerobic cultures did not demonstrate the growth of any bacteria. Lack of anaerobic culture growth from periodontal disease is commonly reported in the human and veterinary literature, and it is suspected the etiology is multifold.[15,17] In this study, most patients that had cultures performed were receiving antibiotic treatment with effective coverage against anaerobes at the time of culture. Other considerations for lack of anaerobic growth include sterile abscess formation, inappropriate incubation temperature or media, or improper collection techniques, such as collecting a sample for culture from the center of the abscess rather than the lining. Besides lack of growth, anaerobic susceptibilities are rarely performed in most microbiology laboratories, and anaerobic spectrum antimicrobials are usually selected empirically.[15,18] The authors concur with previous studies that demonstrate anaerobic bacteria predominating in odontogenic abscesses[14–16] and recommend choosing an appropriate antimicrobial with a broad spectrum of activity to cover against anaerobic bacteria such as metronidazole.

Enucleation of the globe is not routinely recommended for rabbits with retrobulbar abscesses since it would not facilitate access to the abscess due to the presence of the retrobulbar venous plexus. However, if the eye is painful or irreversibly blind, enucleation in conjunction with specific treatment approaches to address the retrobulbar abscess should be considered.[13] In the cases of the present study, there was no indication to perform enucleation since the eyes were functional and not irreversibly painful.

There were inherent limitations to this retrospective study, including the accuracy of record information, inconsistent sample collection, clinician variation, and lack of follow-up. In this study, one-third of retrobulbar abscesses were diagnosed on the basis of CT scans only rather than cytology. It is possible that cases that declined further diagnostics may have had other underlying diseases, including neoplasia, contributing to their retrobulbar mass. While this has been reported in canines[19] and felines,[20] it is rare in rabbits and therefore considered unlikely.[5,10] Further prospective studies are warranted to examine the link between retrobulbar and odontogenic infections and appropriate treatment options, including antibiotics as the sole treatment, abscess packings, and tooth extraction.

This study determined that although retrobulbar abscesses carry a guarded prognosis, surgical treatment in conjunction with long-term systemic antibiotics is an effective treatment method. It also demonstrated that organisms isolated from retrobulbar abscesses in rabbits consist of a mixture of aerobic and anaerobic gram-positive and gram-negative organisms. Culture and susceptibility of any abscess are recommended to provide appropriate antimicrobial treatment.

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Disclosures

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