Ocular melanocytic neoplasia in dogs and cats can result in distant metastasis and may cause painful or vision-threatening sequelae. The relative risk for these complications, along with recommended treatment options, varies according to the species affected, extent and progression of the tumor, and tumor location. These are the important factors to consider when evaluating these tumors.

**EYELID**

Eyelid tumors are the most frequently observed group of ophthalmic neoplasms in dogs but are relatively uncommon in cats. Approximately 20% of all canine eyelid neoplasms are melanocytic, and of those, 62% to 87% are reportedly benign and 13% to 38% are malignant. This is in contrast to melanomas located at other mucocutaneous junctions, which are generally malignant in dogs, but is similar to melanomas arising from haired skin at other locations. In one report, the mean age at diagnosis for canine eyelid melanomas was 9.1 years in dogs with benign tumors and 13.9 years in dogs with malignant tumors. Eyelid melanomas are very rare in cats, accounting for only 2% to 8% of all feline eyelid neoplasia. Thus, there is relatively little specific published information regarding the behavior of these tumors in cats. In general, eyelid dermal melanomas are more likely to follow a benign course but may have multiple local recurrences or distant metastases.

Eyelid melanomas in dogs are typically heavily pigmented and located at the eyelid margin and may grow as a pedunculated or an infiltrative mass. The presence of the mass is often the only observed clinical sign. These lesions can cause epiphora or blepharospasm due to corneal irritation, and more severe ocular signs (e.g., ulcerative keratitis) can occur as the tumor enlarges and affects the normal functional anatomy of the eyelid. Inflammation and ul-
cession of the tumor may also be noted.\textsuperscript{3,5} (Figure 1).

Other types of neoplasms are the primary diagnostic differentials for eyelid melanoma. A wide variety of tumors have been reported to occur in canine and feline eyelids,\textsuperscript{3,4} and nonneoplastic lesions may also cause subcutaneous swelling in the eyelid. Therefore, fine-needle aspiration for cytology or biopsy, along with histopathologic examination, is necessary for definitive diagnosis.

The recommended treatment options for eyelid melanomas depend primarily on the size and aggressiveness of the observed tumor. Both histologically malignant and benign eyelid melanomas are considered unlikely to metastasize. Thus, small masses with no additional signs may be monitored for progression.\textsuperscript{3,4} There are, however, significant advantages to treating these tumors before enlargement or development of further clinical signs. A tumor that occupies less than 25\% to 30\% of the eyelid margin can be removed with a relatively simple V-shaped or four-sided wedge resection.\textsuperscript{9} Larger tumors require a more complicated reconstructive blepharoplasty procedure. An advantage of surgical excision is that it provides the opportunity for submission of the entire neoplasm for histologic evaluation. Also, if the tumor is benign, an excision with only 1- to 2-mm surgical margins may be curative. If the tumor is found to be malignant, an additional, more extensive surgical procedure may be required.

Cryosurgery alone or in conjunction with surgical resection is also an effective treatment modality for small eyelid tumors and can often be curative for benign eyelid melanomas.\textsuperscript{1,4} A biopsy sample should be obtained before application of the cryogen. The techniques and indications for eyelid cryosurgery have been thoroughly described elsewhere.\textsuperscript{10} The use of laser energy for the ablation of canine meibomian gland adenomas has been investigated,\textsuperscript{11} but there is a lack of published information regarding its use with eyelid melanomas. Because excessive tissue damage, swelling, and scar formation are associated with electrosurgery, this technique is not recommended for use near the eyelids.\textsuperscript{4}

**CONJUNCTIVAL**

Conjunctival melanomas occur infrequently in dogs and cats.\textsuperscript{7,12} The most common location in dogs is the third eyelid, but these melanomas may arise from any conjunctival site\textsuperscript{12,13} (Figure 2). The few reports of these melanomas in cats have not revealed a site predilection, but the tumors were often locally invasive into the adjacent eyelid.\textsuperscript{7} These tumors are commonly dark, but some have reportedly been lightly pigmented.\textsuperscript{12,13} The mean age at the time of diagnosis in dogs is 11 years, and Weimaraners may be affected more frequently than other breeds.\textsuperscript{12,13} No age, breed, or sex predilection has been described in cats.\textsuperscript{14} Vascular tumors (e.g., hemangioma, hemangiosarcoma) and pigmented inclusion cysts are other lesions that may have a dark appearance and arise on the conjunctival surface.\textsuperscript{15} Other types of tumors, inflammatory nodules, and prolapsed orbital fat

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**Figure 1.** Canine eyelid melanoma with mild ulceration of the tumor and epiphora. This eyelid melanoma is atypical because it is very lightly pigmented.

**Figure 2.** Canine conjunctival melanoma located on the dorsal bulbar conjunctiva and the conjunctiva of the third eyelid. Chronic epiphora has led to focal alopecia and erythema of the skin near the medial canthus.
should be in the differential diagnosis for a lightly pigmented conjunctival melanoma.\textsuperscript{14,15}

The potential for metastasis of conjunctival melanomas appears higher than that of many other ocular melanocytic tumors.\textsuperscript{7,12,14} In one report,\textsuperscript{12} metastasis was confirmed in two of 12 cases (17\%) and suspected in two additional cases. Local recurrence after surgical resection occurs in approximately half of the cases of canine conjunctival melanoma.\textsuperscript{12,13} The average mitotic index (i.e., number of mitotic figures per 10 high-power microscopic fields) of conjunctival melanomas has been found to be higher than that of canine anterior uveal melanomas, but no correlation between the number of mitotic figures and the chance for local recurrence or distant metastasis has been found.\textsuperscript{12} All three cats in one report were euthanized due to metastatic disease after enucleation; postoperative survival time ranged from 99 to 108 days.\textsuperscript{7}

The recommended treatment for canine conjunctival melanomas is wide surgical excision followed by cryotherapy.\textsuperscript{1,12,14} The formation of intraepithelial nests of neoplastic cells, which are typically found 1 mm or more beyond the gross margin of the tumor, is thought to contribute to the difficulty in determining the histologic margins of the tumor and the likelihood of local recurrence.\textsuperscript{12–14} If the tumor arises from third eyelid conjunctival tissue, the entire third eyelid should be removed. Although this procedure may predispose the patient to deficient aqueous tear production and corneal epithelial damage,\textsuperscript{16} the greater concern is the aggressiveness of the conjunctival melanoma. With recurrence or a large conjunctival melanoma, enucleation or exenteration should be considered. The few reports of conjunctival melanomas in cats indicate that a therapeutic approach similar to that used in dogs is indicated in these cases.\textsuperscript{7,14} Because these tumors are possibly more aggressive in cats, however, enucleation or exenteration may be the preferred treatment at the initial presentation.

**LIMBAL (EPIBULBAR)**

Limbal melanomas are the most common ocular melanomas in dogs, accounting for 20\% to 50\% of these tumors,\textsuperscript{17–19} and are less common in cats.\textsuperscript{7} In both species, this tumor is typically a smooth, black or heavily pigmented, subconjunctival mass (Figure 3) that is noted incidentally by an owner or a veterinarian.\textsuperscript{20,21} These tumors usually involve the adjacent cornea and/or conjunctiva and, much less commonly, may extend intraocularly.\textsuperscript{20,21} Differentiating a tumor of limbal origin from extension of an intraocular uveal tumor into the sclera may be difficult with advanced disease. Most canine limbal melanomas are located along the superior half of the limbus, and German shepherds appear to be affected more frequently than other breeds.\textsuperscript{17,19,22} These tumors are generally considered to be benign, and no cases of confirmed metastasis have been reported in dogs.\textsuperscript{17,19,21} However, subpopulations of cells within the tumor may display more malignant characteristics.\textsuperscript{21} The tumors tend to grow more rapidly in younger dogs and more slowly in older dogs and most affected cats.\textsuperscript{20,21} Limbal melanomas in cats are similar to those in dogs in appearance, treatment, and prognosis, although distant metastasis has been reported.\textsuperscript{7,20,23} The recommended treatment of a limbal melanoma depends on the rate of tumor enlargement, extent of the tumor at presentation, and expertise of the surgeon or the possibility of referral to a specialist. Because of the
benign nature of most of these tumors, small, slowly growing masses may be monitored for progression, particularly in older patients.\(^1\)\(^,\)\(^2\)\(^,\)\(^1\)\(^,\)\(^2\)\(^,\)\(^4\)\(^,\)\(^2\)\(^,\)\(^8\)\(^,\)\(^1\)\(^9\)\(^,\)\(^2\)\(^3\)\(^,\)\(^2\)\(^4\) For rapidly growing tumors, surgical resection (partial- or full-thickness sclerectomy/keratectomy) is potentially curative and may maintain a functional and cosmetic globe.\(^1\)\(^9\)\(^,\)\(^2\)\(^4\) Techniques for removing the mass and repairing the resultant corneoscleral defect are described elsewhere.\(^2\)\(^5\)

Additional treatment modalities have also been evaluated. Cautious application of strontium irradiation\(^2\)\(^6\) or Nd:YAG,\(^1\)\(^7\) diode, or carbon dioxide laser\(^2\)\(^7\) energy treatment alone or in addition to surgical debulking can be effective. Cryotherapy has also been reported as an effective component of the treatment of limbal melanomas.\(^1\)\(^,\)\(^1\)\(^0\)\(^,\)\(^2\)\(^0\) The relative success of cryosurgery in treating limbal melanomas has not been thoroughly evaluated. Enucleation can be curative but is recommended only in eyes in which the melanoma has invaded the anterior chamber, filtration angle, or uveal tract and painful intraocular disease (e.g., glaucoma, uveitis) has resulted. Determining the full extent of the tumor before surgery may require diagnostics (e.g., gonioscopy, high-resolution ultrasonography) typically performed by a specialist.

**UVEAL Canine**

Melanoma is the most common primary intraocular neoplasm in dogs and cats, and most melanomas originate from the iris or ciliary body.\(^1\)\(^9\)\(^,\)\(^2\)\(^4\)\(^,\)\(^2\)\(^8\) The typical clinical presentation and biologic behavior differ between species; cats are discussed in more detail below. Most dogs are older than 7 years at the time of diagnosis, although uveal melanomas have been described in dogs as young as 2 months.\(^1\)\(^9\)\(^,\)\(^2\)\(^2\)\(^,\)\(^2\)\(^9\) As with the tumors described above, the presence of the mass in the iris or anterior chamber may be the only clinical sign. These tumors are typically heavily pigmented and solitary but may be tan to white\(^2\)\(^4\) and can present as diffuse iris thickening.\(^2\)\(^9\) They may distort the pupil (Figure 4), occupy a portion of the anterior chamber, or extend through the sclera.\(^1\)\(^8\)\(^,\)\(^1\)\(^9\)\(^,\)\(^2\)\(^4\)

Untreated anterior uveal melanomas often lead to secondary glaucoma.\(^1\)\(^9\)\(^,\)\(^2\)\(^8\) This occurs through one of three mechanisms. The most common is formation of preiridal fibrovascular membranes due to the release of vasogenic factors by the tumor. The neoplastic cells may also invade the aqueous outflow pathway directly or cause anterior displacement of the lens and resultant blockage of aqueous flow.\(^3\)\(^0\) The clinical signs of secondary glaucoma due to neoplasia are similar to those of primary glaucoma, including scleral venous congestion, corneal edema, squinting, epiphora, and with chronicity, buphthalmos.

A less common secondary complication of uveal melanoma is the development of uveitis.\(^1\)\(^9\)\(^,\)\(^2\)\(^4\) Examination findings in such cases may include aqueous flare, conjunctival hyperemia, posterior synechiae, iridal swelling, or hypopyon. Hyphema may also occur due to hemorrhage from preiridal fibrovascular membranes or from the tumor itself. In patients with secondary complications, diagnosis of intraocular neoplasia may be difficult due to opaque ocular media. Older dogs with unilateral glaucoma or hyphema without a history of trauma to the eye are particularly suspect for an intraocular tumor; therefore, these patients should be closely examined for neoplasia. Ocular ultrasonography may help determine whether an intraocular mass is present.

A subset of canine uveal melanomas comprises those that arise within the choroid. Approximately 4% to 5% of canine ocular melanomas are of choroidal origin.\(^2\)\(^2\) Choroidal melanomas may be detected as an incidental finding on funduscopic examination.\(^2\)\(^4\) They typically appear as a single, raised, darkly pigmented, subretinal lesion (Figure 5) and are commonly associated with focal or diffuse retinal detachment without significant inflam-
mation. As in patients with anterior uveal melanomas, chronic uveitis and glaucoma are common presenting signs in patients with advanced choroidal melanomas. Depending on the location and extent of the tumor, other signs may include blindness, mydriasis, vitreal hemorrhage, or hyphema. Local invasion into the orbital tissues also occurs without timely treatment, and exophthalmos can be a result of extraocular extension posterior to the globe. Choroidal melanomas appear to have very low metastatic potential, although distant metastasis has been reported.

The differential diagnosis of primary intraocular melanocytic neoplasia includes pigmented uveal cysts, metastatic melanoma, melanosis secondary to chronic inflammation, iris freckles and nevi, and melanocytosis. Tumors of ciliary body origin, the second most common primary intraocular tumor in dogs, are typically nonpigmented. If iridociliary tumors are pigmented, they can be clinically indistinguishable from melanomas. However, their biologic behavior is similar to that of melanomas, as are the treatment recommendations. Breed-related conditions, such as ocular melanosis in cairn terriers or pigmentary uveitis in golden retrievers, also cause increased pigmentation of the iris. These conditions, which are described in greater detail elsewhere, typically cause diffuse iridal hyperpigmentation in contrast to the often nodular appearance of canine uveal melanoma.

The treatment recommendations for canine anterior uveal melanoma, as with most neoplastic processes, are based on the expected biologic behavior of the tumor. Unfortunately, ascertaining the potential malignancy of an individual uveal melanoma is difficult due to the risk for severe complications (such as intraocular hemorrhage) associated with either fine-needle aspiration or biopsy of the uveal tract. Therefore, treatment decisions are often made without specific cytologic or histopathologic information.

If painful intraocular disease (e.g., glaucoma, uveitis) is present or the tumor is enlarging rapidly, enucleation is the preferred treatment. If the tumor has invaded through the sclera, orbital exenteration should be performed to decrease the chance of local recurrence. Published reports indicate that death from confirmed metastatic disease occurs in less than 5% of cases of canine anterior uveal melanoma. Because most canine uveal melanomas are behaviorally benign and the effectiveness of early enucleation in preventing metastasis of malignant tumors is not established, automatic enucleation of eyes that are functional and nonpainful is typically not recommended. Small, focal masses may be amenable to surgical resection by a specialist; however, such procedures are technically demanding and are often associated with operative and postoperative complications.

The use of Nd:YAG or diode laser energy is increasingly common in treating focal iridal masses early in the course of development to preserve a functional, comfortable eye. The effect of this treatment on the metastatic rate has not been established; however, there have been no reports of postlaser metastasis. Referral to a specialist is recommended for intraocular laser procedures.

**Feline**

Anterior uveal melanoma is the most common primary intraocular tumor in cats. However, several differences exist between these tumors in dogs and cats. Feline uveal melanomas typically originate as single or multifocal flat areas of hyperpigmentation on the anterior face of the iris (Figure 6). Amelanotic tumors have been reported, but the neoplastic foci are typically golden to dark brown and enlarge and coalesce over a
period of months to years\textsuperscript{29,39} (Figure 7). As they progress, they can form nodular areas of thickened iris or invade the aqueous outflow pathway. Iris hyperpigmentation and secondary glaucoma are the most common presenting signs.\textsuperscript{29,39} Other potential clinical signs include distortion of the iris and evidence of uveitis.\textsuperscript{29,39} The average age at the time of diagnosis is 10 years, although a wide age range has been reported.\textsuperscript{29,36}

The differential diagnosis of feline uveal melanoma includes nonneoplastic iris freckles or nevi, pigmented uveal cysts, iridal discoloration due to inflammation, and other uveal neoplasia (e.g., lymphoma, ciliary body adenoma or adenocarcinoma, metastatic disease).\textsuperscript{29,31} Fine-needle aspiration or biopsy of the uveal tract in cats is associated with the same potential complications as in dogs. Therefore, the presumptive diagnosis is often based on observation of the typical clinical appearance.

As with canine uveal melanoma, if painful intraocular disease is present, enucleation is the preferred treatment. In contrast to the tumor in dogs, metastasis has occurred in approximately 60\% of cases of feline diffuse iris melanoma,\textsuperscript{7,39,40} but many of these tumors may have a long premalignant phase. Thus, affected patients often present with functional, nonpainful eyes. Determining the proper time for enucleation in these cases can be difficult. The postoperative prognosis is related to the extent of the tumor at the time of enucleation. In a study\textsuperscript{40} of cases in which enucleation had been performed, the longest postoperative survival times were associated with cases in which enucleation was performed while the tumor was confined to the iris stroma and trabecular meshwork. The worst prognosis was in cats whose eyes were enucleated after the tumor invaded the ciliary body and sclera. However, the degree of ocular involvement can be difficult to identify clinically.

Various criteria, in addition to increased intraocular pressure and intractable uveitis, have been suggested as possible signs of a malignant process that, if present, increase the need for enucleation. These criteria include an increase in the size and number of pigmented areas, a change in pupil size or shape, and evidence of a mass in the iridocorneal angle.\textsuperscript{1,36} Visualization of these changes may require referral to a specialist for further diagnostics, as mentioned in canine patients with uveal melanomas. Serial photographs can also be helpful in determining the rate and extent of tumor progression.
The effectiveness of laser ablation of feline iris melanomas as a possible early treatment modality has not been thoroughly investigated. Some authors believe that the use of lasers in treating diffuse iris melanomas may not be effective because of the multifocal nature of the lesions, early dissemination of neoplastic cells via the aqueous humor, and involvement of the iris root and pectinate ligament.\textsuperscript{29}

CONCLUSION

Clinicians must evaluate ocular melanocytic tumors with regard to species and specific point of origin to accurately predict the course of the tumor, assess the prognosis, and formulate the treatment.

REFERENCES

1. What is the maximum percentage of eyelid margin length that can be surgically removed using a V-shaped or four-sided wedge resection while maintaining normal eyelid function?
   a. 5% to 10%  
   b. 10% to 15%  
   c. 25% to 30%  
   d. 35% to 40%

2. Which of the following is contraindicated for use near the eyelid because of potential excessive tissue damage and scar formation?
   a. carbon dioxide laser  
   b. scalpel blade excision  
   c. cryosurgery  
   d. electrosurgery

3. Melanocytic tumors of the _______ appear to have the highest rate of metastasis and local recurrence in dogs.
   a. eyelid  
   b. conjunctiva  
   c. limbus  
   d. anterior uvea

4. The most common site of canine limbal melanoma is the _______ limbus.
   a. superior half of the  
   b. inferior half of the  
   c. lateral  
   d. medial

5. The most common site of ocular melanoma in dogs is the
   a. eyelid.  
   b. conjunctiva.  
   c. limbus.  
   d. uvea.

6. In cases of canine anterior uveal melanoma, the approximate percentage of deaths due to metastatic disease is reportedly
   a. 5%.  
   b. 10%.  
   c. 15%.  
   d. 20%.

7. The most common primary intraocular neoplasm in dogs and cats is
   a. melanoma.  
   b. iridociliary adenoma.  
   c. medulloepithelioma.  
   d. lymphoma.

8. Approximately ____% of canine uveal melanomas reportedly arise within the choroid.
   a. 5  
   b. 15  
   c. 25  
   d. 35

9. The typical origin of feline diffuse iris melanoma is the
   a. anterior surface of the iris.  
   b. posterior iris epithelium.  
   c. ciliary body.  
   d. choroid.

10. Metastasis has been found with approximately ____% of feline diffuse iris melanomas.
    a. 20  
    b. 40  
    c. 60  
    d. 80