EARLY DIAGNOSIS OF EQUINE GLAUCOMA IN A FIRST-OPINION PRACTICE ENVIRONMENT

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INTRODUCTION

Glaucoma is a collection of diseases that target retinal ganglion cells, which result in axonal degeneration and irreversible visual deficits or blindness, both of which may go unnoticed for years in the horse. The main risk factor associated with glaucoma is an increase in intraocular pressure (IOP). The range of IOP considered to be normal in the horse is 15 to 30 mmHg. Horses are quite unique to the veterinary species commonly affected with glaucoma, in that they are able to maintain vision despite quite significant and prolonged increases in IOP.

CLINICAL PRESENTATION

The clinical signs associated with glaucoma are relatively non-specific, especially early on in the disease process. Careful consideration of the history and evaluation of concomitant clinical signs is necessary to rule-out other potential causes for their presence. The most common signs associated with glaucoma in the horse are tearing (e.g., epiphora), conjunctival hyperemia, increased IOP, corneal edema, and an enlarged globe. An enlarged globe is often referred to as buphthlamos, which is latin for ox eye. This is a misnomer, as the equine globe is larger in size than a bovine globe. This may, as a result, cause some confusion. We will use the term hydrophthalmos to refer to an enlarged equine globe for the remainder of this presentation. When considering the clinical signs associated with glaucoma, it is important to differentiate between early (i.e., subclinical), acute, and chronic signs. This is not only important for early recognition of the presence of glaucoma, but will also play a vital role in determining the most effective treatment protocol to use.

Early detection of glaucoma is important in the horse, as they can, and usually do, remain visual for prolonged periods of time despite being affected by glaucoma. The earlier the disease is detected the more likely it is that further neuronal degeneration and the deterioration of the globe's health can be postponed.

OPHTHALMIC EXAMINATION AND INTERPRETATION OF SIGNS

Although a complete ophthalmic examination is extremely important when evaluating a horse suspected of having glaucoma, it is also very important that we suspect the presence of glaucoma in cases with subtle signs not immediately associated with this disease. Any horses presenting with epiphora or conjunctival hyperemia (both acute or chronic) should be suspected as a potential subclinical glaucoma case. In addition to performing a thorough ophthalmic examination, these horses shoud also have their IOPs measured via tonometry.

Additional signs that are suggestive of the presence of glaucoma are linear breaks or tears in Descemet's membrane (i.e., Haab's striae), diffuse or focal areas of corneal edema, a visible lens equator prior to, or following, pharmacological mydriasis, and the inability to bring the fundus into focus when performing routine direct ophthalmoscopy.

Each of the above findings are suggestive of early (i.e., subclinical) or even acute glaucoma, that are unlikely to even draw their owner's attention. Horses in this stages of the disease are generally not overtly painful, nor do they suffer from readily detectable visual deficits.

TONOMETRY

The only way to accurately detect elevations in IOP is to perform tonometry (i.e., applanation or rebound tonometry) on a regular basis, especially when the above signs are observed in practice. Additionally, both young and aged (i.e., older than 12 years of age) horses should have their IOP measured at least annually, in order to detect early changes in IOP.

Repeated IOP evaluation via tonometry should be recommended and performed in any horse in which the IOP is 30mmHg or greater in one of the eyes, or if there is a difference of greater than 5 mmHg between the left (OS) and right (OD) eyes. Additionally, any horses presenting with acute or chronic epiphora, Haab's striae, focal or diffuse corneal edema or a visible lens equator following mydriasis should have their IOPs monitored closely, at least once a month in order to establish a baseline and detect subtle changes early.

Two reliable applanation tonometers are available for use in equine practice: Tono-Pen® XL and the Tono-Pen® Avia (Reichert Technologies, Depew, NY). The Tono-Pen® Avia boasts a few improvements over the Tono-Pen® XL that make it more attractive to the equine practitioner. The Tono-Pen® Avia does not require manual calibration, as this is done internally and automatically. Additionally, the Tono-Pen® Avia has an LCD screen on both sides of the instrument. This allows the readings to be seen from either side, regardless of which hand (left or right) was used to perform the examination. The applanation tonometers possess have a small indentation at their tip that must be repeatedly and uniformly placed perpendicularly onto the axial cornea. Once this contact is achieved the instrument emits a tone, indicating that the measurement has been taken. A total of 6 measurements are manually obtained and internally averaged, resulting in a mean IOP value displayed in mmHg. There is a steep learning curve with the Tono-Pen applanation tonometers, as it requires some practice to accurately and consistently place the tip of the instrument perpendicularly to the axial corneal surface. Any deviation in tip placement results in the instrument failing to obtain an accurate measurement. This user error is a direct result of excessive pressure being applied to the instrument, by the clinician, in an attempt to compensate for improper tip alignment with the cornea. Such user error is avoidable over time with practice and experience. However, it should be considered when multiple individuals, with variable experience with the instrument, will be evaluating IOP's over time.

The other type of tonometer is represented by the iCare TonoVet & TonoVet Plus (Jorgensen Laboratories, Loveland, CO) rebound tonometers. Like the applanation tonometers, these rebound tonometers do not require manual calibration. They can be set for use in feline, canine and equine species and function by automatically thrusting a small, plastic-tipped projectile repeatedly and automatically against the corneal surface. The velocity in which the projectile travels is calculated internally (the time it takes for the probe to return (i.e., rebound) to it's initial starting position) and presented as a mean of a series of IOP measurements that are presented on a small LCD screen. The TonoVet and TonoVet plus are useful in the horse as they are required to be held vertically for the examination and individual user error that results in measurement discrepancies are prevented from occurring due to the automatic process in which the probe is projected against the cornea. The iCare TonoVet rebound tonometers eliminate user error, which is advantageous when multiple users will be measuring IOPs interchangeably. Consistent results can be more readily obtained, even when the IOPs are being measured by a novice.

OCULAR ULTRASONOGRAPHY

Although ocular ultrasound has been touted as a means of diagnosing glaucoma, the usefulness of ocular ultrasonography to detect early stages of glaucoma has not been demonstrated in the horse. The most useful finding or measurement in assessing equine globes for glaucoma is the axial globe length, and globe enlargement can be readily detected using ocular ultrasonography. However, this is a finding that occurs very late in the disease process, and is generally associated with chronic, irreversible changes to the globe. Thus, ocular ultrasound should not be considered as a means to identify early glaucomatous changes in the horse.

Ocular ultrasonography may be useful in confirming lens instability or lens displacement that may be contributing to the glaucoma, but these changes can be a challenge to detect and interpret, and are usually addressed during referral evaluation by an ophthalmologist. Comparing axial globe lengths between the affected and non-affected globes (in cases with unilateral disease) can help to confirm the diagnosis of glaucoma.

ESTABLISHING A DIAGNOSIS OF GLAUCOMA

Diagnosing glaucoma, in it's own right, is not a simple task. This is further complicated by the lack of available instrumentation (i.e., tonometer) and adequate level of experience with the disease amongst equine practitioners. Although glaucoma is a term that most equine practitioners are familiar with, the

signs that are most easily recognized are more commonly associated with chronic stages of the disease, or glaucoma arising secondary to other primary ocular diseases, such as equine recurrent uveitis (ERU) or progressive intraocular tumors (e.g., uveal melanocytoma). Therefore, future efforts should focus on rethinking our general approach to glaucoma, and concentrating on ocular signs that suggest subclinical or early/acute stages of glaucoma.

As previously mentioned, these signs are most commonly associated with other, more general, ocular conditions that may present as seemingly harmless diseases but which return in a somewhat cyclical manner. Because horses do not generally present with concomitant visual deficits during the early stages of disease, glaucoma is often not even considered as a differential diagnosis.

The first step in establishing a working diagnosis of glaucoma is to recognize the common signs associated with early clinical manifestations of the disease. This can be very difficult but will include general ocular signs such as epiphora, conjunctival hyperemia, and linear corneal opacifications at the level of Descemet's membrane. While not all horses presenting with the above signs will have glaucoma, the disease should be considered and steps taken to rule out the disease.

REFERRAL TO AN EQUINE OPHTHALMOLOGIST FOR FURTHER EVALUATION AND TREATMENT

Most of the necessary diagnostic tests available to differentiate glaucoma from other types of ocular diseases at this stage of disease will require referral and secondary evaluation by an ophthalmologist, preferably one with significant experience in equine ophthalmology. It is imperative that horses be referred during these stages of the disease in order to rule out glaucoma. An equine ophthalmologist will be able to further characterize the underlying disease process by evaluating the globes for subtle signs of concomitant disease by performing additional clinical evaluations that will help to identify early signs of glaucoma (e.g., streak retinoscopy and fundus photography), as well as performing advanced diagnostic imaging such as optical coherence tomography (OCT) to evaluate the optic nerve head and retinal layers in vivo, which may provide early evidence of the presence of glaucoma.

Once an accurate diagnosis has been established (e.g., primary vs. secondary glaucoma), targeted treatment can be initiated. The first step in treatment usually begins with medical therapy targeting the direct (carbon-anhydrase inhibitors) or indirect (beta-blockers) reduction of aqueous humor production. Many horses with glaucoma will also respond favorably to topical corticosteroid therapy, even if there are no signs of detectable underlying ocular inflammation (e.g., uveitis). The reason for the positive influence of corticosteroids on equine glaucoma remains enigmatic. If medical therapy alone does not result in the desired reduction of IOP and elimination of concomitant ocular signs of disease, transscleral cyclophotocoagulation (TSCP) may be transiently effective in managing the effects.

In cases where medical therapy with carbon-anhydrase inhibitors are ineffective at lowering the IOP placement of a drainage tube (e.g., valved or non-valved glaucoma shunt) with or without TSCP may be performed to better control the IOP. Although these two treatment modalities (TSCP and drainage tube placement) may be performed simultaneously, there is anecdotal evidence to suggest that staggering the surgical interventions may result in a more favorable outcome. Nevertheless, treatment outcomes are very unpredictable, and there is a paucity of available information in the current body of literature. With continued diligence and early referral, targeted treatment options may be effective in achieving better long-term IOP control and a postponing neuronal degeneration associated with glaucoma in the horse.

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