How to Diagnose Ocular Abnormalities with Ultrasound

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Ocular ultrasound is a relatively easy, noninvasive diagnostic modality to evaluate for ocular abnormalities and can be used as a complement to traditional ophthalmoscopic examination. Ocular ultrasound should be performed in horses with ocular trauma, disparity in ocular size or with any condition that impedes visualization of posterior ocular structures. Author's address: Department of Surgical & Radiological Sciences, School of Veterinary Medicine, University of California, Davis, CA 95616. © 2002 AAEP.

1. Introduction
Ultrasonographic evaluation of the equine eye is a relatively easy procedure to perform and can be accomplished with little practice. Ocular examinations can be performed with standard ultrasound equipment available to equine practitioners. The use of ocular ultrasound in horses has been described in various texts and clinical reports.1–5 The purpose of this report is to increase awareness of this diagnostic modality for ocular abnormalities and to encourage practitioners to include ultrasound as part of their ophthalmologic examination.

Indications for ocular ultrasound include any clinical entity which impedes visualization of all or a portion of the globe and retrobulbar region. Severe corneal edema, corneal lacerations or ulcerations, cataracts or ocular masses may preclude visualization of deeper structures with traditional ophthalmoscopic methods. Another common indication for ocular ultrasound is disparity in ocular size or a protruding globe. Ultrasound is important in these cases to differentiate between enophthalmus, buphthalmus, or exophthalmus due to the presence of retrobulbar masses. In cases of ocular trauma, ultrasound can be used to evaluate the integrity of the globe. Ultrasound can also be used to confirm ophthalmoscopic findings, such as retinal detachment or early cataractous changes.

2. Materials and Methods
Horses should be sedated lightly with either detomidine HCl (0.004–0.008 mg/kg IV) or xylazine HO (0.3–0.4 mg/kg IV). Butorphanol tartrate (0.01–0.02 mg/kg IV) may be useful in horses with ocular trauma or significant pain. Local nerve blocks or topical anesthetics are not required for transpalpebral technique. Ultrasound coupling gel is applied to the upper eyelid. It is not necessary to clip the hair of the upper eyelid.

The highest frequency transducer available should be used, but a diagnostic examination can be performed utilizing a 5–10-MHz transducer. Rectal, tendon, and curvilinear transducers can all be utilized to produce diagnostic images. The structures of the globe are evaluated at a depth of 4–6 cm. The retrobulbar region is evaluated at a scanning depth of 6–10 cm.

NOTES
The transducer is placed on the upper eyelid parallel to the upper palpebral fissure. This produces a cross-sectional image of the eye with the medial canthus to the right and lateral canthus to the left of the image. All planes of the globe are evaluated by closing the eyelid with the transducer. It is important to use light pressure to prevent blinking. Attempts should be made to prevent ultrasound gel from contacting the cornea. Ultrasound gel is not detrimental to the intact cornea but will cause the horse to blink excessively. A complete examination of both eyes should be performed. This is important to rule out subclinical abnormalities in the unaffected eye and to compare ocular measurements.

The cornea is best evaluated with a standoff pad placed between the transducer and upper eyelid. The cornea is seen as a thin hypoechoic layer deep and parallel to the eyelid. Corneal abnormalities include corneal edema, corneal infiltrates, or stromal abscesses. Cornea edema is seen as a thickened and diffusely hypoechoic cornea. Corneal infiltrates or stromal abscesses may also cause corneal thickening with echogenic material within the cornea. Infiltrates may dissect between corneal tissue layers or may coalesce into focal accumulations within the corneal stroma. Corneal ulcerations will cause a thickened and irregular surface to the cornea.

Fig. 1 demonstrates the ultrasonographic appearance of the normal globe. The anterior chamber (A) is filled with anechoic fluid and is bordered by the cornea, iris, and anterior reflection of the lens capsule. Abnormalities include anterior synechiae, which are seen as thin hypoechoic strands extending from the cornea to the iris or lens. Anterior chamber fluid depth should be measured and compared to the opposite eye. Anterior uveitis and/or glaucoma can result in distention of the anterior chamber. Ocular or periorbital masses may occasionally be seen to extend into the anterior chamber.

The iris and ciliary body (B) are seen as echogenic linear structures which extend from the peripheral globe towards the lens. The iris and ciliary region appear as a singular structure with standard ultrasound equipment. The corpora nigra or iridic granules are seen as an echogenic mound of tissue on the anterior surface of the dorsal iris. Occasionally, iris cysts may be seen within the corpora nigra. These are spherical structures with anechoic centers and are considered an incidental finding. Iris bombe is infrequently seen as a sequelae to inflammation and/or glaucoma. Horses with iris bombe demonstrate a thickened iris which bulges towards the cornea. Ciliary cysts are the most common finding in Rocky Mountain Horses as part of a complex congenital ocular abnormality. Ciliary cysts are easily seen with ultrasound and may be singular or appear in clusters on the vitreal side of the ciliary body. They are always located temporally near the lateral canthus. Ciliary cysts may be
asymptomatic if no other ocular abnormalities are identified.

The normal lens is anechoic. Only the anterior and posterior reflections of the lens capsule can be seen in normal horses (C). Early cataractous change or nuclear sclerosis is the most common abnormality seen in middle-age to aged horses. This is recognized by a thin hypoechoic rim within the lens capsule. Mature acquired cataracts may vary somewhat in their sonographic appearance. Most cataracts demonstrate a thickened echogenic lens capsule with or without irregular margins. The interior of the cataractous lens may be filled with echogenic material. The lens may demonstrate a misshapen and/or enlarged appearance. Congenital cataracts demonstrate a similar appearance as acquired cataracts. Luxation of a cataractous lens can also be seen. Posterior luxation appears as a spherical echogenic lens which is located ventrally within the vitreal chamber.

The normal vitreal chamber (D) is filled with anechoic fluid. Echogenic swirling material within the vitreous may represent recent hemorrhage or vitreal debris secondary to inflammation. The retina is a layer of cells lining the vitreal chamber (E). The normal retina cannot be differentiated sonographically from the other choroidal layers. Retinal detachment is an easily recognizable finding which can be partial or complete. Complete retinal detachment is recognized as a thin hypoechoic layer of cells in a “V” or “seagull” formation. The detached retina remains attached at the optic disc which results in the V-shape appearance.

Sonographic evaluation of the retrobulbar region, including the optic nerve, extraocular muscles and bony orbit, requires an increased scanning depth of 6–8 cm (Fig. 2). The optic nerve demonstrates a cone shape appearance and a homogeneous echogenicity (F). The optic nerve is surrounded by the extraocular muscles, which demonstrate a hypoechoic and mottled echogenicity (G). The bony orbit is seen deep to the extraocular muscles as a smooth hyperechoic bony surface (H). Sonographic evaluation of exophthalmic horses for retrobulbar masses or abscesses is the most common indication for evaluation of this region. Retrobulbar masses can be detected; however, these can be easily misdiagnosed due to the mottled echogenicity and somewhat vague appearance of the extraocular muscles. The opposite eye should always be evaluated for comparison. Orbital fractures can be seen as a disruption in the cortical surfaces of the orbit or as step defects.

The globe should be measured in an anterior to posterior direction at the point of maximal ocular diameter. The ideal image for measurement includes the anterior chamber, anterior and posterior reflections of the lens capsule, vitreous, and retina/choroidal layers. The anterior chamber should be measured from the cornea to the anterior reflection...
of the lens. A second measurement should be taken from the anterior reflection of the lens to the retina. A total of these measurements indicates the overall size of the globe. Medial to lateral measurements are difficult to obtain in the adult horse as the entire globe seldom fits within the field of view in a medial to the lateral direction. Normal measurements of cadaveric equine eyes have been published and can be used as a reference; however, both eyes should be measured for comparison in the clinical setting.7

3. Results

Ocular ultrasound was performed in 36 horses at the University of California, Davis Veterinary Medical Teaching Hospital (UCD-VMTH) from August 1999 to February 2002. Sonographic abnormalities were detected in all but two cases. The most common sonographic abnormality was cataracts which were seen in 11 horses. Two middle-age Appaloosa horses with cataracts demonstrated posterior luxation into the vitreal chamber. Four foals presented with congenital cataracts. Ultrasound was utilized to rule out retinal detachment before surgical removal of the cataractous lens in all foals. Ciliary cysts were seen in 3 of 3 Rocky Mountain Horses presenting for ocular ultrasound. Retrobulbar masses were seen in two horses. Intraocular masses were seen in two horses. One involved the iris and one involved the retina and optic nerve. Partial or complete retinal detachment was seen in three horses. Two horses demonstrated buphthalmia secondary to glaucoma. The remaining cases demonstrated sonographic findings ranging from corneal edema to iris bombe to a ruptured globe.

4. Discussion

The high incidence of positive findings in 34 of 36 horses is reflected by the fact that the majority of cases were referred from the Ophthalmology Service at the UCD-VMTH. Some of the findings were diagnosed before sonographic evaluation. Ultrasound was beneficial in confirming these diagnoses and to rule out other ocular or orbital abnormalities. Approximately one third of horses demonstrated cataracts that either impeded or completely obscured visualization of posterior structures with traditional methods. The use of ultrasound was important to rule out retinal detachment in these cases.

Ultrasound and ophthalmoscopic findings correlated well in horses presenting with retinal detachment in this study. One report states that ultrasound is able to document the extent of detachment more accurately than ophthalmologic examination alone.8 It would therefore seem advisable to perform ocular ultrasound in all horses with retinal detachment. Ocular ultrasound has also been helpful in the diagnosis of intraocular and retrobulbar masses where ophthalmic exam could not determine the extent of involvement.

Ocular ultrasound examinations at the UCD-VMTH are performed with a 10-MHz linear transducer which produces images with very high resolution and detail. Most practitioners utilize ultrasound equipment designed for reproductive imaging in the mare with a transducer in the mid-frequency range. A 5.0–6.0-MHz rectal transducer used for reproductive work will not produce superior ocular images, but this transducer will produce adequate images to diagnose common abnormalities such as retinal detachment and cataracts. If a higher frequency transducer is available, this should be utilized for the ocular examinations. Transducers are now becoming available in the 12–14 MHz range, which will provide even greater resolution than we are able to obtain with today’s 10-MHz transducers.

In summary, ocular ultrasound is a valuable diagnostic procedure that can be readily performed in the field or hospital setting with standard equipment available to the equine practitioner. Common ocular abnormalities are easily recognizable and should complement ophthalmologic examination in both clinical and prepurchase examinations.

References and Footnotes


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