Research Article

Ultrasonographic evaluation of buffalo eyes

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Abstract: The purpose of this study was to describe the ultrasonography appearance and measurements of normal buffalo eyes. Ocular ultrasonographic examinations were performed on 20 adult buffaloes. Transpalpebral ultrasonographic images were obtained with a 6–8 MHz linear transducer in the axial imaging plane. The ultrasonographic appearance of structures within the buffalo eye is similar to that in other species. When comparing measurements, the anteroposterior depth of the lens, vitreous chamber, and axial length of the globe on the left side were greater than on right, and the anterior chamber depth and scleroretinal rim wall thickness on the left side were also less than on the right side in each of the buffaloes, but these differences were not statistically significant. The knowledge of normal ocular dimensions facilitates the use of ultrasonography in the evaluation of ocular disease in animals.

Key words: Biometry, buffalo, eye, ultrasonography

1. Introduction

Ocular biometry was one of the early uses of ultrasound in human ophthalmology. This application resulted from ultrasound's unique ability to measure the axial dimensions of the eye and determine the position of intraocular components without compression or other artifacts (1). Biometry of the eye has been useful for the assessment of certain pathologic abnormalities such as phthisis bulbi, microphthalmia, pseudo-exophthalmia (unilateral axial myopia), and scleral ectasia. It also has been useful for determining dioptric power for lens replacement following cataract and, in humans, for estimating globe size for optimal placement of encircling elements in retinal detachment repair (1). The ultrasonographic appearance and dimension of the eye of animals have been described as being similar, such as the dog and horse (2–4). However, to the authors' knowledge, the ultrasonographic anatomy and biometry of the buffalo eye in a living subject has not been described. Knowledge of the ultrasonographic appearance and the normal dimensions would serve as a basis for ultrasonographic examination where ocular disease may have caused alterations in dimensions and appearance (2,5). It is quick, painless, and safe and it provides the ocular dimension and appearance, especially when we cannot examine the eye with ophthalmoscopy. Ultrasonography uses high-frequency sound waves to examine the eye. Ocular biometry is useful for the assessment of abnormalities and many systemic diseases.

Ocular opacities preclude the use of ophthalmoscopy, whereas transpalpebral ultrasonography enables evaluation of intraocular structures in these cases (6,7).

The purpose of this study was to describe the normal ultrasonographic appearance of buffalo eyes using B-mode ultrasound and to perform a biometric evaluation. This information could serve as a basis for further clinical investigations of ocular abnormalities in buffalo.

2. Materials and methods

Twenty transpalpebral ocular ultrasonographic examinations were performed on 20 adult buffaloes (mean age: 50 ± 5 months). Examinations were performed with the animals restrained, without the use of sedation or anesthesia/analgesia. Ocular examinations performed before the study were unremarkable in all animals. Ultrasonographic examinations were performed with an ultrasound machine (Aquila, Pie Medical, Esaote Inc., Italy) using a 6–8 MHz linear transducer and the images were recorded using a multi-format camera and video recorder. The globes were examined in a sagittal plane as standard described models in both the right and the left side of the body (1,7,8). One operator (the corresponding author) obtained the images. Ocular distances were measured from the standard views using calibrated electronic calipers.

Direct measurements were made using a mechanical caliper. Optimal B-scan images along the central optic

axis enabled visualization of the cornea, anterior chamber, anterior lens capsule, posterior lens capsule, vitreous chamber, posterior ocular wall, and optic nerve (Figure).

Four intraocular dimensions were recorded: anterior chamber depth, lens diameter, vitreous chamber depth, and axis bulbi. The axial length of the globe (including the scleroretinal rim), vitreous chamber depth (distance from the lens to the scleroretinal rim), depth of the anterior chamber (distance from mid-cornea to the anterior lens capsule), and thickness of the lens were measured along the central axis of the eye. In addition, the thickness of the scleroretinal rim was recorded. A standoff pad was used for measurement of anterior chamber depth.

The mean and standard deviation for each set of measurements were calculated and ocular dimensions and data are presented as mean ± standard deviation. B-mode measurements were compared on both sides. Student's t-test was used to determine whether differences between the measurements were significant. The level of statistical significance was set at P < 0.05.

3. Results
Diagnostic quality transpalpebral images were obtained for all eyes examined. On B-scan images, the buffalo eyes appeared as well-defined, ovoid structures with mostly anechoic contents. In this study, the anterior lens capsule, posterior lens capsule, and scleroretinal rim appeared hyperechoic, whereas the anterior aqueous chamber, lens, and vitreous chamber were anechoic. The cornea appeared as a double-peaked echo (2 convex interfaces) with a central, narrow anechoic space. The anterior lens capsule appeared as a convex echogenic line separated from the concave echogenic line of the posterior lens capsule by the anechoic lens. The iris and ciliary body were observed as

linearly shaped moderately echoic structures. The iris was identified immediately adjacent to the anterior lens capsule with the thicker, irregular ciliary body lying peripheral to it.

The anterior and posterior chambers of the aqueous appeared as a single, anechoic space. The vitreous chamber imaged as a homogeneous, anechoic region between the posterior lens capsule and ciliary body anteriorly and the posterior ocular wall. The posterior ocular wall had a good echogenicity encountered. The scleroretinal rim appeared as a concave echogenic line and its 3 layers could not be differentiated ultrasonographically. The optic nerve casts acoustic shadows from its margins and there are many reports regarding the diameter of optic nerve (1,7). In this study it was not possible to identify individual retinal, choroidal, or scleral layers. Occasionally, several parallel linear echogenicities were seen within the retina/choroid/sclera complex that may have represented one or more of these layers, but this was not a consistent finding.

The ultrasonographic measurements of ocular distances are recorded in the Table.

4. Discussion
Two-dimensional ultrasound is an excellent way to evaluate the eye and orbit (3,8,9). The ultrasonographic anatomy and biometry of the eye have been investigated previously in many animals (7,8,9). To the authors' knowledge there are no published studies on a living buffalo eye ultrasonography. A report on ultrasonographic anatomy of the enucleated eyes of a buffalo after slaughtering is the only study available in buffaloes (10). Biometric measurements for the axial length, anterior chamber depth, vitreous depth, scleroretinal rim thickness, and lens reported by this study were similar to those reported for
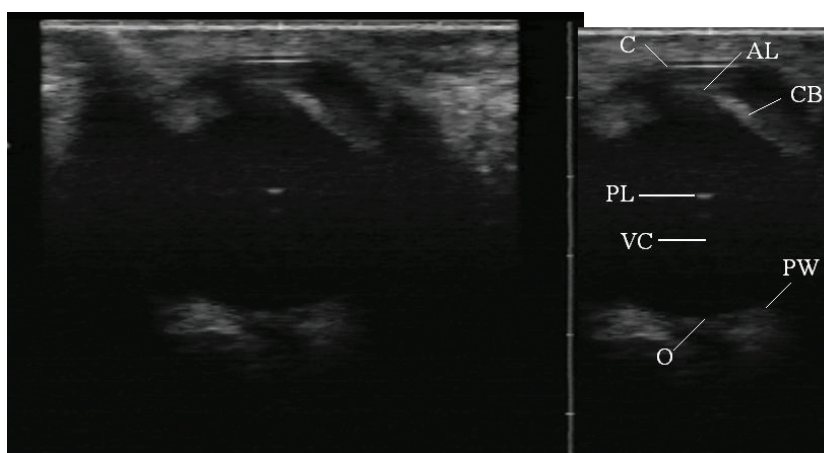

Figure. Sagittal B-mode ultrasonogram of a buffalo eye. In the magnified part of this scan, the cornea (C), anterior lens capsule (AL), ciliary body (CB), posterior lens capsule (PL), vitreous chamber (VC), posterior ocular wall (PW), and optic nerve region (O) can be identified.

Table. Ultrasonographic biometric measurements of ocular distances (mean ± SD).

Parameters	Left	Right	Measurements in right and left
Anterior chamber depth (cm)	0.287 ± 0.015	0.291 ± 0.014	0.289 ± 0.015
Vitreous chamber depth (cm)	1.677 ± 0.042	1.670 ± 0.040	1.673 ± 0.040
Scleroretinal rim thickness (cm)	0.155 ± 0.011	0.158 ± 0.010	0.156 ± 0.010
Anteroposterior depth of the lens (cm)	1.135 ± 0.052	1.132 ± 0.053	1.133 ± 0.052
Axial length of the globe (cm)	3.297 ± 0.037	3.292 ± 0.037	3.294 ± 0.037

ultrasonographic examination in other animals (1,7,8). Ultrasonography of the buffalo eyes revealed many similarities to those described for cattle (1,7), dogs (5,8), and horses (4), with some variations in the shape and dimensions.

The result of this study shows that ultrasonographic evaluation of buffalo eyes can be achieved in a similar way to those of other animals (2,7). In this study, ultrasonographic evaluation of the eye was performed in a rostrocaudal orientation. There was no statistically significant difference between measurements of the right and left eye.

Anteroposterior depth of the lens, vitreous chamber, and axial length of the globe on the left side were greater than the same depths on the right side. The anterior chamber depth and scleroretinal rim wall thickness in the left side also measured less than those in the right side in each buffalo, but this difference was not statistically significant and is unlikely to be of clinical significance. Alternatively, the reduction in depth of the anterior chamber when measured in the live animal may be due to corneal flattening as a result of transducer contact during the scanning process and must be considered (1). A 6–8 MHz transducer has a focal range of approximately 2–4 cm with sufficient depth of penetration, and it can be used in eye ultrasonography (1,7). Other studies that performed biometric measurements of live animals showed that the measurements were similar to those reported from cadaveric specimens (1). The physical measurements of many ocular structures have been reported (11–13). Ocular measurements were probably affected by postmortem changes. Ocular measurements were probably also affected by frozen material; this may be due to the expansion of water during the freezing process. This change has also been reported for other animals such as the cow, dog, and horse (1).

Therefore, it is better to perform studies on living animals, and if cadavers are used, then postmortem changes and changes due to the method of preservation should be taken into account. Many parameters in the anterior segment may be lost in the near-field reverberation artifact (2,8) and a standoff can be used to avoid this problem (2).

Different structures of the eye have varying tissue ultrasound wave velocities and intraocular structures vary among species, especially for the lens (5,7). In B-mode display of ultrasonographic scans, the optic nerve is seen with a hypoechoic status with parallel margins coursing posteriorly from the globe. This hypoechogenicity is presumably due to orientation of the beam parallel to the nerve fibers and the highly organized, homogeneous structure of the optic nerve compared to adjacent fat (2,7). In this study, the ultrasonographic measurements in buffalo eyes appear similar to those of cattle (1,7). This study aimed to provide the normal ultrasound appearance and ocular biometry of the buffalo eye by using a widely available, general-purpose ultrasonographic scanner. This investigation will provide baseline information for the study of pathologic conditions affecting the eyes of buffaloes with an ultrasound unit commonly available to the practicing veterinarian. The difference in actual calibrated tissue velocity may lead to some discrepancy between ultrasonographic and physical measurements.

It appears that ultrasonography is a valuable diagnostic tool for evaluating the eye, although further studies, especially regarding different disease conditions, are required.

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