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Ultrasonographic anatomy and biometry of eye in calves and goats

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The eyes of goats have been used for *in vitro* research for diseases of humans (Mohammadi *et al*. 2011) and in pharmacodynamic studies of drugs (Pawar and Majumdar 2007), or for training novice surgeons in different techniques of phacoemulsification (Dada and Sidhu 2000). The ultrasonographic anatomy and biometry of eye have been investigated previously in cattle (Potter *et al.* 2008), sheep and goats (Ribeiro *et al.* 2009), pigs, dogs and rabbits (Gorig *et al*. 2006), and camel (Yadegari *et al*. 2013). Documentation of normal and ocular dimensions of ultrasonographic appearance of farm animals would facilitate the diagnosis of ocular disease especially when the opaque anterior segment precludes complete ophthalmoscopic examination. This study aimed to provide the normal ultrasound appearance and ocular biometry of calves and goats by using a widely available, general purpose ultrasonographic scanner.

The study was conducted at Livestock Research Station, Thiruvizhamkunnu, Mannarkkad. Six calves with an average age of 2 months and six Attappady Black goats, with an average age of 10 months were used. After the completion of ophthalmic examination with pupillary light reflexes, Schirmer tear test, and fluorescein staining, auriculopalpebral nerve block with 2% Lignocaine was given to reduce palpebral reflex. For ocular sedation, topical anesthetic (0.5% Proparacaine) was instilled on the cornea (Shah *et al.* 2010). The animal head was firmly held, tilted and the eyelids were spaced out to facilitate the probe placement. Ultrasonographic examination was performed using a B-mode ocular ultrasound unit equipped with a 8 MHz sector transducer with standoff pad. Using the direct corneal contact technique, the transducer covered with sterile sheath filled with the coupling gel was placed directly on the cornea (Nyland and Mattoon 1995). Light pressure was applied to maintain good contact between the transducer and the cornea. Both eyes were examined and normal appearance of ocular structures were evaluated in respect to location and echo texture compared to the surrounding tissues. Ultrasonograms of the cornea, anterior chamber, anterior lens capsule, posterior lens capsule, vitreous chamber, scleroretinal rim and optic nerve were obtained. Intraocular dimensions of anterior chamber depth (AC), vitreous chamber depth (VC), lens thickness (L) and axial length (AL) were assessed and recorded.

B-mode ultrasonography using 8 MHz tranducer, diagnostic quality transcorneal images were obtained for all eyes examined in calves and goats. Ocular ultrasonogram appeared as well defined, ovoid structures with mostly anechoic contents. Four major echoes viz. cornea, anterior lens capsule, posterior lens capsule and scleroretinal rim were observed (Figs. 1–4). The cornea was observed as a curved hyper echoic interface immediately under the standoff pad. Posterior lens capsule and scleroretinal rim appeared hyperechoic; whereas the anterior aqueous chamber, lens and vitreous chamber were anechoic. 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 was identified as moderately echoic immediately adjacent to the anterior lens capsule with the thicker, irregular ciliary body lying peripheral to it. The vitreous chamber imaged as a homogenous anechoic region between the posterior lens capsule and ciliary body

Table 1. Ultrasonographic ocular biometric measurements in calves and goats (Mean ± SD)

Parameter	Calves		Goats	
	Right eye	Left eye	Right eye	Left eye
Anterior chamber depth (mm)	1.47 ± 0.06	1.46 ± 0.06	1.14 ± 0.08	1.17 ± 0.08
Vitreous chamber depth (mm)	12.2 ± 0.31	12.3 ± 0.18	9.5 ± 0.15	9.51 ± 0.27
Lens thickness (mm)	7.09 ± 0.19	7.07 ± 0.15	5.58 ± 0.20	5.65 ± 0.15
Axial globe length (mm)	20.2 ± 0.33	20.3 ± 0.17	16.44 ± 0.14	16.45 ± 0.15

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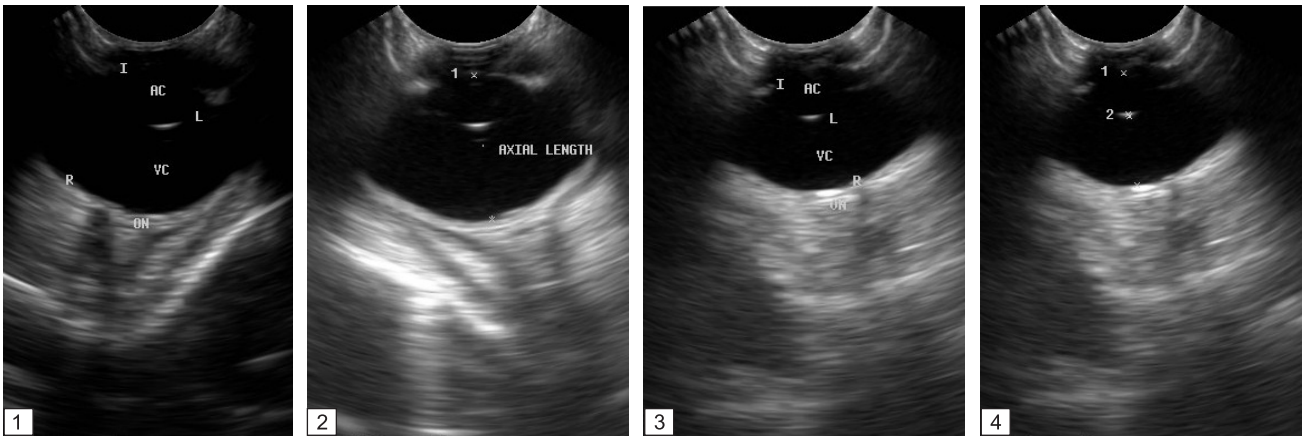

Figs 1–4. **1.** Normal ocular ultrasonogram in calves showing iris (I), anterior chamber (AC), vitreous chamber (VC), lens (L), retina (R) and optic nerve (ON). **2.** Normal ocular ultrasonogram in goats showing iris (I), anterior chamber (AC), vitreous chamber (VC), lens (L) and retina (R).**3.** Ocular biometry in calves showing axial length. **4.** Ocular biometry in goats showing anterior chamber depth and vitreous chamber depth.

anteriorly and the posterior scleroretinal rim. The scleroretinal rim appeared as a concave echogenic line and its layers could not be differentiated ultrasonographically. The optic nerve casts acoustic shadows from with parallel margins coursing posteriorly from the globe. The data of the ecobiometric values measured in calves and goats are summarized in Table 1.

The ultrasonographic ocular images obtained from calves and goats showed similarity in the structures with respect to location and echogenicity. No significant differences ($P \leq 0.05$) could be observed between left and right eyes of the animals.

Clinical manifestations like corneal oedema corneal ulceration, keratitis, anterior uveitis, and many systemic diseases would prevent the direct visuslization of intraocular structures by ophthalmoscopy (Whittaker *et al.* 2003). So the study was performed to visualize the ocular structures and evaluate the dimensions in calves and goats through ultrasonography. The ultrasonographic anatomy and biometry of eye have been investigated previously in cattle (Potter *et al.* 2008, Ribeiro *et al.* 2009, El-Maghraby *et al.* 1995), goats (Ribeiro *et al.* 2010, El-Tookhy and Tharwat 2013) and camel (Yadegari *et al.* 2013). Ultrasonographic appearance and biometry obtained in this study was found to be similar to previous reports with variations in the shape and dimensions.

The study documented ultrasonographic anatomy and biometry of eye in calves and goats, which would facilitate the evaluation of ocular disease in adult cattle and goats.

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