



Ocular biometry in Gaddi breed goats of Himachal Pradesh

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Ophthalmic ultrasonography is a widely used diagnostic modality for examination of various eye affections as it provides useful information to evaluate intraocular structure in opaque eyes (Potter *et al.* 2008). The familiarity with normal dimensions or biometric appearance of the eye aid in sonographic diagnosis of various affections. It is quite easy to diagnose the ocular conditions restricted to the outer layer, i.e. cornea, but the rest of the eye ball cannot be examined if the corneal transparency is compromised because of any corneal diseases. Most of the time, keratitis and corneal edema obstruct the use of any kind of ophthalmoscopy for diagnosis of pathology related to aqueous chamber, lens, vitreous and retina.

Gaddi goat, also known as White Himalayan Goat, is the breed of high altitudes with the native tracts belonging to Himachal Pradesh. The present study is an effort to document the normal ocular biometry of the eyes of healthy Gaddi goat, to facilitate the clinicians to diagnose various disease conditions like glaucoma, uveitis, cataracts, various vitreous lesions, retinal degeneration and retinal detachment, etc. by comparing the sonographic findings in the particular case.

Twenty Gaddi (White Himalayan goat) goats (aged 8-10 months) were studied for biometrical evaluation of the normal eye at Gaddi goat unit, CSK Himachal Pradesh Krishi Vishvavidyalaya, under All India Coordinated Research Project on Goat Improvement with the help of ultrasound. All the animals were clinically healthy without any visual abnormality. Preliminary blood examination of all animals revealed blood parameters within normal reference range. Scanning of the eye was done by trans-corneal and trans-palpebral technique in standing position without any sedation or regional nerve block. Trimming of the eyelashes was done in all the animals to reduce interference of the eyelashes with the ultrasound probe

while doing trans-corneal scanning and single application of xylocaine ointment (5%) was used to desensitize the cornea. The ultrasound scans were done after 5 min of application of 5% xylocaine jelly. Lignocaine jelly (2%) was applied thereafter directly on the cornea to serve as a conductive medium for ultrasound waves in trans-corneal technique.

For trans-palpebral technique, the area above the eyelids was not shaved and coupling gel was applied on the outer aspect of eyelids. B-mode ultrasound scan in both transverse and sagittal planes of the eyes were done with Sonosite M Turbo ultrasound system (FUJIFILM-Sonosite Inc., USA) with L38xi linear transducer (5-10 MHz frequency). Corneal thickness (CT), aqueous chamber depth (ACD), lens thickness (LT), lens diameter (LD), vitreous chamber depth (VCD), eye ball diameter (EBD) and eye ball length (EBL) were recorded as B-mode echo-biometric measurements. After completion of the eye examination, both eyes were thoroughly flushed with normal saline solution. The sonograms were recorded in a sequence of right eye followed by left eye to keep the uniformity in recording.

Forty eyes (20 goats) were scanned for ocular biometric evaluation of Gaddi goat eye. The cornea was observed as a thick hyperechoic line just below the eyelid in the trans-palpebral technique. The cornea was seen as a double hyperechoic line where the first corresponded to its epithelium and the second to its Descemet's membrane. Measurement of cornea thickness was done at 2 cm depth adjustment (Fig. 1). The corneal thickness was 0.03 to 0.07 cm and 0.03 to 0.05 cm in right and left eye, respectively. The overall average of corneal thickness of 40 eyes in Gaddi goat was 0.045 ± 0.002 cm. Al-Redah (2016) reported corneal thickness as 0.059 ± 0.001 cm in domestic young healthy Iraqi goats which is higher than the thickness recorded in the present study. Athar *et al.* (2021) also reported a greater central corneal thickness in Bakerwal breed of goat (0.0967 ± 0.003 cm) and in non-descript breed of goats (0.090 ± 0.004 cm). So, the overall average of corneal thickness in Gaddi goats was less than other breeds of goats like Iraqi, Bakerwal, and non-descript.

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Aqueous chamber was observed as an anechoic fluid filled structure between the anterior capsule of lens and posterior boundary of the cornea (Fig. 1). The aqueous chamber depth varied from 0.12 to 0.29 cm and 0.12 to 0.31 cm in right and left eye, respectively. The average anterior chamber depth of 40 eyes was 0.195 ± 0.01 cm. Athar *et al.* (2021) reported a greater Aqueous chamber depth in Bakerwal breed of goat as 0.26 ± 0.026 cm and in non-descript breed of goats as 0.26 ± 0.01 cm. Al-Redah (2016) also reported a little higher Aqueous chamber depth (0.198 ± 0.014 cm) in domestic young healthy Iraqi goats. Kumar *et al.* (2018) reported that the average Aqueous chamber depth varied from 0.205 ± 0.014 to 0.323 ± 0.010 at various life time intervals from birth to 15 years in dog breeds found in India. Neves *et al.* (2020) reported aqueous chamber depth of 0.44 to 0.53 cm in 1 to 58 months of Jersey cattle. So, the Aqueous chamber depth in Gaddi goat in present communication is less than the other breeds of goat, dogs and Jersey cattle.

Ciliary body and iris were observed as echogenic projectories present in antero-lateral position of the lens (Fig. 1). In total 18 eyes out of 20, both the ciliary bodies were not visible simultaneously in one view.

Ocular lens was recognized from its anterior and

posterior capsule just posterior to the aqueous chamber which appeared as a thin convex hyperechoic interface. The lens thickness and lens diameter varied from 0.81 to 0.96 (0.85 ± 0.008) cm and 0.92 to 1.36 (1.07 ± 0.03) cm in right eye, whereas it was recorded as 0.78 to 0.94 (0.84 ± 0.008) cm and 1.0 to 1.29 (1.05 ± 0.02) cm in left eye. The average lens thickness and lens diameter of 40 eyes was 0.845 ± 0.008 cm and 1.06 ± 0.025 cm. Other studies reported the lens thickness and lens diameter of different goat eye lens varying from 0.773 to 0.93 cm and 1.18 to 1.19 cm, respectively (Al-Redah 2016, Athar *et al.* 2021).

Vitreous chamber is present as a homogeneous anechoic structure, between the posterior lens capsule and posterior eye wall (Fig. 1). Vitreous chamber depth varied from 0.91 to 1.08 cm with average of 0.98 ± 0.01 for right eye and 0.9 to 1.06 cm with the average of 0.98 ± 0.01 cm for left eye. Al-Redah (2016) reported vitreous chamber depth as 0.985 ± 0.012 cm in domestic young healthy Iraqi goats, whereas Athar *et al.* (2021) reported vitreous chamber depth of 1.03 ± 0.02 and 1.02 ± 0.04 cm in Bakerwal and non-descript breed of goats, respectively.

Posterior wall of the eyeball appeared as hyperechoic interface. Optic nerve was observed behind the posterior eye wall as a hypoechoic region easily distinguished from the surrounding hyperechoic structure as shown in Fig. 2 (AA). The length of the eye ball from cornea to posterior

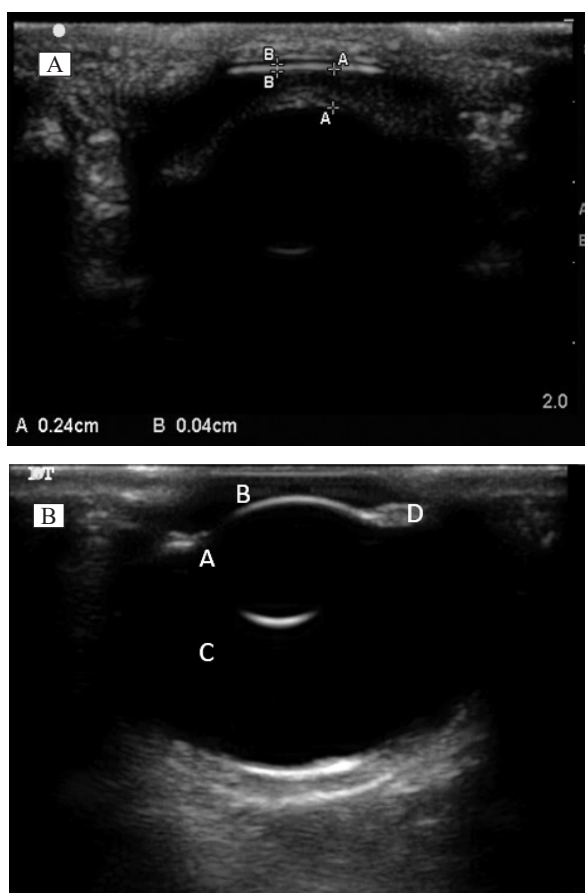


Fig. 1. Representative ultrasonogram of goat eye: A. Trans palpebral ultrasonogram of goat eye BB, Corneal thickness; AA, Aqueous chamber depth; B. Trans corneal ultrasonogram of goat eye A, Lens; B, Aqueous chamber; C, Vitreous chamber; D, Ciliary body.

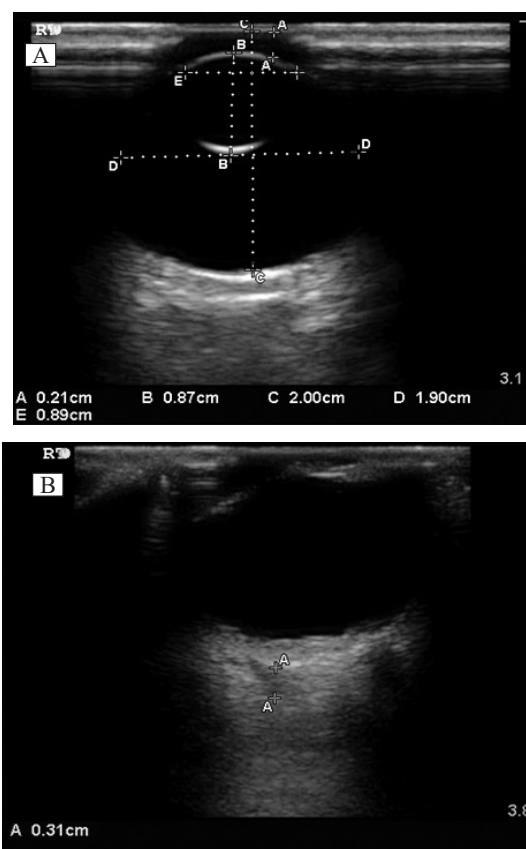


Fig. 2. Representative ultrasonogram of goat eye lens, posterior chamber and optic nerve: A. BB, Lens thickness; AA, Aqueous chamber depth; E, Lens diameter; DD, Eyeball diameter; CC, Eyeball length; B. AA, Optic nerve.

Table 1. Ocular biometric parameter of normal Gaddi goat

Biometric parameter (Mean±SE)	Right eye (cm)			Left eye (cm)			Significant difference in between the eyes
	Min.	Max.	Mean	Min.	Max.	Mean	
Corneal thickness	0.03	0.07	0.05±0.002	0.03	0.05	0.04±0.001	No
Aqueous chamber depth	0.12	0.29	0.19±0.01	0.12	0.31	0.201±0.01	No
Lens thickness	0.81	0.96	0.85±0.008	0.78	0.94	0.84±0.008	No
Lens diameter	0.92	1.36	1.07±0.03	1.0	1.29	1.05±0.02	No
Vitreous chamber depth	0.91	1.08	0.98±0.01	0.90	1.06	0.98±0.01	No
Eye ball length	1.94	2.12	2.06±0.02	1.90	2.10	2.05±0.02	No
Eye ball diameter	1.90	2.66	2.28±0.05	1.93	2.62	2.22±0.05	No

eye wall was 1.94 to 2.12 cm and 1.90 to 2.1 cm with an average of 2.06±0.02 cm and 2.05±0.02 cm in right and left eye, respectively, with mean length of of 40 eyes being 2.037±0.014 cm. According to Kumar *et al.* (2018), while studying dog breeds found in India, the average axial length of eye was variable, being smallest in Doberman (1.7±0.08 cm) and highest in Labrador retriever (1.96±0.03) cm. Al-Redah (2016) reported average axial length of eye as 2.04±0.02 cm in domestic young healthy Iraqi goats, whereas Athar *et al.* (2021) reported average axial length of eye as 2.27±0.04 and 2.25±0.15 cm in 12-month-old Bakerwal and non-descript breed of goats, respectively.

The diameter of the eye ball was 1.90 to 2.66 (2.28±0.05, n=15) cm and 1.93 to 2.22 (2.22±0.05, n=13) cm in right and left eye, respectively. There was no significant difference between the parameters of left and right goat eye ($p<0.05$) in the present study. All the eco-biometric parameters of both left and right eye have separately been summarized in Table 1.

In conclusion, the echo-biometrical evaluation of 8 to 10 months old Gaddi goats showed corneal thickness varying from 0.03 to 0.07 cm, aqueous chamber depth varying from 0.12 to 0.31 cm, lens thickness (0.78 to 0.96 cm), lens diameter (0.92 to 1.36 cm), vitreous chamber depth of 0.90 to 1.08 cm, eye ball length of 1.90 to 2.12 cm and eye ball diameter varying from 1.90 to 2.66 cm. No significant difference between right and left eye were observed while comparing different ocular-biometric parameters. Also, there was no difference in echo-biometric measurements between transverse and sagittal planes.

SUMMARY

The echo-biometrical evaluation of normal eye was done

in 20 Gaddi goats with the help of ultrasonography at Gaddi goat unit, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur. Trans-corneal and trans-palpebral ultrasound scanning of the normal eye was done in standing position without any sedation or regional nerve block. Xylocaine ointment (5%) was used to desensitize the cornea and 2% lignocaine jelly was applied directly on the cornea to serve as a conductive medium for ultrasound waves in trans-corneal technique. B-mode ultrasound scan of the eyes was done in both the transverse and sagittal planes. Corneal thickness varied from 0.03 to 0.07 cm, aqueous chamber depth from 0.12 to 0.31 cm, lens thickness from 0.78 to 0.96 cm, lens diameter from 0.92 to 1.36 cm, vitreous chamber depth from 0.90 to 1.08 cm, eyeball diameter from 1.90 to 2.66 cm and eyeball length from 1.90 to 2.12 cm. There was no statistically significant difference between the echo-biometric parameters of the left and right eye in the present study.

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