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Research Article

B-MODE ECHO-BIOMETRIC AND BLOOD VELOCITY INDICES OF EYE IN DIFFERENT AGE GROUPS OF GIR CATTLE

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ABSTRACT

Diagnostic B-scan ultrasonography permits topographic examination of the eye and characterize the location, size, shape, echotexture, consistency, insertion and relationship to neighboring structures. Doppler parameters represent indirect measurement of blood flow resistance that may be used to evaluate vascular changes in several diseases. Thus, the knowledge of normal ultrasonographic eye patterns and biometry is helpful for correct diagnosis of ocular pathologies. In the present study, forty-two (42) Gir cattle were divided into three groups based on age, each group having 14 animals. Animals of age up to 3 months were kept in Group-I, Group-II included animals of age 4-6 months and Group-III included animals of age 7-12 months. The study was planned with objective to study the comparison of B -mode echo-biometric and blood velocity indices of eye in different age groups of Gir cattle. It was observed that B-mode echo biometric indices i.e., Axial globe length (AGL), Anterior Chamber Depth (ACD), Lens Thickness (LT), Lens Length (LL) and Vitreous Chamber Depth (VCD) in different age groups showed significant ($p<0.05$) increase in values with increase in age. Color Doppler biometric indices i.e., Systolic peak velocity (SPV), Resistivity Index (RI), Pulsality index (PI) in different age groups showed significant ($p<0.05$) increasing trend while End Diastolic Velocity (EDV) showed decreasing trend from group-I to III.

Keywords: B-scan ocular sonography, Colour Doppler, Echo- biometric indices, Gir

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Gir is a pure dairy cattle breed originated from Gir forest and hills situated in southern part of Saurashtra region of Gujarat. Gir cattle has prominent, convex and broad forehead, which form a bony shield. Broad forehead overhangs eyes in such a way that they appear to be partially closed and gives the animals a sleepy appearance.

Ocular diseases cause discomfort to the farm animals due to the pain and often lead to impairment of vision which causes decreased production and even culling of animals. It causes direct economic losses to the farmers and the society. The losses due to the various ocular diseases in food producing animals are well documented (Whittaker *et al.*, 1999). Cattle, as other animals, are also prone to various ocular disorders both primary (i.e., infectious bovine kerato-conjunctivitis) and secondary (i.e., uveitis), capable to impair cattle's welfare and production at both the individual and herd level (Athar *et al.*, 2018).

Ophthalmic ultrasonography is widely used in human and veterinary medicine for studying ocular biometry, eye examination and emergency medicine. Knowledge of the ultrasonographic appearance and normal dimensions (biometry) of the eye would serve as a basis for ultrasonographic examinations (Singh *et al.*, 2015). The ocular diseases are difficult to diagnose with the naked eyes particularly in the initial stages of the disease and need elaborate imaging diagnostic facilities (Tamilmahan *et al.*, 2013; Athar *et al.*, 2018).

Keeping in view, its early diagnosis, economic losses to farming community, increasing trend of ocular disorders in cattle and lack of literature available in the country regarding baseline echo-biometric values of eye in Gir cattle in general, the present study was undertaken. The aim of investigation was to study the echo structure of intraocular aspects and to generate reference value of intraocular B-mode echo-biometric indices and colour Doppler velocimetric values for eye of Gir Cattle.

MATERIAL AND METHODS

The present study was conducted at Veterinary clinical complex (VCC) and animals were included from Livestock Farm (LSF) College of Veterinary Science & A.H., Jabalpur and cattle in and around Jabalpur. Forty two clinically healthy animals were selected after thorough eye examination. These 42 animals were divided into three groups based upon age, consisting of 14 animals in each group. Group-I included animals of age up to 3 months, Group-II included animals of age 4-6 months and Group-III included animals of age 7-12 months. The ultrasound assessment of the eye components were made with the help of a Portable ultrasound machine1 using linear transducer of frequency 05-10 MHz. Ultrasonography gel applied over the transducer and it was placed directly on the centre of cornea or eyelid. Sweepings were made on the sagittal or dorsal planes and measurements were obtained. Same

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procedure was performed for scanning of left eye (Silva *et al.*, 2018). Different B-Scan parameters, Axial Globe Length (AGL), Anterior Chamber Depth (ACD), Lens Thickness (LT), Lens Length (LL) and Vitreous Chamber Depth (VCD) were recorded. Colour Doppler velocimetric indices measured by a transducer placed sagittal or dorsally on the eyeball. The external ophthalmic artery (EOA) was visualized identified by colour Doppler in topography of the optic nerve at 2 mm from posterior wall of eyeball. An insonation angle of less than 60º was used and the flow means was determined using the pulse Doppler mode guided by the colour Doppler (duplex mode) and the measurements for Systolic Peak Velocity (SPV), End Diastolic Velocity (EDV), Resistivity Index (RI), Pulsatility Index (PI) were obtained (Silva *et al.*, 2018).

Data was statistically analysed with the help of IBM SPSS-20 software using one way ANOVA with Duncan post hoc multiple comparisons, Paired t-test and applied descriptive statistics ($P \leq 0.05$) (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

In all Gir cattle the Axial Globe Length (AGL) was assessed by measuring the distance between the middle of cornea and the internal face of the retina-choroid-sclera complex.

Exago 1505EX02 Ultrasound system

The Axial Globe Length (AGL) values of right eye in different age groups varied significantly ($P<0.05$) with an ascending trend in group-I, II and III i.e., 23.05±0.06, 24.72±0.08 and 26.87±0.07 mm, respectively. Similar ascending trend was recorded in left eye of group-I, II and III i.e., 23.10±0.05, 24.75±0.08 and 26.90±0.06 mm, respectively. Non-significant differences were observed in the values of left and right eye in all different age groups.

These values were in accordance with Kassab (2012) and Singh *et al.* (2015), who also observed ocular biometric values of buffalo increased with age. Similarly, Verma (2018) reported that AGL values in adult cow and buffalo were generally higher than in young cow and buffalo which suggest eye growth increases according to the age of Animal. These values were consistent with Athar *et al.* (2021) who conducted study in sheep and goat and reported that the AGL values increased significantly with advancement of age.

The anterior chamber depth (ACD) was assessed by measuring the distance between the central points of cornea to the central point of the anterior lens capsule. The ACD values of right eye in different age groups increased significantly ($p<0.05$) in group-I, II and III i.e., 2.32±0.03, 2.57±0.04 and 3.25±0.04 mm, respectively. Similar increasing trend was recorded in left eye of group-I, II and III i.e., 2.35±0.03, 2.60±0.04 and 3.27±0.04 mm, respectively. Non-significant differences were observed in the values of left and right eye in all age groups. The values obtained in present study possess similarity with the value reported by Reddy (2021a) in dogs and Reddy (2021b) in calves as the ACD values increases with respect to age in their study.

Lens thickness (LT) was assessed by measuring the distance between the anterior and posterior lens capsule. The LT values of right eye in various groups increased significantly ($p<0.05$), minimum value 8.32±0.03 and maximum value 10.30±0.03 mm was recorded in group-I and III, respectively. Similarly, LT values in left eye showed significant change in all three groups, from group-I to III i.e., minimum value 8.29 ±0.03 and maximum value 10.28±0.03 mm in group in I and group-III. Non-significant differences were observed in the values of left and right eye in all different age groups.

These findings are in agreement with Kassab (2012) and Singh *et al.* (2015) who observed that lens thickness increased with age. Similarly, Reddy (2021 b) stated that LT values of eye increased gradually and significantly ($P<0.01$) with increase in age of the calves.

In present study the lens length (LL) was assessed by measuring the distance between the side and mid poles of the lens.

The LL values of right eye in different age groups varied significantly ($P<0.05$) with an ascending trend in group-I, II and III i.e., 16.24±0.08, 17.22±0.05 and 18.82±0.09 mm, respectively, lowest value recorded in group-I and highest in group-III. Similar ascending trend was recorded in left eye of group-I, II and III i.e., 16.26±0.08 17.246±0.05 and 18.87±0.09 mm, respectively. Non-significant differences were observed in the values of left and right eye in all different age groups.

These findings are in congruence with Silva *et al.* (2018) who reported that there was correlation between the values of the eyeball structures and the age of the dogs, which suggests that eye growth increases according to the age of the animal. Similar result was obtained by Reddy (2021a) who concluded that lens length increases with age and varies significantly but no significant variation was found between right and left eye of same animal.

The vitreous chamber depth (VCD) was assessed from distance between the posterior lens capsule and the posterior eyeball wall. The VCD values of right eye in different groups increased significantly ($P<0.05$) from group-I, II and III i.e., 12.43±0.04, 12.65±0.02 and 13.33 ±0.04 mm, respectively. Similar increasing trend was recorded in left eye of group-I, II and III i.e., 12.46±0.04, 12.67±0.02 and 13.35±0.04 mm, respectively. Non-significant differences were observed in the values of left

Table 1. Measurements of different B- mode indices in different age groups

S. No.	Parameters (Mean±SE)	EYE	Gr-I	Gr-II	Gr-III
1	Axial globe length (mm)	Right eye	23.05^{a}±0.06	24.72^{b}±0.08	26.87^{c}±0.07
		Left eye	23.10^{a}±0.05	24.75^{b}±0.08	26.90^{c}±0.06
2	Anterior chamber depth (mm)	Right eye	2.32^{a}±0.03	2.57^{b}±0.04	3.25^{c}±0.04
		Left eye	2.35^{a}±0.03	2.60^{b}±0.04	3.27^{c}±0.04
3	Lens thickness (mm)	Right eye	8.32^{a}±0.03	9.50^{b}±0.03	10.30^{c}±0.03
		Left eye	8.29^{a} ±0.03	9.49^{b}±0.05	10.28^{c}±0.03
4	Lens length (mm)	Right eye	16.24^{a}±0.08	17.22^{b}±0.05	18.82^{c}±0.09
		Left eye	16.26^{a}±0.08	17.25^{b}±0.05	18.87^{c}±0.09
5	Vitreous chamber depth (mm)	Right eye	12.43^{a}±0.04	12.65^{b}±0.02	13.33^{c}±0.04
		Left eye	12.46^{a}±0.04	12.67^{b}±0.02	13.35^{c}±0.04

Mean value between group (a, b, c) with different superscripts differed significantly ($p<0.05$)

Table 2. Measurements of different colour Doppler indices of external ophthalmic artery in different groups

S. No.	Parameter	Eye	Gr-I	Gr-II	Gr-III
1.	Systolic peak velocity (mm) (Mean±SE)	Right eye	32.5^{a}±0.80	35.5^{b}± 0.38	37.5^{c}± 0.51
		Left eye	32.8^{a}± 0.82	35.5^{b}± 0.34	37.9^{c}± 0.44
2.	End diastolic velocity (mm) (Mean±SE)	Right eye	16.5^{a}±0.62	14.6^{b}±0.74	11.8^{c}±0.40
		Left eye	16.7^{a}±0.58	14.7^{b}±0.86	11.8^{c}±0.38
3.	Pulsatility index (Mean±SE)	Right eye	0.69^{a}±0.01	0.82^{b}±0.02	1.1^{c}±0.01
		Left eye	0.65^{a}±0.02	0.83^{b}±0.01	1.1^{c}±0.01
4.	Resistivity index (Mean±SE)	Right eye	0.44^{a}±0.01	0.57^{b}±0.02	0.64^{c}±0.01
		Left eye	0.45^{a}±0.02	0.58^{b}±0.02	0.65^{c}±0.02

Mean value between groups (a, b, c) with different superscripts differed significantly ($p<0.05$)

and right eye in all different age groups. The aforementioned findings are in congruence with Verma (2018) who reported VCD in adult cow and buffalo was generally higher than that in young cow and buffalo. The values differed non significantly in both right and left eye in all different age groups as reported by and Assadnassab and Farashvand (2011) in cattle.

This implies that vitreous chamber depth in adult animals was significantly higher than that in young animals within either species. Singh *et al.* (2015) also observed significant difference in VCD between calf and adult buffalo. Ribeiro *et al.* (2009), Bapodra *et al.* (2010) and Kassab (2012) also reported that VCD increased with age.

Colour Doppler measurements:

Systolic peak velocity (SPV) index was measured in spectral Doppler ultrasound. On Doppler wave form, the peak systolic velocity corresponds to each tall peak in the spectrum window. The mean SPV values of right eye in different age groups were 32.5±0.80, 35.5± 0.38 and 37.5± 0.51 mm while in left eye were 32.8± 0.82, 35.5± 0.34 and 37.9± 0.44 mm, respectively, these values increased significantly from group-I to group-III in both eyes. Highest value was found in group-III, while lowest value in group-I. Non-significant differences were observed in the values of left and right eye in all different age groups.

Similarly, Silva *et al.* (2018) and Reddy (2021a) described positive correlation between animal age and systolic peak velocity demonstrating that the ophthalmic artery developed gradually with the progression of the animal's age. End diastolic velocity (EDV) of external ophthalmic artery was measured in spectral Doppler ultrasound. On a Doppler waveform, the end diastolic velocity corresponds to the point marked at the end of the cardiac cycle.

The EDV values of right eye in different age groups varied significantly ($P<0.05$) with a descending trend in group-I, II and III i.e., 16.5±0.62, 14.6±0.74 and 11.8±0.40 mm, respectively. Similar descending trend was recorded in left eye of group-I, II and III i.e., 16.7±0.58, 14.7±0.86 and 11.8±0.38 mm. Highest value is recorded in group-I and lowest value in group-III in both eyes. Non-significant differences were observed in the values of left and right eye in all different age groups. These findings are in consonance with Greenfield *et al.* (1995), who observed that EDV significantly decreased ($P<0.05$) as function of age and non-significant differences were noted between right and left eye of individual. Similar findings were also reported by Silva *et al.* (2018) and Reddy (2021a). The Descending trend in EDV values may be due to increase in vascular Resistance in flow of blood within artery as the age advanced.

Pulsatility Index (PI):

PI was measured as difference between maximum and minimum blood flow velocity, normalized to the average velocity. The PI values of right eye in various age groups increased significantly ($P<0.05$), minimum value

0.69±0.01 recorded in group-I and maximum value 1.1±0.01 in group-III. Similarly in left eye, values showed significant change in all three groups i.e., minimum value 0.65±0.02 in group-I and maximum value 1.1±0.01 recorded in group-III. Non-significant differences were observed in the values of left and right eye in all different age groups.

Silva *et al.* (2018) and Reddy (2021a) reported that there was positive correlation in velocimetric values of the eyeball structures and the age of the dogs and similarly Di Pietro *et al.* (2015) stated that there were non-significant differences in the PI mean values between the left and right eyes of examined cows.

Resistivity Index (RI):

RI was measured of pulsatile blood flow that reflects the resistance to blood flow caused by micro vascular bed distal to the site of measurement. The RI values of right eye in various age groups increased significantly (P<0.05) with minimum value in group-I i.e., 0.44±0.01 and maximum value recordedin group-III i.e., 0.64±0.01. Similarly, values of left eye increased significantly (P<0.05) with minimum value recorded in group-I and maximum value recorded in group-III i.e., 0.45±0.02 and 0.65±0.02, respectively. Non-significant differences were observed in the values of left and right eye in all different age groups.

These findings are in agreement with Greenfield *et al.* (1995) who observed that vascular resistance increased with respect to advancing age and RI values varied non-significantly between right and left eye. Similarly, Silva *et al.* (2018) correlated mean RI values with animal's age and demonstrated that the ophthalmic artery developed gradually with the progression of the animal's age. Similar observations were also noticed by Lee *et al.* (2002) and Reddy (2021a) in dogs and Di Pietro *et al.* (2015) in cows.

CONCLUSION

In Gir cattle, B-mode echo biometric indices i.e., AGL, ACD, LT, LL, VCD in different age groups showed significant (P<0.05) increasing trend with the increase in age. Color Doppler biometric indices i.e., SPV, RI, PI in different age groups showed significant (P<0.05) increasing trend while EDV showed decreasing trend with the increase in age. Non-significant difference was observed between right and left eyes in B-mode echo biometric and color Doppler velocimetric indices at different age intervals. This study is the first to describe the ocular echobiometric and blood velocimetric indices measurements in Gir cattle at different age interval. The study is thus significant as it establishes the baseline echobiometry of various ocular structures at different ages of Gir cattle for future reference while performing ocular sonography.

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