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Ocular ultrasonography and echobiometry findings in dogs affected with vitreoretinal affections[#]

Sree Lekshmi M. Nair [1*], Laiju M. Philip[1], Syam K. Venugopal [1], K. D. John Martin[2], S. Anoop[1] and Hiron M. Harshan[3]

[1]Department of Veterinary Surgery and Radiology, [3]Department of Animal Reproduction, Gynaecology and Obstetrics, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, [2]University Veterinary Hospital, Kokkalai, Kerala Veterinary and Animal Sciences University, Pookode, Wayanad, Kerala

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Abstract

Vitreoretinal affections are a major cause of visual impairment across many animal species. In most cases, opaque ocular media secondary to the disease obstructs a detailed examination of the eye, which is essential for timely treatment. B-mode ultrasonography plays a critical role in the accurate diagnosis of various pathologies in the posterior segment of the eye under these conditions. In this study, canine ocular ultrasonography and ocular biometrical evaluation of healthy eyes and eyes with vitreoretinal affections were compared. There was a significant increase in axial length, anterior chamber depth and vitreous chamber depth in vitreoretinal affections in the study as compared to healthy eyes. Various affections like retinal detachment, vitreous haemorrhage, posterior vitreous detachment, retinal oedema, choroidal retinal detachment with posterior scleritis and optic disc cupping were observed in the study. B-mode ultrasonography proved to be an invaluable tool in diagnosing and managing vitreoretinal diseases, helping in preventing severe visual impairment.

Keywords: *B-mode ultrasonography, choroidal, vitreoretinal*

Ocular ultrasound is a two-dimensional imaging technique employed to assess anatomical structures and identify pathological alterations, particularly when intraocular opacities obstruct the evaluation of the posterior segment (Philip *et al.,* 2017; Vali and Razeghi, 2019). Vitreoretinal affections comprise a wide range of disorders affecting the posterior segment, which are common causes of visual impairment and blindness (Rai *et al*., 2019). Retinal detachment and vitreous degeneration are the most prevalent vitreoretinal disorders in dogs (Labruyère *et al*., 2008; Papaioannou and Dubielzig, 2013). These conditions are often accompanied by episcleral congestion, epiphora, buphthalmia and corneal oedema (Raut *et al*., 2023). A thorough examination of vitreoretinal affections is essential for the accurate diagnosis and timely treatment for the prevention of visual impairment. Hence the present study was undertaken to assess the ultrasonographic imaging and echobiometry in vitreoretinal diseases and compare it with healthy eyes.

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[*]Corresponding author: sreelekshmimnair22@gmail.com, Ph. 9496758224

Materials and methods

The study was conducted in 80 dogs presented to the University Veterinary Hospital, Kokkalai and Teaching Veterinary Clinical Complex, Mannuthy over a period of 13 months irrespective of breed, age and sex. All the dogs were subjected to detailed clinical and physical examination. Schirmer tear test I (mm/min), tonometry (mm of Hg), pachymetry (nm) and ophthalmoscopy were carried out in all the animals selected for the study. Transcorneal B mode ocular ultrasonography (MY LAB SIGMA VET e-Saote, SpA, Italy) was performed with 10-15 MHz linear probe after corneal desensitisation with 0.5 per cent proparacaine hydrochloride eye drops (Paracaine, Sunways PVT.LTD., Mumbai). A two per cent hydroxypropyl methyl cellulose ophthalmic gel was applied on the cornea and probe to reduce artifacts and enhance image quality.

Based on the ultrasonographic examination, dogs with vitreoretinal affections were identified and classified as Group I (n=27 eyes) and echo biometric findings were compared with normal healthy eyes in Group II (n=14 eyes). The following echo biometric parameters were measured and recorded for each eye: axial length (D1), which is the distance between the echogenic layers of the posterior corneal surface and the retina; anterior chamber depth (D2), the distance between the echoes of the corneal surface and the anterior capsule of the lens; lens thickness (D3), the distance between the echoes of the anterior and posterior capsules of the lens; lens equatorial length (D4), the distance between the echoes of opposite points of the lens equator; and vitreous chamber depth (D5), the distance between the echogenic layers of the posterior capsule of the lens and the retina (Lavanya *et al.,* 2021). Echo biometry was performed by placing the cursor at the center of the exact locations (Fig. 1).

Results and discussion

All the physiological parameters were within the normal range in eyes with posterior segment diseases which was in agreement with Shanthala (2018). A significant (p<0.01) decrease in STT I values was noticed in eyes affected with vitreoretinal diseases and the reduction might be due to uveitis associated with these affections impairing the tear production (Leis *et al.,* 2017). A significant (p<0.01) increase in intraocular pressure was noticed in vitreoretinal affections consistent with the findings of Lavanya (2021) in dogs with glaucoma. This could cause retinal changes such as choroidal haemorrhage, papilledema, subretinal effusions leading to retinal detachment, and retinal degeneration (Anoop *et al.,* 2020). Similar to the findings of Wongchaisuwat *et al.* (2018), ocular pachymetry revealed no significant difference in the central corneal thickness in dogs with vitreoretinal affections compared to healthy eye. Pachymetry was not measured in four eyes with opaque cornea. On ophthalmoscopic examination, fundus was not visible in eight eyes with corneal opacities. Three eyes exhibited retinal detachment with advanced retinal vessels, with focal grayish discoloration. Retinal haemorrhages appeared as dark spots or bloats in the fundus. Smith (2014) reported similar findings during ophthalmoscopic examinations of the fundus in systemically infected dogs. Optic disc cupping with peripapillary retinal degeneration was noticed in one eye. Gilger (2006) had similar findings in dogs with glaucoma.

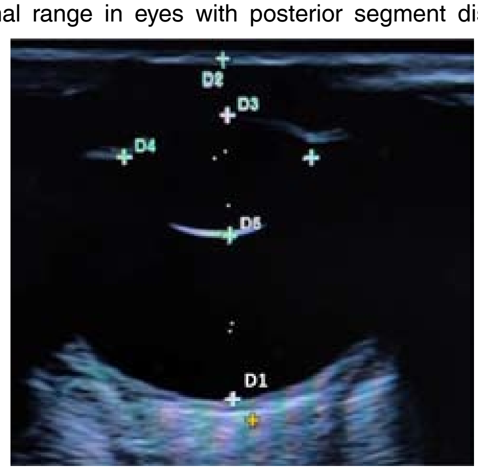

Fig. 1. Axial length (D1), Anterior chamber depth (D2), Lens diameter (D3), Lens thickness (D4) and Vitreous chamber depth (D5)

B mode ultrasonography was performed in animals in lateral recumbency as reported by Audu *et al.* (2017) that provided superior image clarity and ease of procedure during ocular ultrasonography. The transcorneal technique with 10-15 MHz linear probe provided higher-quality images without artifacts (Philip *et al.,* 2017). The cornea appeared as a thin curvilinear hyperechogenic line parallel to the probe in B mode ultrasonography. Behind the cornea, the anterior chamber was visible which was filled with anechoic aqueous humor. The lens appeared anechoic with a thin echogenic capsule anteriorly and posteriorly. Vitreous chamber was lined between the posterior lens capsule and posterior wall of eyeball filled with vitreous humor (Silva *et al.,* 2018). The retina-choroid-sclera complex was visible as a single hyperechoic curved line, and the optic tract was seen as a funnel-shaped hypoechogenic structure on the posterior wall of the eyeball (Abarca*,* 2020).

The comparison of biometrical parameters in vitreoretinal affections and normal eye is shown in Table 2. There was a significant (p<0.01) increase in the axial length, anterior chamber depth and vitreous chamber depth in dogs affected with vitreoretinal affections when compared to healthy eyes. This was in accordance with the findings of Raut (2023) in buphthalmic eyes in canine glaucoma. The possible reason for the increased anterior chamber depth could be due to the forward displacement of the lens and iris caused by elevated intraocular pressure in dogs with glaucoma.

The eyes affected with vitreoretinal diseases had

Table 1. Comparison of different ocular parameters between groups

Variables	Group I (affected eyes)	Group II (healthy eyes)	F -value	p-value
STT I	18.33 ± 1.41	22.36 ± 0.40	2.75**	0.010
Tonometry	26.78 ± 1.94	18.63 ± 0.42	4.10**	<0.001
Pachymetry	565.68 ± 13.92	567.86 ± 7.40	0.14^{ns}	0.891

*** Significant at 0.01 level; ns non-significant using independent t test*

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Fig. 2 Rhegmatogenous retinal detachment

Fig. 3. Exudative retinal detachment

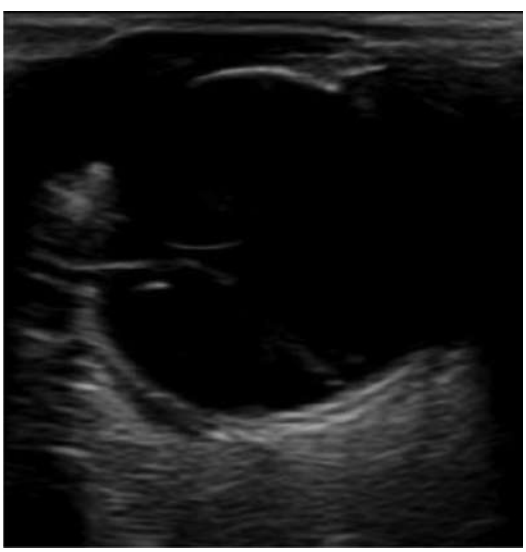

Fig. 4. Posterior vitreous detachment

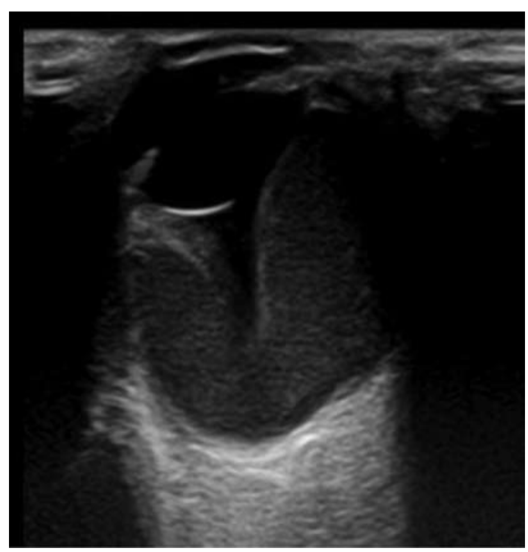

Fig. 5. Vitreal haemorrhage

Table 2. Comparison of ocular biometric parameters in vitreoretinal affections with healthy eyes

Variables (mm)	Group I (affected eyes)	Group II (healthy eyes)	F- value	p- value
Axial length	20.12 ± 0.4	18.34 ± 0.17	4.07**	<0.001
Anterior chamber depth	2.86 ± 0.28	2.33 ± 0.10	1.78^{ns}	0.084
Lens thickness	6.75 ± 0.16	6.65 ± 0.07	0.57^{ns}	0.573
Lens diameter	12.20 ± 0.28	11.76 ± 0.13	1.44^{ns}	0.159
Vitreous chamber depth	10.54 ± 0.38	9.29 ± 0.18	2.97**	0.005

*** Significant at 0.01 level; ns non-significant using independent t test*

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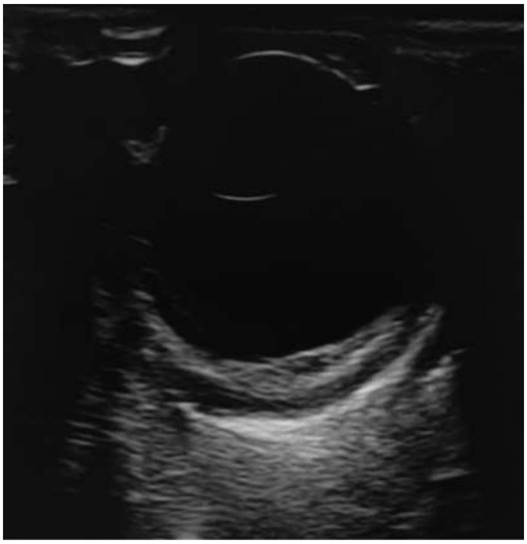

Fig. 6. Choroidal detachment with

Fig. 7. Retinal oedema posterior scleritis

altered sonoanatomy compared to healthy eyes. Retinal detachment was noticed in 16 eyes (59.53 per cent), while vitreal degeneration of varying echogenicity was observed in 11 eyes (40.77 per cent). Based on the shaped of the detached retina, retinal detachment appeared as V, Y, or seagull-shaped hyper-reflective echoes (Pandey *et al.,* 2024). According to the integrity of retina, retinal detachments were classified as rhegmatogenous retinal detachment (Fig. 2) which was observed in eight eyes (50 per cent), while non rhegmatogenous retinal detachment comprising of exudative retinal detachment (Fig. 3) was seen in in five eyes (31.25 per cent) and tractional retinal detachments in three eyes (12.5 per cent). Sultan *et al.,* 2020 had similar findings where rhegmatogenous retinal detachment was the most common type in human patients. Posterior vitreous detachment, vitreal haemorrhage, choroidal detachment with posterior scleritis, retinal oedema and optic disc cupping were other concomitant findings in vitreoretinal affections. Posterior vitreous detachment (Fig. 4) which appeared as an undulating membrane moving freely away from the optic disc (Moon *et al.,* 2020) was found in 15 eyes. Hyperechogenecity indicative of vitreal haemorrhage (Fig. 5) was detected in 13 eyes. Similar results were also observed by Polo *et al.* (2016) in the examination of human eye wherein vasoproliferative diseases such as diabetic retinopathy, retinal tears, posterior vitreous detachment, retinal macroaneurysms, age-related macular degeneration and trauma were observed to cause vitreous haemorrhage. Choroidal detachment was associated with posterior scleritis (Fig. 6) which appeared as thick and rigid bands with fluid accumulation in episcleral spaces in five eyes (Li *et al.,* 2012; Maleki *et al.*, 2022). Retinal oedema (Fig. 7) as noticed in four eyes with hypoechogenic areas with increased retinal thickness. This was similar to macular oedema in humans (Aziz *et al.*, 2018) where the extend of thickness correlated to the severity of the oedema. Optic disc cupping (Fig. 8) was observed in three eyes as

Fig. 8. Optic disc cupping (arrow)

a posterior concavity located anterior to the acoustically clear area of the optic nerve consistent with the findings of Murthy and Sharma (2019) in human patients with glaucoma.

Conclusion

The present study was aimed in assessing the echobiometry and ultrasonographic imaging in various vitreoretinal affections when compared to healthy eyes. There was a significant increase in the intraocular pressure and decrease in the STT I values in dogs with vitreoretinal affections. The mean axial length, anterior chamber depth and vitreous chamber death was significantly increased. Various posterior segment affections like vitreal haemorrhage, posterior vitreous detachment, choroid detachment and posterior scleritis, retinal oedema, retinal detachment and optic disc cupping were noticed under present study. Hence ocular ultrasonography is a critical diagnostic tool in evaluating vitreoretinal affections which will aid in the management and treatment planning of vitreoretinal diseases.

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Conflict of interest

The authors declare that they have no conflict of interest.

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