



Ultrasonographic features of malignant catarrhal fever induced corneal oedema in cattle

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Malignant catarrhal fever (MCF), also known as bovine malignant head catarrh, is a fatal lymphoproliferative systemic infectious disease, affecting cattle and other ungulates caused by gamma herpes viruses alcelaphine herpesvirus 1 (AIHV-1) and ovine herpesvirus 2 (OvHV-2) (Hussain *et al.* 2017). These viruses cause inapparent infection in their reservoir host (wildbeast for AIHV-1 and sheep for OvHV-2) but fatal lymphoproliferative disease when they infect MCF-susceptible hosts, including cattle, bison, water buffalo, deer, and pigs (Russel *et al.* 2009). MCF causes huge economic losses in several major species of ruminants (Moore *et al.* 2010).

Ocular symptoms are predominantly recorded in the 'head and eye' form of the diseases, which include lacrimation, mucopurulent ocular discharge, eyelid oedema, blepharospasm, photophobia, nystagmus, episcleral injection, keratitis, anterior uveitis, exophthalmos, blindness (Radostits *et al.* 2007, Smith 2009). Corneal oedema is usually a consistent feature of MCF and it may vary from mild perilimbal to dense complete corneal oedema (Cullen and Webb 2007, Radostitis *et al.* 2007). Progressive bilateral corneal opacity, starting at the periphery has been described as the consistent feature of malignant catarrhal fever (Hussain *et al.* 2017). Lesions of the posterior segment of the eye are difficult to assess clinically due to the opacity of the cornea (Whitely *et al.* 1985).

Diagnosis of the disease is based on the clinical signs, characteristic histopathological changes, ELISA and detection of viral DNA from the infected animals. Perusal of the available literature revealed that there is no published report about the ocular ultrasonography in cases of malignant catarrhal fever. In addition to the clinical findings the present report describes the various ultrasonographic changes recorded in the eyes of animals suffering from the malignant catarrhal fever.

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The animals were subjected to thorough clinical examination. Direct ophthalmoscopic examination was performed using Heinz hand-held ophthalmoscope. Trans-corneal ultrasonographic examination was performed on a well restrained animal in a crush without the use of sedation. A topical anaesthetic (proparacaine 0.5% eye drops) was applied at a dose of one drop to the cornea 1 minute before the scanning. Eye lids were kept separate using two fingers and sterile gel was applied in liberal amounts to form a gel-pad through which eye was scanned using a 10–18 MHz linear transducer (My Lab 40 Vet). The focal range 10–12 MHz was used for scanning of vitreous chamber and retinal wall and 12–18 MHz was used for the scanning of the anterior chamber and lens. Time gain compensation was adjusted to observe the clear image. Eyes were scanned in sagittal plane (El-Maghraby *et al.* 1995). Images were obtained by a single operator. At the end of the examination, gel was removed from the eye by sterile eye wash. Optimal positioning was confirmed when the ultrasonogram appeared symmetrical and the reflections from the four principal landmarks (cornea, anterior lens capsule, posterior lens capsule and retina) along the optic axis were perpendicular. Ocular distances were measured from the standard views using in-built electronic callipers.

For comparison of the ocular ultrasonographic biometric measurements between healthy and affected cattle, eyes of six apparently healthy adult female bovines were scanned and measurements recorded. Ocular echobiometric parameters that were studied include:

Central corneal thickness: Distance between echoes from the anterior to posterior corneal surface.

Anterior chamber depth: Distance between echoes from the posterior corneal surface and the anterior lens surface.

Antero-posterior depth of the lens: Distance between echoes from the anterior and posterior lens surfaces.

Latero-medial diameter of the lens: Distance between echoes from the lateral zonule and medial zonule of ciliary body.

Vitreous depth: Distance between echoes from the

posterior lens surface and the retina.

Axial length: Distance between echoes from the anterior corneal surface to the retina.

Retinal rim thickness: Thickness of sclera and retina.

For confirmation of malignant catarrhal fever cases, ten millilitres of whole blood taken from each animal was subjected to hemi-nested polymerase chain reaction assay targeting a DNA fragment in ORF 75 of the OvHV-2 genome which was used in this study.

The statistical analysis was performed using SPSS 20.0 version for Windows. For comparison between healthy and diseased eyes, student's t test was used. P-value less than 0.05 were considered significant.

Animals in the present study appeared dull with elevated body temperature ranging from 102.8 to 104.6°F, inappetence to anorexia, nasal discharge and had a history of being reared along with the sheep. The duration of illness ranged from 4 to 10 days with a median duration of 6 days. Predominant clinical signs recorded were lacrimation, chemosis, corneal oedema, photophobia, and hyperemia of conjunctiva. Similar finding of high fever, inappetence, profuse nasal and ocular discharge, corneal opacity, generalized lymphadenopathy, erosion of the upper respiratory tract and alimentary tract and occasional diarrhea and neurologic signs have been reported by Sood *et al.* (2017). Death can occur within a few days or up to several weeks after the onset of clinical signs. The head and eye form is the most common manifestation of the disease in cattle (Russell *et al.* 2009).

Mild corneal oedema was recorded in two animals while as moderate and severe corneal oedema was observed in four animals each. In all the animals, the corneal oedema was initially recorded near limbus followed by involvement of the entire cornea with varying degree of severity. Corneal and palpebral reflexes were intact in all the animals while a weak menace reflex was observed only in five animals. Moreover, the pupillary light reflex could not be assessed in four animals due to severe corneal opacity. Ocular lesions associated with the 'head and eye' form of MCF include corneal oedema, uveitis, exophthalmos, bilateral blindness, photophobia, nystagmus, severe lacrimation (Zemljic *et al.* 2012), similar to the findings in the present study.

Comparison of the Mean±SE value of ultrasonographic biometric measurements of ocular structures in normal and diseased cattle is presented in the Table 1. In all the animals, there was a significant ($P<0.05$) increase in the thickness of the cornea. On B-Mode ultrasonography, cornea appeared as double convex hyperechoic interface with a central space filled with echogenic material in the affected animals. Anterior uveitis was characterized by significant ($P<0.05$) increase in thickness of the iris which appeared as crusts and troughs just in front of the lens (Figs 1–2). The thickened and wavy appearance of iris, covering the entire anterior surface of the lens was recorded in nine animals. No significant difference in the measurement was recorded in rest of the ocular structures when compared with the apparently healthy animals. The lens appeared as

Table 1. Mean±SE value of ultrasonographic biometric measurements of ocular structures in normal and diseased cattle

Parameter	Normal	Diseased
Corneal thickness (cm)	0.11±0.001*	0.21±0.01**
Iris thickness (cm)	0.066±0.003*	0.24±0.01**
Ciliary body thickness (cm)	0.19±0.001*	0.33±0.01**
Anterior chamber depth (cm)	0.40±0.01	0.38±0.02
Antero-posterior depth of lens (cm)	1.20±0.02	1.21±0.24
Latero-medial diameter of lens (cm)	1.59±0.02	1.58±0.18
Vitreous chamber depth (cm)	1.54±0.03	1.56±0.03
Axial length (cm)	3.21±0.03	3.23±0.02
Retinal rim thickness (cm)	0.18±0.001	0.18±0.01

Values with different superscript differ significantly at $P<0.05$.

two curvilinear echogenicities representing the anterior and posterior lens capsules. The internal appearance of the lens was anechoic. The vitreous chamber imaged as a homogenous, anechoic region between the posterior lens



Fig. 1. B Mode ultrasonogram showing thickened cornea filled with echogenic material (arrow), thickened wavy iris (yellow arrow) and thickened ciliary body (red arrow).

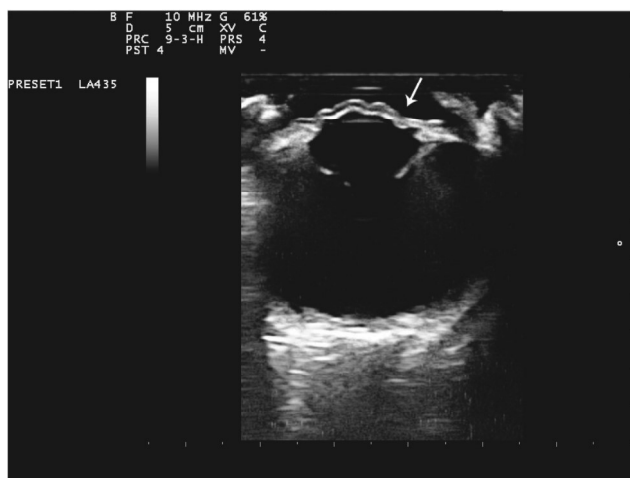


Fig. 2. Pronounced thickening of the iris visible as wavy hyperechoic structure with central anechoic area just in front of the lens (arrow).

capsule and ciliary body anteriorly and ocular wall posteriorly. The posterior ocular wall had the highest echogenicity. Retinal, choroidal or scleral layers were not individually identifiable on ultrasonography. No observable changes were recorded in the optic nerve upon ultrasonography.

Degree of corneal oedema has no prognostic value for the disease outcome. However, the progression of the corneal oedema correlates well with the outcome of the disease (Zemljic *et al.* 2012). Ultrasonography can be used to quantify the severity of corneal oedema and may thus be of value in predicting the outcome of the disease. Non improvement of the uveitis has been considered as a bad prognostic indicator (Zemljic *et al.* 2012)

The iris is difficult to image but can be seen under ideal condition by use of a standoff and a high-frequency transducer (LeMay 1978). The iris is seen as a flat uniform echogenic area. An anterior uveitis is evident by fibrin, cells, and flare in the anterior chamber as well as by miosis and iris texture changes (Whiteley *et al.* 1985, Zemljic *et al.* 2012). On ultrasonography, anterior uveitis was characterized by thickening of the iris with formation of crusts and troughs. The anterior segment abnormalities found in our study were similar to those reported in the literature (Radostitis *et al.* 2007, Smith 2009). In the present study, none of the affected animal survived the course of the disease. Recovery from MCF has been infrequently reported (Zemljic *et al.* 2012).

In conclusion, significant ultrasonographic changes were evident in eyes of animals affected with the malignant catarrhal fever. Ultrasonography may be used for monitoring the ocular changes especially in the anterior portion of the opaque eyes. Since none of the affected animal survived the course of the disease, predicting the prognosis of the cases through ultrasonography was not possible in the present study. However, as a limitation, histopathology of the eyes in the affected animals was not possible. In addition, serial ocular ultrasonography of the affected eyes could not be performed.

SUMMARY

The study was aimed to record the ocular ultrasonographic changes in the confirmed clinical cases of MCF. The cases were confirmed using hemi-nested polymerase chain reaction assay. Ocular ultrasonography was performed using a 10–18 MHz linear transducer (My Lab 40 Vet). Clinical signs observed were corneal oedema, lacrimation, photophobia, corneal oedema and hyperaemia of conjunctiva. In two animals, mild corneal oedema was observed while in four animals each, moderate and severe

corneal oedema was recorded. In all the animals, corneal oedema initially appeared at the limbus with subsequent involvement of the entire cornea with varying degree of severity. Hemi-nested polymerase chain reaction was used for confirming the diagnosis. Ocular ultrasonographic examination revealed significant increase in the thickness of the cornea, iris and ciliary body. Anterior uveitis, characterized by thickened iris, exhibiting crust and trough formation covering the major part of the anterior surface of the lens was recorded in nine animals. There was no recovery in any of the case and the animals died within one month of the diagnosis of the MCF. Significant ultrasonographic changes were evident in eyes of animals affected with the malignant catarrhal fever. Ultrasonography may therefore be used for monitoring the ocular changes especially in the anterior segment of the opaque eyes.

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