Indian Farmer
Volume 9, Issue 02, 2022, Pp. 73-80.
Available online at: www.indianfarmer.net
ISSN: 2394-1227 (Online)

ORIGINAL PAPER

Blue Tongue- A disease of concern in small ruminants

Dharanya M[1]* and Eben Titus E[2]

[1]MVSc Scholar, Department of Veterinary Microbiology, Lala LajpatRai University of Veterinary and Animal Sciences, Hisar, Haryana.
[2]MVSc Scholar, Department of Veterinary Microbiology, Indian Veterinary Research Institute, Bareilly, Uttar Pradesh

**Corresponding Author- dharanyamuthiah@gmail.com*

Article Received: 03 February 2022 *Published Date: 06 February 2022*

INTRODUCTION

Blue tongue is a non-contagious, arthropod borne viral disease that affects a huge population of domestic and wild ruminants. It is also known as sore muzzle, pseudo foot and mouth, epizootic catarrh, Beksiette and muzzle disease. It is an OIE listed disease affecting multi species animals caused by BlueTongue Virus (BTV) that belongs to the genus *Orbivirus* of the family *Reoviridae* (OIE 2008). It is transmitted by the *Culicoides spp.* of midges which is a biological vector of transmission.Till date, thereare about 28 serotypes of BTV existing globally, which results in devastation of the animal husbandry economy dueto higher morbidity and mortality in the infected population, especially sheep. The outbreak of BT in 2005 has made a great annual economic loss to the Indian sheep farming community. This accounts for nearly 231 million rupees which is 60% with that of other diseases (Ranjan*et.al.*2015). In 2009,a study published that BT was found to have a profound economic devastation than PPR, sheep and goat pox, FMD, and enterotoxemia (Singh and Prasad 2009). Multiple serotypes of BTV and high density of ruminant population and vector control are the major hindrances in the control of bluetongue disease despite having a mass vaccination programme. So, a better understanding on etiology, epidemiology, distribution, life cycle, host range, pathogenesis, diagnosis, prevention and control will help in preventing future outbreak and its aftermath economic losses.

Etiology

The causative agent of Bluetongue disease belongs to the genus *Orbivirus,* subfamily-*Sedoreovirinae* and family *Reoviridae*. It is a non-enveloped virus with icosahedral symmetry of size ranging from 80-90nm. The virus possesses 10 segmented genome, linear double stranded RNA molecule that codes for 7 structural proteins (VP1-VP7) and 5 non-structural (NS1,NS2, NS3/NS3A,NS4,NS5) proteins (Ratinier*et.al.*2011).

The variations in the genomic sequence of segment 2 and its translated product-VP2 protein regulate the multiplicity in BTV serotypes. Currently, there are 28 serotypes that have been reported worldwide (Bumbarov*et al.*2020). In India, 23 serotypes (except 22, 25-28) were reported by virus isolation and the presence of neutralizing antibodies. All these serotypes can potentially infect the ruminants .In contrast, the serotypes BTV-25,-26,-27 and -28 are regarded as "atypical" serotypes as they are reported to be non-pathogenic and are unable to culture in *Culicoides* cell lines. (Bumbarov*et al.*2020).

Epidemiology

The first case was reported in the African continent (Spreull 1905) in the late 18th century, since then, the disease had its global existence. It is a non-contagious disease but in-contact transmission was reported in case of BTV-28 serotype infection (Saminathan*et al.*2020).The vector *Culicoides spp.* plays a crucial role in transmitting BTV among the susceptible ruminants. Therefore,BT outbreaks are reported to occur in tropical, subtropical and temperate regions of the world as the temperature here favors the breeding of competent vector species. In India, BT is an endemic disease and serves as a major source of BTV in Asia due to the vast animal populations. Thus the outbreak and prevalence of BT depends on the density of host and vector population and their distribution, climatic conditions and rainfall *(*Rao*et al.*2016*).*

Host Range

The BTV infects both domestic and wild ruminants. The susceptibility and severity of disease varies among species.The most sensitive species to BTV infection are sheep, white-tailed deer, pronghorn antelope, bighorn sheep, American and European bison, mouflon, alpaca, llama, and yak. The species like cattle, goat, camelid, and deer species are susceptible and often have subclinical infection.

The cattle is regarded as an amplifying host/maintenance host/reservoir host for BTV because of its prolonged and persistent viremic period and also the vector *Culicoides* often feeds on cattle and thus results in transmission of BTV to other susceptible species (Barratt-Boyes and MacLachlan 1994).

Transmission

The virus can spread through numerous routes and establish the infection. Among them, the *Culicoides* has a greater potential in mechanical and biological transmission of the BTV to other susceptible species. The oral, contact, transplacental, venereal, mechanical and iatrogenic transmissions are some of the other possible routes for spread of BTV infection among the susceptible hosts.

Pathogenesis

The vector *Culicoides spp.* takes up the virus by feeding on the infected animals (host to vector transmission) and has an extrinsic incubation period of 4-20 days depending on temperature (Saminathan*et al.*2020). The susceptible host when subjected to the bite of infected midges (vector to host transmission), the virus is cutaneously instilled and transported from the skin to the regional lymph nodes for the primary replication by the dendritic cells of skin (Hemati*et al.* 2009). The virus reaches the blood circulation (viraemia) within 2-7 days and is disseminated to the secondary organs like liver, heart, lungs, uterus, spleen and starts to replicate in the vascular endothelial cells and mononuclear phagocytes. The endothelial damage results in excessive release of cytokines and vasoactive mediators (cytokine storm)which plays a key role in pathogenesis of BTV like increased vascular permeability, severe hemorrhages, oedema and effusions, thrombosis, infarction and disseminated intravascular coagulation that results in cyanotic tongue, coronitis. The cytokine storm is also responsible for lymphoid depletion and immunosuppression resulting in secondary bacterial infection in the affected animals (Umeshappa, Singh, Nanjundappa, *et al.* 2010). The BTV infection in pregnant ruminants will result in malformations in the brain like hydranencephaly in the newborn.

Clinical signs

The clinical manifestation can vary from either asymptomatic to a deadly disease and can be either acute or chronic depending on the species affected, serotypes of the virus, environmental factors and immune status of the animal. Therefore, mortality and morbidity rates in cattle and goats are often less when compared to sheep. The morbidity rate among sheep can vary from <5% to 50-70% or even upto 100% and have 30% mortality on an average..

In sheep and some species of deer, acute form of BT causes pyrexia upto 42 °C, excessive salivation(hyperptyalism), dysphagia and panting. Initially, there will be clear nasal discharge but later it becomes mucopurulent which may form crust around nares upon drying. The congestion and oedema of muzzle, lips, face, ears, eyelids and submaxillary region ('monkey-face' appearance), oral erosion, weight loss, apathy, dermatitis, alopecia, and break in the wool are reported. The tongue becomes oedematous and later turns cyanotic.

After 2 weeks of infection, the hyperaemia can be extended upto the coronary band of the hoof, the groin, axilla and perineum and may have lameness due to coronitis or pododermatitis and myositis. The infected pregnant ewes may abort or give birth to lambs with malformations. In severe cases, animals show respiratory distress, bleeding from nostrils, torticollis, profuse hemorrhagic diarrhea and vomiting that can cause aspiration pneumonia (Susmitha et al. 2012) resulting in death within 8-10 days. In chronic cases, the affected animal may be susceptible to secondary bacterial infection.

The BTV infected cattle are reported to have signs like fever, ocular and nasal discharge, ulcers in oral mucosa, oedema and necrotic lesions in lips and tongue, coronitis, conjunctivitis, reduced milk yield and severe neurological signs. However, the severity of the disease in cattle is less when compared to sheep (Tweedle and Mellor 2002).

Lesion

The postmortem examination of the affected animals revealed congestion, oedema, hemorrhages and ulcerations of digestive and respiratory mucosa and severe bilateral broncho lobar pneumonia. In fatal cases, lungs may show interalveolarhyperaemia with severe alveolar oedema and froth filled bronchial trees. A large quantity of plasma-like fluid can be seen in the thoracic cavity and pericardial sac. Hypertrophy of lymph nodes and splenomegaly are often noticed. The pathognomonic lesions of BT includes necrosis of cardiac muscles and petechial to ecchymotic hemorrhages at the base of the tunica media of pulmonary artery and subserosal hemorrhage at the base of the aorta (Batten *et al.* 2013)

Diagnosis

The field diagnosis is often based on the investigation of history, clinical signs and postmortem examination (if dead) of the suspected animals. They have to be differentiated from the diseases like foot and mouth disease, vesicular stomatitis , peste des petits ruminants, bovine viral diarrhea, contagious ecthyma, infectious bovine rhinotracheitis, malignant catarrhal fever , sheep pox, parainfluenza-3 infection, pneumonia, polyarthritis, footrot, foot abscesses, plant poisonings (photosensitisation) and epizootic hemorrhagic disease of deer (OIE 2021). The field diagnosis of subclinical and inapparent infections of affected animals is difficult. Therefore,different diagnostic techniques are required to detect the virus and the antibodies against BTV were developed.

Samples to be collected

The whole blood in heparin or EDTA and paired sera samples collected from live animals are used for laboratory investigations. In freshly dead animals, the organs like spleen, liver, red bone marrow, heart blood, lymph nodes are collected. In case of

aborted and congenitally infected newborn animals, the pre-colostrum serum and organs like spleen, liver, lymph nodes and bone marrow can be collected. All the samples must be preserved at 4°C, and should not be frozen (OIE 2021).

AGENT DETECTION

1. Virus isolation

The BTV can be isolated from field samples using 9 to 12 days old embryonated chicken eggs by inoculating through the I/V route or yolk sac route. Now-a-days, the Intravenous route is mostly preferred as they are 100–1000 times more sensitive than the yolk sac route (Dadhich 2004).

The BTV can be isolated from both insect and mammalian cell lines. The KC cell line derived from *C. sonorensis* or *C. variipennis* midges and C6/36 cell line from *Aedesalbopictus*mosquito are mostly used for isolation and propagation of BTV and there are no CPEs observed in these cell lines (McHolland and Mecham 2003). The mammalian cell lines like Baby hamster kidney-21 (BHK-21), African green monkey (Vero) and mouse L cell lines are commonly used for growth and maintenance of BTV. The appearance of foci of round, retractile and aggregation of floating dead cells is the characteristic CPE that is well appreciated in BHK-21 cell lines.

The BTV can be isolated by using lab animals like mice or hamsters or from the natural host such as sheep. But animal inoculation techniques are not preferred due to animal welfare reasons.

2. Serodiagnostics

The antigen capture enzyme-linked immunosorbent assay (ELISA) is the most sensitive test used for identification of the antigen (Saminathan *et al* 2020*)*.

Immunospot test for detection and identification of group specific antigen of BTV from infected cell culture fluids (Afshar 1994).

The serotyping of BTV can be done by virus neutralization test, plaque reduction, plaque inhibition, microtitre neutralization and fluorescence inhibition test. Neutralization based testing is the gold standard test for serotyping of BTV isolates (OIE 2008).

3. Molecular diagnostics

Real-time reverse-transcription polymerase chain reaction tests (RT-PCR) is used for detection of BTV genome in various samples and it is one of the extremely sensitive techniques when compared to virus isolation or neutralization assays (Saminathan*et al.* 2018, 2020).

Reverse-transcription polymerase chain reaction, capillary sequencing or whole genome sequencing can be used for serotyping the BTV.

DETECTION OF ANTIBODIES

The indirect ELISA (i-ELISA) is a simple and rapid technique for detecting and quantifying the antibodies in samples (Rojas *et al.*2019) and it is often used in surveillance purposes (OIE 2008).

The c-ELISA (Competitive ELISA) is also known as inhibition ELISA or blocking ELISA is predominantly employed to measure the concentration of BTV antibodies in ruminant sera (Rojas *et al.*2019)

AGID assay is a simple procedure that is commonly used for diagnosis of major group-specific antibodies against VP7 of BTV as a precipitin (Chandel*et al.*2003). But, this test lacks specificity as it can detect antibodies to other Orbiviruses also.

PREVENTION AND CONTROL

The BT virus is quite stable in the presence of protein but they are sensitive to pH less than 6 and more than 8. They can be inactivated at the temperature of 50°C for 3 hours or 60°C for 15 minutes. The chemicals like β-propiolactone, iodophors and phenolic compounds can be used for inactivating the viruses (OIE 2021).

The control of animal movement, quarantine, serological survey, vector control in disease-free areas using insecticides and destruction of their breeding sites on establishments and animal housing facilities in infected areas can help in control of the diseases.

There are no specific therapeutic protocols and effective antiviral drugs against the BT infection. The symptomatic therapy like administration of antipyretic, antihistamine, antiphlogistic or nonsteroidal anti-inflammatory (NSAID) drugs may help in reducing the inflammation and pain, which inturn helps in recovery in sheep (Tweedle and Mellor 2002).

The most economical and sustainable approach in controlling any vector borne diseases like BT is through vaccination (Ranjan*et al.*2019). Currently both killed BTV and live attenuated serotype specific vaccines are available. It is advised to avoid the usage of Live attenuated vaccines during Culicoides vector seasons because these midges may transmit the vaccine virus(es) from vaccinated to unvaccinated animals and that may result in reassortment of genetic material which gives rise to new and potentially more pathogenic viral strains. Recombinant vaccines are under development but have not yet been licensed yet.

REFERENCES

1. Afshar A. 1994. Bluetongue: laboratory diagnosis. Comp ImmunolMicrobiol Infect Dis. 17(3–4):221–242.
2. Barratt-Boyes SM, Maclachlan NJ. 1994. The dynamics of viral spread in bluetongue virus infected calves. Vet Microbiol. 40(3–4):361–371.
3. Batten CA, Henstock MR, Bin-Tarif A, Steedman HM, Waddington S, Edwards L, Oura CAL. 2013. Bluetongue virus serotype 26: infection kinetics, pathogenesis and possible contact transmission in goats. Vet Microbiol. 157(1–2):119–124.
4. BluetongueSOP1.Etiology and Ecology,FADPReP
5. Bumbarov V, Golender N, Jenckel M, Wernike K, Beer M, Khinich E, Zalesky O, Erster O. 2020. Characterization of bluetongue virus serotype 28. TransboundEmerg Dis. 67(1):171–182.
6. Chandel BS, Chauhan HC, Kher HN. 2003. Comparison of the standard AGID test and competitive ELISA for detecting bluetongue virus antibodies in camels in Gujarat, India. Trop Anim Health Prod. 35(2):99–104.
7. Dadhich H. 2004. Bluetongue: an overview of recent trends in diagnostics. Vet Ital. 40(4):564–566.
8. Hemati B, Contreras V, Urien C, Bonneau M, Takamatsu HH, Mertens PPC, Breard E, Sailleau C, Zientara S, Schwartz[1]Cornil I. 2009. Bluetongue virus targets conventional dendritic cells in skin lymph. J Virol. 83(17):8789–8799.
9. Mcholland LE, Mecham JO. 2003. Characterization of cell lines developed from field populations of Culicoides sonorensis (Diptera: Ceratopogonidae). J Med Entomol. 40(3):348–351.
10. OIE. 2008. Bluetongue. In Manual of diagnostic tests and vaccines for terrestrial animals (mammals, birds and bees). Vol. 1. Paris: OIE. p. 195–210.
11. Office International des Épizooties (2021) World Organization For Animal Health..Bluetonguue (infection with bluetongue virus), Article 3.1.3.In:OIE Terrestrial Manual 2018, part 3, section 3.1, chapter 3.1.3.
12. Rao PP, Hegde NR, Reddy YN, Krishnajyothi Y, Reddy YV, Susmitha B, Gollapalli SR, Putty K, Reddy GH. 2016. Epidemiology of bluetongue in India. TransboundEmerg Dis. 63(2):e151
13. Ranjan K, Minakshi P, Prasad G. 2015. Bluetongue: Indian perspective. Acta Virol. 59(4):317–337
14. Ranjan K, Prasad M, Lambe U, Guray M, Prasad G. 2016. Molecular typing of bluetongue virus 16 from Karnataka State of India.JMRR. 2(1):43–49.
15. Ratinier M, Caporale M, Golder M, Franzoni G, Allan K, Nunes SF, Armezzani A, Bayoumy A, Rixon F, Shaw A, et al. 2011. Identification and characterization of a novel non-structural protein of bluetongue virus.PLoSPathog. 7(12):e1002477
16. Rojas JM, Rodriguez-Martin D, Martin V, Sevilla N. 2019. Diagnosing bluetongue virus in domestic ruminants: current perspectives.VMRR. 10:17–27.
17. Saminathan M, Singh KP, Khorajiya JH, Dinesh M, Vineetha S, Maity M, Rahman AF, Misri J, Malik YS, Gupta VK, Singh RK, Dhama K. An updated review on

bluetongue virus: epidemiology, pathobiology, and advances in diagnosis and control with special reference to India. Vet Q. 2020 Dec;40(1):258-321. doi: 10.1080/01652176.2020.1831708. PMID: 33003985; PMCID: PMC7655031.

18. Singh B, Prasad S. 2009. A model based assessment of eco[1]nomic losses due to some important diseases in sheep in India. Indian J Anim Sci. 79(12):1265–1268
19. Susmitha B, Sudheer D, Rao PP, Uma M, Prasad G, Minakshi P, Hegde NR, Reddy YN. 2012. Evidence of bluetongue virus serotype 21 (BTV-21) divergence. Virus Genes. 44(3):466–469.
20. Tweedle N, Mellor PS. 2002. Technical review – blue[1]tongue: the virus, hosts and vectors. Version 1.5. Report to the Department of Health, Social Services and Public SafetyU.K.(DEFRA),25p.http://archive.defra.gov.uk/foodfarm/farmanimal/diseases/atoz/documents/blue[1]tongue_technical.PDF (accessed July 28, 2011)
21. Umeshappa CS, Singh KP, Nanjundappa RH, Pandey AB. 2010. Apoptosis and immune-suppression in sheep infected with bluetongue virus serotype-23. Vet Microbiol. 144(3–4):310–318.