BLUETONGUE

AETIOLOGY

Classification of the causative agent

Virus family *Reoviridae*, genus *Orbivirus* with 22 recognised species in the genus. The bluetongue virus (BTV) species contain 27 recognised serotypes and are most closely related to the viruses in the epizootic hemorrhagic disease (EHD) serogroup.

Resistance to physical and chemical action

Temperature:	Inactivated by 50°C/3 hours; 60°C/15 minutes.
pH:	Sensitive to pH <6.0 and >8.0.
Chemicals/Disinfectants:	Inactivated by ß-propiolactone; iodophores and phenolic compounds.
Survival:	Very stable in the presence of protein (e.g. has survived for years in blood stored at 20°C).

EPIDEMIOLOGY

- Non-contagious by casual contact
- Some midges (vector species) of the genus *Culicoides* (insect host) can be infected by feeding on viraemic animals and can subsequently transmit BTV among susceptible ruminants;
  - replication period in the insect's salivary gland of 6–8 days
  - infected midges infective for life
- Midges are the only significant natural transmitters of BTV; thus distribution and prevalence of the disease is governed by ecological factors (i.e. high rainfall, temperature, humidity and soil characteristics) impacting geographical distribution of vector species
  - in many parts of the world infection has a seasonal occurrence
- BTV does not establish persistent infections in ruminants thus survival of the agent in the environment is primarily dependent upon the distribution and relative abundance of virus competent midge species.
- Morbidity in sheep can reach 100% with mortality between 30 and 70% in more susceptible breeds mortality in wild deer and antelopes can reach 90%
  - BTV serotype 8 in Europe (post 2008) saw uncharacteristically higher numbers of cattle affected, however mortality remained below 1%

Hosts

- BTV vertebrate hosts include domestic and wild ruminants; sheep, goats, cattle, buffaloes, deer, most species of African antelope and other Artiodactyla such as camels
  - the role of non-ruminant species in the maintenance of disease in the wild is considered minimal
  - considerable variation in sheep breed susceptibility
- Variation in susceptibility amongst ruminant species
  - Cattle, goats, dromedaries, wild ruminants: generally inapparent infection

Transmission

- Biological vectors: *Culicoides* spp.
- Infective period in ruminant host: < 60 days, with most prolonged periods seen for cattle

For detailed information regarding the recommendations for trade in animals and animal products and surveillance, please refer to Chapter 8.3 *Infection with bluetongue virus* in the latest edition of the OIE *Terrestrial Animal Health Code*.

Sources of virus

- Infected *Culicoides*
- Blood
- Semen

Occurrence

Globally the distribution of BTV is directly associated with the presence of competent vectors and their habitats (episystems). BTV activity can be found on all continents except Antarctica, but is absent from New Zealand. Different strains (including strains of the same serotype) can cause markedly variable disease.

For more recent, detailed information on the occurrence of this disease worldwide, see the OIE *World Animal Health Information Database* (WAHID) interface [http://www.oie.int/wahis/public.php?page=home]

DIAGNOSIS

Incubation period is usually 4–8days. Subclinically infected cattle can become viraemic 2–4 days post-infection.

Clinical diagnosis

Disease outcome of infection ranges from inapparent, in the vast majority of infected animals, to fatal with severity dependent on factors related to agent, host, the environment and concomitant stress factors.

Acute form (sheep and some species of deer)

- Pyrexia up to 42°C, excessive salivation, depression, dyspnoea and panting
- Initially clear nasal discharge becomes mucopurulent and upon drying may form a crust around the nares
- Hyperaemia and congestion of the muzzle, lips, face, eyelids and ears; leading to oedema
- Ulceration and necrosis of the mucosae of the mouth
- Tongue may become hyperaemic and oedematous; later cyanotic and protrude from the mouth
- Extension of hyperaemia to coronary band of the hoof, the groin, axilla and perineum; lameness due to coronitis or pododermatitis and myositis
- Torticolis in severe cases
- Abortion or birth of malformed lambs
- Complications of pneumonia
- Emaciation
- In severe cases either death within 8–10 days or long recovery with alopecia, sterility and growth delay

Inapparent infection

- Frequent in cattle and other species for certain strains

Lesions

- Congestion, oedema, haemorrhages and ulcerations of digestive and respiratory mucosae (mouth, oesophagus, stomach, intestine, pituitary mucosa, tracheal mucosa)
- Severe bilateral broncholobular pneumonia (when complications occur); in fatal cases, lungs may show interalveolar hyperaemia, severe alveolar oedema and the bronchial tree may be filled with froth
- Thoracic cavity and pericardial sac may contain large quantities of plasma-like fluid
- Distinctive haemorrhages found at base of pulmonary artery
- Congestion of hoof laminae and coronary band
- Hypertrophy of lymph nodes and splenomegaly

Differential diagnosis

- Contagious ecthyma
- Foot and mouth disease
- Vesicular stomatitis
- Malignant catarrhal fever
- Bovine virus diarrhoea
- Infectious bovine rhinotracheitis
- Parainfluenza-3 infection
- Sheep pox
- Photosensitisation
- Pneumonia
- Polyarthritis, footrot, foot abscesses
- Plant poisonings (photosensitisation)
- Peste des petits ruminants
- Coenurosis (*Oestrus ovis* infestation)
- Epizootic haemorrhagic disease of deer

Laboratory diagnosis

Samples

- Living animals: whole blood in heparin or EDTA
- Paired sample sera
- Freshly dead animals: spleen, liver, red bone marrow, heart blood, lymph nodes
- Aborted and congenitally infected newborn animals: pre-colostrum serum plus same samples as for freshly dead animals
- All samples have to be preserved at 4°C, and **not frozen**

Procedures

Isolation of the agent

- Intravascular inoculation in 10- 12-day-old embryonated chicken eggs or inoculation of cell culture
- Inoculation of sheep (rarely performed for diagnostic purposes, for welfare reasons)
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Identification of the agent

- Virus isolation
    - performed in: embryonated chicken eggs or cell culture
    - same diagnostic procedures are used for domestic and wild ruminants
- Immunological methods
    - Serogrouping of viruses by
        - Immunofluorescence
        - Antigen capture enzyme-linked immunosorbent assay (ELISA)
        - Immunospot test
    - Serotyping by virus neutralisation via
        - Plaque reduction
        - Plaque inhibition
        - Microtitre neutralisation
        - Fluorescence inhibition test
- Real-time reverse-transcription polymerase chain reaction tests
- Reverse-transcription polymerase chain reaction, capillary sequencing or whole genome sequencing

Serological tests

- Competitive ELISA

    - BT competitive or blocking ELISA detects BTV-specific antibody (directed to the VP7 core protein) with no cross-reactivity with antibody to other Orbiviruses
    - specificity is the result of using one of a number of BT serogroup (VP7)-reactive MAbs
- Indirect ELISA
    - shown to be reliable and useful for surveillance purposes for bulk milk samples
- Agar gel immunodiffusion
    - simple to perform and the antigen used in the assay is relatively easy to generate
    - one of the disadvantages of the AGID used for BT is its lack of specificity in that it can detect antibodies to other Orbiviruses, particularly those in the EHD serogroup
    - AGID positive sera may have to be retested using a BT serogroup-specific assay

For more detailed information regarding laboratory diagnostic methodologies, please refer to Chapter 3.1.3 *Bluetongue* in the latest edition of the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* under the heading "Diagnostic Techniques".

PREVENTION AND CONTROL

Sanitary prophylaxis

- No efficient treatment
- Disease-free areas:
    - animal movement control, quarantine and serological survey
    - vector control, especially in aircraft and during transportation on land
- Infected areas:
    - vector control both during transportation and on establishments and animal housing facilities. Physical barriers, insecticides, alarm systems and elimination of breeding sites should be applied

Medical prophylaxis

- Both live attenuated and killed BTV vaccines are currently available; attenuated vaccines are serotype specific.
    - Live attenuated vaccines should not be used during *Culicoides* vector seasons because these insects may transmit the vaccine virus(es) from vaccinated to nonvaccinated animals (including other ruminant species). This may result in reassortment of genetic material and give rise to new and potentially more pathogenic viral strains
- Recombinant vaccines are under development but have not yet been licensed.

Surveillance

- The objective is determination of transmission of BTV in a country or zone
- Capacity of the vector provides a measure of disease risk
- In a seasonally free zone – early warning system
- The target population for surveillance aimed at identification of disease or infection should cover susceptible domestic ruminants and camelids, and other susceptible herbivores of epidemiological significance within the country or zone
- Surveillance strategies
    - Clinical surveillance: individual or population
    - Serological surveillance: establishing the status of a country or zone
    - Virological surveillance: further investigate serotype and genetic characteristics of virus concerned
    - Sentinel animals: preferred form of surveillance. Naïve animals placed strategically on boundaries of infected zones to detect changes on BTV distribution
    - Vector surveillance: aims to demonstrate the presence or absence of *vectors*, their respective seasonal occurrence, and abundance

For more detailed information regarding vaccines, please refer to Chapter 3.1.3 *Bluetongue* in the latest edition of the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* under the heading "Requirements for Vaccines and Diagnostic Biologicals".

For more detailed information regarding safe international trade in terrestrial animals and their products, please refer to the latest edition of the OIE *Terrestrial Animal Health Code*.

REFERENCES AND OTHER INFORMATION

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The OIE will periodically update the OIE Technical Disease Cards. Please send relevant new references and proposed modifications to the OIE Science Department (scientific.dept@oie.int). Last updated January 2021