



| | | |
|--------------------------------|---|---|
| S l i d e 1 | <p style="text-align: center;">Bluetongue</p> <p style="text-align: center;"><i>Sore Muzzle, Pseudo Foot-and-Mouth Disease, Muzzle Disease</i></p> | <p>Bluetongue is also known as sore muzzle, pseudo foot-and-mouth disease, and muzzle disease.</p> |
| S l i d e 2 | <p style="text-align: center;">Overview</p> <ul style="list-style-type: none">• Organism• Economic Impact• Epidemiology• Transmission• Clinical Signs• Diagnosis and Treatment• Prevention and Control• Actions to Take  | <p>In today's presentation we will cover information regarding the organism that causes bluetongue and its epidemiology. We will also talk about the economic impact the disease has had in the past and could have in the future. Additionally, we will talk about how it is transmitted, the species it affects, clinical findings and necropsy signs, as well as diagnosis and treatment of the disease. Finally, we will address prevention and control measures for the disease, and actions to take if bluetongue is suspected.</p> <p>[Photo: A sheep. Source: www.flickr-creative-commons]</p> |
| S l i d e 3 | <p style="text-align: center;">THE ORGANISM</p> | |
| S l i d e 4 | <p style="text-align: center;">Bluetongue Virus</p> <ul style="list-style-type: none">• Family Reoviridae<ul style="list-style-type: none">- Genus <i>Orbivirus</i>• 24 serotypes worldwide<ul style="list-style-type: none">- 6 serotypes isolated in the U.S.• Non-contagious• Insect-borne viral disease• Ruminants: Primary host is sheep• Others infected: Cattle, goats, deer | <p>Bluetongue is a non-contagious, insect-borne, viral disease of ruminants. Bluetongue virus (BTV) belongs to the genus <i>Orbivirus</i> in the family Reoviridae. There are 24 serotypes identified worldwide, six of which have been isolated in the U.S. Bluetongue primarily affects sheep and wild ruminants, with asymptomatic infections occurring in cattle, goats, deer, and carnivores. This disease can result in significant morbidity.</p> |
| S l i d e 5 | <p style="text-align: center;">IMPORTANCE</p> | |

S
I
d
e
6

History

- First described in South Africa
 - Broad distribution worldwide
- Mediterranean outbreak, 1997-2002



BTV was first described in South Africa, and the virus has since been recognized in other parts of Africa, Europe, the Middle East, the South Pacific, North and South America, and parts of Asia. The virus cannot be transmitted between susceptible animals without the presence of insect carriers, so distribution of the vector limits the spread of infection. In the U.S., the distribution of *Culicoides variipennis* var *sonorensis*, the principal vector of BTV, limits infections to the southern and western states. From 1997 to 2002, there was a progressive spread of bluetongue within the Mediterranean region, as shown in red in the map above (Source: Federation of American Scientists. www.fas.org).

S
I
d
e
7

Economic Impact

- Trade restrictions
 - Imposed by BTV-free countries
 - Animals and animal products
- Cost to U.S.
 - Greater impact on cattle industry
 - Reservoir for virus
 - \$125 million per year
 - Lost trade and animal testing

Bluetongue has a strong impact on trade; countries that are free of bluetongue restrict importation of live animals or animal products, including semen and embryos, from countries that may have BTV. Although BTV primarily affects sheep, it also has great economic impact on the cattle industry (which is larger than the sheep industry in the U.S.) because cattle can carry the virus post-infection and show no clinical signs. This costs U.S. sheep and cattle producers \$125 million per year in lost trade and in testing to certify that animals or animal products for export are free from the bluetongue virus.


S
I
d
e
8

EPIDEMIOLOGY

S
I
d
e
9

Morbidity/Mortality: Sheep

- Sheep
 - Severity of disease varies
 - Breed
 - Strain of virus
 - Environmental stress
 - Morbidity
 - As high as 100%
 - Mortality
 - Usually 0 to 30%




In sheep, the severity of disease varies with the breed of sheep, strain of virus, and environmental stress. Morbidity can be as high as 100%. Mortality is usually 0 to 30%, but can reach up to 70% in highly susceptible sheep.

[Photo: A flock of sheep. Source: USDA ARS]

S
I
d
e
10

Morbidity/Mortality: Other Species

- Cattle, goats
 - Morbidity: up to 5%
 - Death is rare
- Deer, antelope
 - Severe infection
 - Morbidity
 - Up to 100%
 - Mortality
 - 80 to 90%
- Lasting effects



Most infections in cattle, goats, and North American elk are asymptomatic. In cattle, morbidity may be as high as 5%, but death is rare. Infections are usually severe in whitetail deer and pronghorn antelope, with morbidity rates as high as 100%, and mortality usually reaching 80 to 90% in these two species. In some animals, lameness and poor condition can persist for some time.

[Photo: (Top) Cow. Source: Alice Welch/USDA; (Middle) Goat. Source: www.wikimedia-commons.org ; (Bottom) White-tailed deer. Source: Bob Nichols/USDA]

S
l
i
d
e

1
1


TRANSMISSION

S
l
i
d
e

1
2

Animal Transmission

- Biting midges
 - Genus *Culicoides*
 - Principal vector (U.S.)
 - *C. variipennis* var. *sonorensis*
- Ticks, sheep keds
- In utero
- Mechanical
- Venereal?



BTV is transmitted by biting midges in the genus *Culicoides* (shown above), with *Culicoides variipennis* var *sonorensis* the principal vector in the U.S. Ticks or sheep keds can be mechanical vectors but are probably of minor importance in disease transmission. While bluetongue is not a contagious disease, the virus can be transmitted to the fetus *in utero* or spread mechanically on surgical equipment and needles. Although BTV can be found in semen, venereal spread does not appear to be a major route of infection.

[Photo: Two *Culicoides* biting midges. Source: www.culicoides.net]

S
l
i
d
e

1
3


ANIMALS AND BLUETONGUE

S
l
i
d
e

1
4

Clinical Signs: Sheep

- Incubation period: 5 to 10 days
- Most asymptomatic
- Oral erosions and ulcerations
- Tongue
 - Swollen, protruding
 - Cyanotic = "blue-tongue"
- Reproductive failure





The incubation period for bluetongue is 5 to 10 days. The vast majority of infections with bluetongue are clinically inapparent. In a percentage of infected sheep and occasionally other ruminants, more severe disease can occur. The tongue is occasionally cyanotic ("blue-tongue") (middle photo, www.fao.org), swollen, and protrudes from the mouth (top photo, www.usda.org). Erosions and ulcerations are often found in the mouth; these lesions may become extensive and the mucous membranes may become necrotic. Pregnant ewes may abort their fetuses, or give birth to "dummy" lambs.

[Photo: Sheep, mouth. Most of the dental pad is eroded; the remaining pale mucosa is necrotic. Armed Forces Institute of Pathology/CFSPH]

S
I
d
e
1
5

Clinical Signs: Sheep

- Coronitis
 - Inflammation of coronary band
- Lameness
 - Painful hooves



In sheep, the coronary bands on the hooves are often inflamed and the hooves painful. Lameness is common and animals may slough their hooves if they are driven.

[Photos: (Left) Sheep, foot. There are multiple petechiae in the hoof wall, and there is marked hyperemia of the coronary band. Source: Armed Forces Institute of Pathology/CFSPH; (Right) A lame sheep holding up its painful front leg. Source: USAHA Foreign Animal Disease “The Gray Book” at www.usaha.org/Portals/6/Publications/FAD.pdf]

S
I
d
e
1
6

Clinical Signs

- Cattle and goats
 - Usually subclinical
 - Erosions, crusts around nose and teats
 - Coronitis
 - Reproductive failure
- Antelope and deer
 - Hemorrhage, death

Cattle can become viremic starting at 4 days post-infection but rarely develop symptoms; often, the only signs of disease are changes in the leukocyte count and a fluctuation in rectal temperature. Rarely, cattle have mild hyperemia, vesicles or ulcers in the mouth, erosion and crusting around the nose (top photo), hyperemia around the coronary band, or lesions around the teats of lactating cows (bottom photo). Temporary sterility may be seen in bulls, and infected cows may give birth to “dummy” calves with hydranencephaly or cerebral cysts. Cattle that have clinically apparent disease may develop severe breaks in the hooves several weeks after infection; such breaks are usually followed by foot rot. In pronghorn antelope and whitetail deer, the most common symptoms are hemorrhages and sudden death. Infections in goats are usually subclinical and resemble disease in cattle.

[Photos: (Top) Sheep. There is bilateral nasal exudate, erosion of the nasal planum, and excessive salivation. Source: Plum Island Animal Disease Center/CFSPH; (Bottom) Bovine, mammary gland. There is extensive coalescing ulceration of the teat skin. Source: Plum Island Animal Disease Center/CFSPH]

S
I
d
e
1
7

Post Mortem Lesions

- Sheep
 - Face and ears edematous
 - Dry, crusty exudate on nostrils
 - Coronary bands hyperemic
 - Internal hemorrhaging
 - Hydranencephaly, cerebellar dysplasia
- Cattle
 - Skin: edematous, ulcerated, dry, thick folds
 - Mouth: vesicles, ulcers, necrosis

In sheep, the face and ears are often edematous, and a dry, crusty exudate may be seen on the nostrils. The coronary bands of the hooves are often hyperemic; petechial or ecchymotic hemorrhages may be present and extend down the horn. Petechiae, ulcers, and erosions are common in the oral cavity, particularly on the tongue and dental pad, and the oral mucous membranes may be necrotic or cyanotic. In some cases, hyperemia, hemorrhages, and edema are found throughout the internal organs. Hemorrhage at the base of the pulmonary artery is particularly characteristic of bluetongue. In newborn lambs, there may be hydranencephaly or cerebellar dysplasia.

In cattle infected with BTV, the skin is often edematous and ulcerated, or eroded with dry, thick folds. Vesicles, ulcers, and necrotic debris may be found in the mouth; these erosions are most common on the buccal mucosa and dental pad. The external nares may contain erosions and a crusty exudate. Hyperemia is often seen at the coronary band. Affected fetuses can have hydranencephaly or cerebral cysts. In deer, the most prominent lesions are widespread petechial to ecchymotic hemorrhages. More chronically infected deer may have ulcers and necrotic debris in the oral cavity, and lesions on the hooves, including severe fissures or sloughing.

S
I
d
e
1
8

| Differential Diagnosis | |
|---|--|
| <ul style="list-style-type: none"> • Foot-and-mouth disease • Vesicular stomatitis • Peste de petits ruminants • Malignant catarrhal fever • Bovine virus diarrhea • Contagious pustular dermatitis | <ul style="list-style-type: none"> • Infectious bovine rhinotracheitis • Parainfluenza-3 infection • Sheep pox • Foot rot • Actinobacillosis • <i>Oestrus ovis</i> infestation • Plant photosensitization |

Differential diagnoses includes foot-and-mouth disease, vesicular stomatitis, peste de petits ruminants, malignant catarrhal fever, bovine virus diarrhea, contagious pustular dermatitis (contagious ecthyma), infectious bovine rhinotracheitis, parainfluenza-3 infection, sheep pox, foot rot, actinobacillosis, *Oestrus ovis* infestation, and plant photosensitization. In cattle and deer, epizootic hemorrhagic disease can also result in similar symptoms.

S
I
d
e
1
9

| Sampling |
|---|
| <ul style="list-style-type: none"> • Before collecting or sending any samples, the proper authorities should be contacted • Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease |

Before collecting or sending any samples from animals with a suspected foreign animal disease, the proper authorities should be contacted. Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease.

S
I
d
e
2
0


| Diagnosis | |
|---|--|
| <ul style="list-style-type: none"> • Clinical signs • History <ul style="list-style-type: none"> - Insect activity - Wasting or foot rot | <ul style="list-style-type: none"> • Laboratory <ul style="list-style-type: none"> - Virus isolation - ELISA, IFA, VN - PCR - Serology, complement fixation - Examination of proteins |

Bluetongue should be suspected when typical clinical signs are seen during seasons when insects are active. A recent history of wasting and foot rot in the herd supports the diagnosis. Bluetongue can be diagnosed by isolating the virus in cell cultures or embryonated chicken eggs. It can also be isolated by inoculation into sheep, and sometimes suckling mice or hamsters. Virus identity is confirmed by antigen-capture ELISA, immunofluorescence (IFA), immunoperoxidase, virus neutralization (VN), or polymerase chain reaction (PCR) tests. These techniques allow for rapid diagnosis and can identify the virus serogroup and serotype. Serology and complement fixation tests are also used, and recently a method has been developed to examine bluetongue virus proteins and genes, which helps to differentiate between BTV and related viruses that cause epizootic hemorrhagic disease (EHD).

S
I
d
e
2
1

| Treatment |
|--|
| <ul style="list-style-type: none"> • No specific treatment • Supportive therapy <ul style="list-style-type: none"> - Protection from the elements - Fluids and electrolytes - Antibiotics • Control of vectors by insecticide <ul style="list-style-type: none"> - Reduce transmission - Protect susceptible animals |

There is no specific treatment for acute cases of bluetongue. Supportive therapy includes protection from the elements (e.g., the wind or sun), keeping animals warm and dry, and giving fluids and electrolyte solutions if needed. Antibiotics may also be given to prevent secondary infections. Treatment may include vector control to reduce transmission of the virus to non-infected animals.

| | | |
|---|---|--|
| <p>S l i d e 2 2</p> | <p style="text-align: center;">BLUETONGUE IN HUMANS</p> | |
| <p>S l i d e 2 3</p> | <p style="text-align: center;">Bluetongue in Humans</p> <ul style="list-style-type: none"> • Not a significant threat to humans • One human infection documented <ul style="list-style-type: none"> - Reasonable precautions should be taken • Disease in humans is not fatal • Treatment is supportive care | <p>Bluetongue is not a significant threat to human health; however, one human infection has been documented in a laboratory worker. Reasonable precautions should be taken while working with the virus. BTV is not fatal in humans; treatment includes supportive care.</p> |
| <p>S l i d e 2 4</p> | <p style="text-align: center;">PREVENTION AND CONTROL</p> | |
| <p>S l i d e 2 5</p> | <p style="text-align: center;">Recommended Actions</p> <ul style="list-style-type: none"> • IMMEDIATELY notify authorities <ul style="list-style-type: none"> • Federal <ul style="list-style-type: none"> - Area Veterinarian in Charge (AVIC) http://www.aphis.usda.gov/animal_health/area_offices/ • State <ul style="list-style-type: none"> - State veterinarian http://www.usaha.org/StateAnimalHealthOfficials.pdf • Quarantine <p style="text-align: right; font-size: small;"><small>Center for Food Security and Public Health, Iowa State University, 2011</small></p> | <p>If you suspect a case of bluetongue, state or federal authorities should be notified immediately. Animals suspected with bluetongue should be isolated, and the farm should be quarantined until definitive diagnosis is determined.</p> |
| <p>S l i d e 2 6</p> | <p style="text-align: center;">Quarantine</p> <ul style="list-style-type: none"> • Quarantine and movement controls <ul style="list-style-type: none"> - Prevent spread of virus • Confine animals indoors (i.e., barn) <ul style="list-style-type: none"> - When vectors are active <div style="text-align: center;">  </div> | <p>Control strategies for bluetongue include using a combination of quarantine and movement controls to prevent spread of the virus (pictured above). When there is suspicion of BTV circulating in an area, animals should be confined indoors at times when the vectors are active. Slaughter may also be necessary, depending upon the situation.</p> <p>[Photo: A gate with quarantine signage. Source Katie Steneroden/CFSPH]</p> |

S
I
d
e
2
7

Disinfection

- Does not stop virus transmission
- Cleaning the premises
 - Sodium hypochlorite (bleach)
 - 3% Sodium hydroxide (lye)
- Insect control
 - Pyrethroids
 - Organophosphates

Disinfectants cannot prevent the virus from being transmitted between animals; however, where disinfection is warranted, sodium hypochlorite or 3% sodium hydroxide (lye) are effective (above photo). Insect control is important in limiting the spread of the disease; synthetic pyrethroids or organophosphates are effective against *Culicoides*.

S
I
d
e
2
8

Vaccination

- Available
 - Serotype specific
- Adverse effects
 - Fetal malformations
 - Recombination
 - New strains of virus

Vaccines are available but are specific for each serotype. There are also adverse effects to the use of vaccines; they can cause fetal malformations during the first 100 days of gestation in ewes, and may be able to recombine with field strains to produce new strains of virus. We all need to do our part to keep our sheep healthy and free from foreign animal diseases, such as bluetongue.

S
I
d
e
2
9

Additional Resources

- World Organization for Animal Health (OIE)
 - www.oie.int
- U.S. Department of Agriculture (USDA)
 - www.aphis.usda.gov
- Center for Food Security and Public Health
 - www.cfsph.iastate.edu
- USAHA Foreign Animal Diseases ("The Gray Book")
 - www.usaha.org/Portals/6/Publications/FAD.pdf

Center for Food Security and Public Health, Iowa State University, 2011

Last updated: March 2011

S
I
d
e
3
0

Acknowledgments

Development of this presentation was made possible through grants provided to the Center for Food Security and Public Health at Iowa State University, College of Veterinary Medicine from the Centers for Disease Control and Prevention, the U.S. Department of Agriculture, the Iowa Homeland Security and Emergency Management Division, and the Multi-State Partnership for Security in Agriculture.

Authors: Jean Gladon, BS, DVM; Anna Rovid Spickler, DVM, PhD;
Reviewers: James A. Roth, DVM, PhD; Raufford Davis, DVM, MPH, DACVPM; Binky Comito, BA; Katie Spaulding, BS; MS; Glenda Dvorak, DVM, MPH, DACVPM; Kerry Leedom Larson, DVM, MPH, PhD

Center for Food Security and Public Health, Iowa State University, 2011