Bovine Ephemeral Fever

Bovine Epizootic Fever,
Ephemeral Fever,
Three-Day Sickness,
Three Day Fever,
Three-Day Stiffsickness,
Dragon Boat Disease,
Lazy Man's Disease,
Dengue of Cattle

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USDA

Importance

Bovine ephemeral fever is an economically important arboviral disease that affects cattle and water buffalo, and is widespread in tropical and semitropical areas of the Eastern Hemisphere. In most cases, the main impact is on productivity. While the illness is usually brief, it can result in decreased milk yield, loss of condition and reproductive losses, and recovery can be prolonged in some animals. Mortality is typically low (1-2%); however, significantly higher case fatality rates were reported in some recent outbreaks.

Etiology

Bovine ephemeral fever is caused by bovine ephemeral fever virus (BEFV), a member of the genus *Ephemerovirus* in the family Rhabdoviridae. At least 4 antigenic subtypes have been identified, but there is only one serotype. Some closely related viruses, such as kotonkan virus, may cause similar illnesses. Additional ephemeroviruses and unclassified rhabdoviruses (e.g., Adelaide River virus, Kimberley [Malakal] virus, Berrimah virus, Puchong virus, Yata virus, Koolpinyah virus, Obodhiang virus) are not known to cause disease in domesticated animals, but can cross-react with BEFV in some serological tests.

Species Affected

Only cattle and yaks (both members of the genus *Bos*) and water buffalo (*Bubalus bubalis*) are known to be affected by BEFV. Camels (*Camelus dromedarius*) can be seropositive, and a disease resembling ephemeral fever has been reported in this species, but its cause is still unknown. Antibodies to BEFV have also been found in asymptomatic sheep, goats and pigs, and in many wild animals including African buffalo (*Syncerus caffer*), hartebeest (*Alcelaphalus buselaphus*), waterbuck (*Kobus ellipsiprymnus*), wildebeest (*Connochaetes taurinus*), kudu (*Tragelaphus strepsiceros*), giraffe (*Giraffa camelopardalis*), elephant (*Loxodonta africana*), hippopotamus (*Hippopotamus amphibius*), warthog (*Phacochoerus aethiopicus*) and various species of deer and antelope. Seroprevalence can be high in some African wildlife, and some species might act as reservoir hosts. However, cross-reactivity with similar viruses complicates the interpretation of serological tests. Experimental infections have been established in sheep, but there is currently no evidence that this species plays any role in the epidemiology of bovine ephemeral fever in nature.

Zoonotic potential

There is no evidence that humans can be infected by BEFV.

Geographic Distribution

Bovine ephemeral fever occurs in some tropical, subtropical and warm temperate regions of Africa, Australia, the Middle East and Asia. Some countries experience localized outbreaks in most years; others report cases only during epizootics. BEFV does not occur in Europe (although seropositive animals have been detected in central Russia), North or South America, the islands of the Pacific or New Zealand. Kotonkon virus has been detected in Africa (Nigeria).

Transmission

BEFV appears to be transmitted by arthropods, but the identity of the vector or vectors is not entirely clear. This virus has been isolated from various genera of mosquitoes, and from a number of *Culicoides* species (biting midges). Laboratory observations, together with epidemiological evidence from some locations, currently suggest that mosquitoes are the primary biological vectors. However, there are some indications that *Culicoides* might be significant vectors in parts of Africa (e.g., Kenya). Windborne transmission of infected vectors has been suspected in some outbreaks.

There is no evidence that bovine ephemeral fever can be transmitted directly between animals in nature; BEFV is not spread by close contact, body secretions, or aerosol droplets. However, animals can be infected in the laboratory by intravenous

inoculation of small amounts of blood. This virus does not seem to be transmitted in semen and it is rapidly inactivated in meat. There is no evidence that animals become carriers.

Disinfection

BEFV is not thought to be transmitted directly between animals, and does not persist for long periods in the environment. If disinfection is needed, this virus is reported to be very susceptible to disinfectants, including sodium hypochlorite, and lipid solvents.

Incubation Period

Based on natural and experimental infections, the incubation period is thought to be 2-4 days in most cases, with a maximum of 10-11 days.

Clinical Signs

Clinical signs vary in individual animals, but the classic course begins with a fever, which is often biphasic to polyphasic. The temperature peaks typically occur 12 to 18 hours apart. In lactating cows, milk production often drops dramatically during the first fever spike. There are often few other clinical signs at this time, although some animals may be depressed, stiff or reluctant to move. However, the illness soon becomes more obvious; most animals become inappetent and depressed, with an increased heart rate, tachypnea, and serous or mucoid discharges from the nose. Profuse salivation, muscle twitching, waves of shivering or lacrimation may also be seen.

Some animals develop submandibular or periorbital edema, or patchy edema on the head. Shifting lameness, stiffness and joint pain are common; the joints may or may not be swollen. The lameness can be severe enough to mimic a fracture or dislocation. Dyspnea, pulmonary emphysema and rales may be found in severe cases. Many animals, particularly cows in good condition and bulls, become recumbent for periods that range from 8 hours to several days or more. Most animals lie in sternal recumbency, but in severe cases, animals may become laterally recumbent. Some animals temporarily lose their reflexes and are unable to rise. Recumbent animals may be bloated, have ruminal stasis, or lose their swallowing reflex. These clinical signs can be exacerbated by severe environmental stress or forced exercise.

Most animals begin to improve a day or two after the initial signs, and recover completely within another 1-2 days. Lactating cows, bulls and animals in good condition are usually affected more severely, and may take up to a week to recover. Generally, animals lose condition rapidly during the illness, and regain their weight only slowly. Complications are uncommon in most outbreaks, but can include temporary or (rarely) permanent paralysis, as well as gait impairment, aspiration pneumonia, emphysema, mastitis, and the subcutaneous accumulation of air along the back. Many of these complications may be the result of trauma or complications of recumbency. Temporary infertility (up to 6 months) can develop in bulls, and abortions sometimes occur in cows. Permanent infertility is rare. In recovered animals, milk production is generally decreased for the rest of the lactation, but usually returns to normal after subsequent pregnancies. Cows that become ill late in lactation may not return to production. Death is uncommon in most outbreaks, but may occur during either the febrile or the convalescent stage. During recent outbreaks in China, some severely ill cattle died with signs of dyspnea, 6-12 hours after they first became ill. Secondary complications such as pneumonia or trauma are thought to contribute significantly to the death rate. Subclinical infections are also seen.

Water buffalo have similar signs. The disease is usually thought to be milder in this species; however, some severe outbreaks have been reported in the field. Experimentally infected sheep remained asymptomatic.

Post Mortem Lesions

The most obvious lesion is a small amount of fibrin-rich fluid in the pleural, peritoneal and pericardial cavities, resulting from polyserositis of the pleural, pericardial and peritoneal surfaces. Edema, lobular congestion and atelectasis may be apparent in the lungs, and emphysematous lesions are sometime detected in the lungs, mediastinum and subcutaneous connective tissue. Serofibrinous polysynovitis (with variable amounts of yellow to brown, typically gelatinous fluid), polyarthritis, polytendinitis, and cellulitis are common. Other lesions can include lymphadenitis, edema and petechial hemorrhages in the lymph nodes, and areas of focal necrosis in the major muscle groups.

Diagnostic Tests

Most cases of bovine ephemeral fever are confirmed by serology. A rising titer should be demonstrated, but single serum samples may be suggestive in areas where this disease does not normally occur. Anamnestic (rather than primary) responses to BEFV can occur during the first exposure, if the animal was previously exposed to another ephemerovirus. Virus neutralization or enzyme-linked immunosorbent assays (ELISAs) are the most commonly used serological tests. Some of these tests, including certain ELISAs, can distinguish BEFV from other members of the *Ephemerovirus* genus. Complement fixation was mainly used in the past, and identifies the antibodies only as *Ephemerovirus*-specific.

Reverse transcription polymerase chain reaction (RT-PCR) assays are used regularly for diagnosis in some countries. These assays may be able to detect viral RNA in blood during the (typically short) febrile period, and from tissue samples such as the lung at necropsy. A real-time loop-mediated isothermal amplification (RT-LAMP) assay has been published. Virus isolation may occasionally be successful, especially during the first 24-48 hours. The virus is often recovered initially in *Aedes albopictus* (mosquito) cell lines, and propagated in BHK-21 or Vero

cells. The identity of the virus can be confirmed by RT-PCR, virus neutralization and some ELISAs. Immunofluorescence has also been used, but may be able to identify the virus only as an *Ephemerovirus*.

While animal inoculation is generally discouraged if there are alternatives, BEFV can be recovered by intracerebral inoculation into unweaned mice.

Treatment

Treatment may be unnecessary in milder cases, but more severely affected animals are often treated symptomatically, particularly when they have become recumbent. Animals are often given anti-inflammatory drugs, with the addition of calcium borogluconate injections if they have signs of hypocalcemia (e.g., ruminal stasis, paresis, loss of reflexes). Some animals with a more prolonged course of disease were resistant to these measures during recent outbreaks in Chinese Taipei (Taiwan). Antibiotics may be administered to control secondary infections, and rehydration with isotonic fluids is sometimes employed.

Good nursing can also aid recovery. Recumbent animals should be provided with water, food and shelter if necessary, but animals should not be forced to stand or move. Force-feeding is not advisable due to the risk of aspiration pneumonia. Laterally recumbent animals may be rolled periodically to prevent loss of circulation and muscle damage.

Control

Disease reporting

A quick response is vital for containing outbreaks in disease-free regions. Veterinarians who encounter or suspect bovine ephemeral fever should follow their national and/or local guidelines for disease reporting. In the U.S., state or federal veterinary authorities should be informed immediately.

Prevention

Because illness and viremia are both transient, and carriers are not known, a short quarantine in vector-free facilities should prevent the introduction of BEFV in transported animals. If an outbreak occurs among imported animals in a limited area, placing them in an insect-proof area and treating the area with insecticides has a chance of success. BEFV is not spread by casual contact or in secretions, and it is rapidly inactivated in carcasses after death.

In endemic areas, vaccination is generally used to prevent disease, particularly in lactating cattle and bulls. Vaccines are not necessarily employed in regions where outbreaks occur regularly and most animals are immune before they become adults. Vaccination can also be used in the face of an outbreak. Although insect control might theoretically be helpful in some situations, its efficacy is unknown. Moving valuable animals into insect-proof facilities may be considered during outbreaks or in high-risk seasons.

Morbidity and Mortality

Bovine ephemeral fever can occur as localized outbreaks or in seasonal epizootics that sweep across broad geographic areas. Seasonal patterns can vary with the region, depending on the environmental factors that favor the multiplication of biting insects. In some areas, outbreaks tend to be associated with high rainfall. When it is dry, bovine ephemeral fever has been reported in cattle gathered around sources of water. Outbreaks usually end with the first heavy frosts in temperate climates. In other areas, cases may decrease or end during the dry season.

The morbidity rate is highly variable, depending on previous exposures, the age of the animals, and other factors. It can approach 100% in some outbreaks, and be as low as 1-10% in others. Clinical signs are usually more severe in adults than calves; symptomatic infections are rare in cattle less than 6 months of age, even when they have no maternal antibodies. Bulls, animals in good condition and high-producing cows are more severely affected; mortality rates up to 10-30% have been reported in these animals. Overall, the mortality rate is usually 1-2%; however, case fatality rates of 2-20%, and occasionally higher, were described during some recent outbreaks in the Middle East and Asia. Why deaths were more common in these outbreaks is currently uncertain.

Overall, buffalo are thought to be less severely affected than cattle. However, severe outbreaks can be seen, and mortality was reported to be 5% during one outbreak in the Philippines.

Internet Resources

United States Animal Health Association.
Foreign Animal Diseases
http://www.aphis.usda.gov/emergency_response/downloads/nahems/fad.pdf

World Organization for Animal Health (OIE)
http://www.oie.int

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* Link is defunct