



Foot and Mouth Disease Backgrounder

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Causative agent

Foot and mouth disease (FMD) is caused by a picornavirus; other members of this viral family include the swine vesicular disease virus, the human hepatitis A virus, and rhinoviruses. Picornaviruses are 22 to 30 nanometers (nm) in diameter, naked (unenveloped), and icosahedral in shape. The FMD virus (FMDV) belongs to the genus aphthovirus. The virus is a positive sense, single-stranded RNA virus. Most picornavirus species are host-specific and are highly resistant to most disinfectants.

There are 7 immunologically distinct serotypes of FMDV: FMDV-A, FMDV-O, FMDV-C, FMDV-ASIA1, FMDV-SAT1, FMDV-SAT2, and FMDV-SAT3. More than 60 subtypes of the virus exist.

Natural distribution

FMD appears to have been first observed in 1514 in Italy. Nine outbreaks of FMD occurred in the United States of America between 1905 and 1929, including serious outbreaks in 1905, 1914, 1924, and 1929. The U.S. has been free of FMD since 1929. The A, O, and C types of FMDV were first isolated in Europe, but have also been identified in South America and the Middle East. The SAT types are limited to the southern African territories. The ASIA type is generally only observed in Asia, with occasional incursions in the Middle East.

Foot and mouth disease affects swine, sheep, goats, deer, water buffalo, and other cloven-hooved ruminants. The virus is widespread but as of January 2007 sixty-one countries were considered FMD-free without vaccination by the World Organization for Animal Health (OIE), three countries were FMD-free with vaccination, seven countries had FMD-free zones without vaccination, and three countries had FMD-free zones with vaccination (http://www.oie.int/eng/info/en_fmd.htm#Liste). The virus can persist in contaminated feed and the environment for up to one month. FMD is endemic in regions of Africa, Asia, South America, and Europe. Persistence in wildlife reservoirs contributes to difficulty in eradicating and controlling FMD.

Foot and mouth disease is considered to be the most economically devastating livestock disease in the world, and represents a worst-case scenario for livestock diseases because of the variety of species involved, rapid spread, and difficulty in controlling outbreaks. The 2001 FMD outbreak in Great Britain resulted in the slaughter of more than 6 million animals and an estimated economic loss of 20 billion dollars. The World Organization for Animal Health (OIE) classifies FMD as a listed disease that requires notification within 24 hours of its first occurrence in a free country or zone or reoccurrence after a previously eradicated outbreak. Immediate notification is necessary because of its rapid spread and substantial impact on the international trade of animals and animal products.

Transmission

Foot and mouth disease virus is spread via contact and fomites (including contaminated inanimate objects and people moving between infected and uninfected animals). Inhalation and ingestion are routes of infection. Outbreaks may originate in swine herds fed raw garbage containing infected meat, and are usually propagated by the transport of infected animals to markets or new locations. Introduction of an infected animal to a susceptible herd or insemination of a susceptible cow with infected semen may also initiate outbreaks.

Airborne transmission has been reported, and cattle may be more susceptible to this route of infection. Dispersion of airborne viruses is influenced by weather conditions.

The incubation period is usually two to five days, but may be longer in sheep and goats. The disease is highly contagious and infectious. Cattle may shed the virus for four or more days before clinical

signs are observed. Swine shed larger quantities of virus once infected, and may be responsible for amplifying infection in other species. Infected animals will shed the virus in secretions and excretions for three to four days during the acute phase of the disease.

Clinical Signs

Affected animals develop vesicular lesions of the tongue, dental pad, gums, cheek, hard and soft palates, lips, nostrils, muzzle, interdigital space (between the hooves), and on the coronary band. In affected ruminants, vesicular lesions may be observed on the udder and teats. Lesions may be observed on the snout of affected swine. Excessive salivation is often the first observed clinical sign; the saliva is sticky, foamy, and stringy in consistency. A transient, high fever may be observed. Over a period of seven to 14 days, the vesicles break, erode, ulcerate, then heal. Abortions may also occur. Marked loss of condition is often observed because of reduced feed consumption secondary to oral pain. Milk production may be markedly decreased. The malignant form may produce myocardial degeneration and death in calves. Lameness and reluctance to move may be observed. A carrier state is possible in recovered ruminants, but plays an unknown role in transmission of the virus.

Clinical signs may be more subtle in sheep and goats, resulting in delayed recognition that may increase the risk of spread of the outbreak. Lameness is often the first observed clinical sign of FMD, and the vesicles may be more difficult to recognize. Up to 25% of affected sheep may not develop clinically apparent vesicles, and others may only develop a single lesion or develop vesicles that are visible for less than three days.

Human infection with FMDV is rare. Clinical signs include vesicular lesions on the hands, feet, and in the mouth.

Other diseases that produce clinical signs similar to FMD in cattle and small ruminants include vesicular stomatitis (VS), bluetongue, rinderpest, infectious bovine rhinotracheitis, bovine viral diarrhea, sheeppox, goatpox, sore mouth, and foot rot. Vesicular stomatitis and FMD are clinically indistinguishable in ruminants. Vesicular exanthema of swine and swine vesicular disease are clinically indistinguishable from FMD in swine. Clinical signs similar to FMD can also be caused by trauma to the oral mucosa from objects in livestock feed such as weed awns or thistles.

Diagnosis

A tentative diagnosis of FMD is made based on clinical signs, but distinguishing FMD from VS is not possible based on clinical signs. Diagnosis can be confirmed by detection of the virus in samples from affected tissues or esophageal-pharyngeal fluid. Laboratory methods to confirm FMD include enzyme-linked immunosorbent assay (ELISA), complement fixation, virus isolation, virus neutralization, mouse inoculation, cell culture, and polymerase chain reaction (PCR).

Treatment

Foot and mouth disease is a reportable disease. State or Federal animal health officials should be immediately notified when vesicular disease is observed.

There is no treatment for FMD. Strict quarantine and slaughter methods are employed to control outbreaks. Vaccination may also be used to control outbreaks. Infected, recovered, and FMD-susceptible contact animals are slaughtered, and carcasses, bedding, and all animal products in the affected area are destroyed. Vaccinated animals may be killed and destroyed, or slaughtered with salvage of the meat under supervised procedures.

Recovery from uncomplicated FMD is relatively rapid, but the virus can persist in the pharyngeal tissues. Permanent reduction in productivity has been observed following recovery from acute FMD infection.

Morbidity and Mortality

Morbidity of FMD approaches 100%, but the case fatality rate usually does not exceed 5%. Higher fatality rates (approaching 90%) are observed in young animals.

Prevention and Control

A cell culture-origin vaccine is available, but must be matched to both the type and subtype of virus involved in the affected region. Vaccinated animals develop protection against clinical signs of FMD within seven to eight days. In the face of an outbreak, the use of interferon is being researched to bridge the gap in protection before vaccination is effective. Vaccination can be instituted to create a barrier of protected animals between infected and susceptible animals. Vaccination complicates diagnosis of FMD (although tests are being developed that differentiate vaccinated from infected animals), and may increase the risk of subclinical infection and subsequent outbreak but the level of risk is unknown. Rarely, vaccination may result in an outbreak if the vaccines are not properly manufactured.

Prohibition of importation of live ruminants and swine and their products from FMD-affected countries is paramount to preventing outbreaks. Travelers returning from FMD-affected countries are advised to avoid contact with livestock, zoo animals, or wildlife for a minimum of five days.