

FOOT AND MOUTH DISEASE

AETIOLOGY

Classification of the causative agent

A virus of the family Picornaviridae, genus *Aphthovirus*. Seven immunologically distinct serotypes: A, O, C, SAT1, SAT2, SAT3, and Asia1 which do not confer cross immunity. Mutation from error-prone RNA replication, recombination, and host selection generate constant new FMDV variants.

Resistance to physical and chemical action

Temperature: Preserved by refrigeration and freezing. Progressively inactivated by temperatures above 50°C. Heating meat to a minimum core temperature of 70°C for at least 30 minutes inactivates the virus.

pH: Quickly inactivated by pH <6.0 or >9.0.

Disinfectants: Inactivated by sodium hydroxide (2%), sodium carbonate (4%), citric acid (0.2%), acetic acid (2%), sodium hypochlorite (3%), potassium peroxymonosulfate/sodium chloride (1%), and chlorine dioxide. Resistant to iodophores, quaternary ammonium compounds, and phenol, especially in the presence of organic matter.

Survival: Survives in lymph nodes and bone marrow at neutral pH, but destroyed in muscle at pH <6.0 i.e. after *rigor mortis*. Survives in frozen bone marrow or lymph nodes. Residual virus survives in milk and milk products during regular pasteurisation, but is inactivated by ultra high-temperature pasteurisation. Survives drying but may persist for days to weeks in organic matter under moist and cool temperatures. Can persist in contaminated fodder and the environment for up to 1 month, depending on the temperature and pH conditions.

EPIDEMIOLOGY

- One of the most contagious animal diseases, with important economic losses
- Low mortality rate in adult animals, but often high mortality in young due to myocarditis
- Cattle are usually the main host, although some strains appear to be specifically adapted to domestic pigs or sheep and goats
- Wildlife, other than African buffalo (*Syncerus caffer*) in Africa, has not so far been shown to maintain FMD viruses
- Evidence indicates that infection of deer in the past was derived from contact, direct or indirect, with infected domestic animals

Hosts

- All domestic cloven-hoofed animals are susceptible, including cattle, pigs, sheep, goats, and buffalo
- All wild cloven-hoofed animals are also susceptible, including deer, antelope, wild pigs, elephant, giraffe, and camelids
- Old World camels may be resistant to natural infection with some strains and South American camelids such as alpacas and llamas are mildly susceptible, but are probably of no epidemiologic significance
- African buffalo are the only wildlife species to play a significant role in the epidemiology of FMD
- Strains of FMD virus that infect cattle have been isolated from wild pigs and deer
- Capybaras and possibly hedgehogs are susceptible. Rats, mice, guinea pigs and armadillos can be infected experimentally

Transmission

- Direct contact between infected and susceptible animals
- Direct contact of susceptible animals with contaminated inanimate objects (hands, footwear, clothing, vehicles, etc.)
- Consumption (primarily by pigs) of untreated contaminated meat products (swill feeding).

- Ingestion of contaminated milk (by calves)
- Artificial insemination with contaminated semen
- Inhalation of infectious aerosols
- Airborne, especially temperate zones (up to 60 km overland and 300 km by sea)
- Humans can harbour FMDV in their respiratory tract for 24±48 hours, leading to the common practice of 3-5 days of personal quarantine for personnel exposed in research facilities
- During an active outbreak, this may be reduced to an overnight period of time after thorough shower and shampoo, change of clothing, and expectoration

Sources of virus

- Incubating and clinically affected animals
- Breath, saliva, faeces, and urine; milk and semen (up to 4 days before clinical signs)
- Meat and by-products in which pH has remained above 6.0
- Carriers: recovered or vaccinated and exposed animals in which FMDV persists in the oropharynx for more than 28 days
- The rates of carriers in cattle vary from 15±50%
- The carrier state in cattle usually does not persist for more than 6 months, although in a small proportion it may last up to 3 years
- Domestic buffalo, sheep and goats do not usually carry FMD viruses for more than a few months; African buffalo are the major maintenance host of SAT serotypes, and may harbour the virus for at least 5 years
- Circumstantial field evidence indicates that on rare occasions carriers may transmit infection to susceptible animals of close contact: the mechanism involved is unknown

Occurrence

FMD is endemic in parts of Asia, Africa, the Middle East and South America (sporadic outbreaks in free areas).

DIAGNOSIS

Incubation period is 2±14 days. For the purposes of the OIE *Terrestrial Animal Health Code*, the incubation period for FMD is 14 days.

Clinical diagnosis

The severity of clinical signs varies with the strain of virus, exposure dose, age and breed of animal, host species, and degree of host immunity. Signs can range from mild or inapparent to severe. Morbidity may approach 100%. Mortality in general is low in adult animals (1±5%) but higher in young calves, lambs and piglets (20% or higher). Recovery in uncomplicated cases is usually about two weeks.

Cattle

- Pyrexia, anorexia, shivering, reduction in milk production for 2±3 days, then
 - smacking of the lips, grinding of the teeth, drooling, lameness, stamping or kicking of the feet: caused by vesicles (aphthae) on buccal and nasal mucous membranes and/or between the claws and coronary band
 - after 24 hours: rupture of vesicles leaving erosions
 - vesicles can also occur on the mammary glands
- Recovery generally occurs within 8±15 days
- Complications: tongue erosions, superinfection of lesions, hoof deformation, mastitis and permanent impairment of milk production, myocarditis, abortion, permanent loss of weight, and loss of heat control (panters).
- Death of young animals from myocarditis

Sheep and goats

- Pyrexia. Lameness and oral lesions are often mild
- Foot lesions along the coronary band or interdigital spaces may go unrecognised, as may lesions on the dental pad
- Agalactia in milking sheep and goats is a feature. Death of young stock may occur without clinical signs

Pigs

- Pyrexia
- May develop severe foot lesions and lameness with detachment of the claw horn, particularly when housed on concrete
- Vesicles often occur at pressure points on the limbs, especially along the carpus ('knuckling')
- Vesicular lesions on the snout and dry lesions on the tongue may occur. High mortality in piglets is a frequent occurrence

Lesions

- Vesicles or blisters on the tongue, dental pad, gums, cheek, hard and soft palate, lips, nostrils, muzzle, coronary bands, teats, udder, snout of pigs, corium of dewclaws and interdigital spaces
- Erosions on rumen pillars at post mortem. Gray or yellow streaking in the heart from degeneration and necrosis of the myocardium in young animals of all species ('tiger heart')

The OIE periodically update Technical Disease Cards. Please send relevant new references and proposed modifications to the OIE Scientific and Technical Department (scientific.dept@oie.int). Last updated April 2013