

Foot and Mouth Disease (FMD) [etiology, transmission, clinical signs, diagnosis, treatment and control]

Synonym

- Aphthous fever, Epizootic apthae, Aftosa, Fast Moving Disease

Introduction

- Foot and Mouth Disease (FMD) is an acute, febrile, highly contagious disease of almost all cloven-hoofed animals characterized by the formation of vesicles (fluid-filled blisters) and erosions in the mouth, nose, teats, and feet with high morbidity and low mortality.

Etiology

- The causative agent is Aphthovirus, which is an infectious, positive sense, ss-RNA virus. There are 7 serotypes of the virus: Types O, A, C, South African Territories 1, 2, and 3 (SAT-1, -2, -3) and Asia-1. Large numbers of subtypes were also identified.
- In our country only four major serotypes, O, A, C, and Asia 1 are known to occur. Among which A 22, A5 & A 10 subtypes are more commonly occur.
- Infection with one serotype does not confer immunity against another. This disease occurs naturally in cloven-hoofed animals (Both domestic and wild animals).
- Cattle are most susceptible followed by pigs and the disease is rare in sheep and goats. Several wildlife species including African buffalo, elephants, hedgehogs, deer, and antelopes are also susceptible. A man may contract the disease with mild symptoms such as vesicles on the hand.
- Horse is refractory to Foot and Mouth Disease virus (FMDV) infection.

Transmission

- The healthy animals are infected by contact with the secretions and excretions of the FMD affected animals.
- The main route of transmission is by inhalation and aerosol route. In addition to inhalation, the transmission also occurs by direct or indirect contact with infected animals such as through abraded skin, conjunctiva, ingestion of contaminated garbage,

inoculation with contaminated vaccines, and insemination. Mechanical transmission may also occur with wild animals, birds, and other non-susceptible domestic animals.

Clinical signs

- Incubation period is 2 days to 3 weeks. (In pigs, the incubation period is as short as 1-3 days).

Cattle

- The onset is heralded by a precipitate fall in milk yield and a high fever (40-41 °C) accompanied by loss of appetite, depression. This is followed by the appearance of painful stomatitis and the temperature subsides.
- There is profuse salivation, the saliva hanging in long, ropy strings, a characteristic smacking of the lips, and the animal chews carefully.
- Vesicles and bullae (1-2 cm in diameter) appear on the buccal mucosa, dental pad, udder, and tongue.
- The vesicles that are thinly walled contain a straw-colored fluid. Vesicles rupture within 24hrs, leaving a raw painful surface, which heals in about 1 week.
- Vesicles appear on the feet, particularly in the clefts and on the coronet.
- The lesions on the tongue often heal within a few days but those on the feet and nasal cavities are contaminated with bacteria, maggots, which result in lameness and mucopurulent discharge.
- Vesicles may also develop on the teats, which results in severe mastitis. The virus does not cross the placenta but the abortion mostly during the second trimester of pregnancy is mainly due to fever. Morbidity is high (reaches 100%) and mortality is very low (less than 2%). Due to myocarditis the mortality in young calves up to 6 months of age, is very high.
- A sequel to FMD in cattle due to endocrine damage, is a chronic syndrome of dyspnea, deleterious effects on testes causing the production of poor quality of semen, anemia, overgrowth of hair, and lack of heat tolerance described as 'panting'.

Sheep and goats

- The pronounced clinical sign is sudden and acute lameness.
- The vesicles develop in the inter-digital space of the feet, which rupture in about 2-3 days. Sometimes, the upper layer of the hoof is lost. Oral lesions are rare or they may develop only on the tongue and upper palate but there is no salivation.

Pigs

- Large vesicles and bullae occur in the snout and feet and these may rupture to expose the large raw surface.
- Lameness is the first sign. The foot lesions are very painful. Vesicles in the mouth are very less prominent.

DIAGNOSIS

- The highly contagious nature of the disease, profuse salivation and the presence of typically raised vesicles with blanched covering epithelium filled with a clear straw color fluid is usually pathognomonic.

Samples to be collected

- Vesicular fluids
- Epithelial fragments of recent vesicles especially from lesions of tongue, feet, udder, or lips of about 1gm
- Recently dead animals - pieces of cardiac muscle and pancreas
- Transport medium-The samples should be kept in a solution of phosphate buffer saline at pH 7.6 which contains equal parts of glycerol and 0.00196 phenol red indicator.
- The outside of the container should be disinfected with 4% Na₂ Co₃ or 0.2% citric acid.
- The container is wrapped with cotton wool and kept in a sealed fluid-tight container packed in a strong outer box of wood and sent to the lab.

By Serological tests

- Complement fixation test (CFT) is the most commonly used and important test to identify the type of virus. The suspension of the original serum is used as the antibody.

- Virus and serum neutralization tests may be used to detect specific antibodies in the serum of recovered animals or for identifying the causative virus.
- The test is done with known hyperimmune sera
- Gel diffusion test, Fluorescent Antibody Test (FAT), Immunoperoxidase test (IPT), and Isoelectric focusing are also useful
- Enzyme-Linked Immunosorbent Assay (ELISA) and Polymerase Chain Reaction (PCR) are now standard methods for virus detection and typing in reference laboratories

Cell culture

- The virus grows very well in cell cultures.
- The cell cultures that are commonly used are primary bovine tongue epithelium or bovine thyroid cells, primary pig kidney, calf kidney, and lamb kidney cells.
- Cell lines such as Baby Hamster Kidney-21 (BHK-21) and IB-RS-2 cells are highly suitable. Most strains of the virus multiply to produce a cytopathic effect within 24-48 hrs. This virus is highly cytolytic. Guinea pigs, suckling mice, hamsters, and rabbits are used as experimental animals. Some strains grow in embryonated eggs (14 days old). The route is the chorioallantoic membrane or intravenous route.
- Monolayers of bovine thyroid or pig kidney cells are inoculated and CPE develops within 24-48 hours at 37°C.

Mouse inoculation

- The suspected material is inoculated in unweaned mice and the mice die within 1-7 days.

Cross immunity

- For accurate identification inoculation of groups of susceptible and immune cattle are used.

CONTROL

1. Spread by airborne route is very difficult to control. Control of movement of livestock is one of the effective measures.

2. Where the disease is not endemic the policy of quarantine, slaughter, and disinfection of infected premises has proved efficient and economical also.
3. Slaughter of infected animals stops the production of virus and slaughter of animals in direct or indirect contact with the source of infection breaks the infective chain.
4. This is an economic method only in countries where disease incidence is low. In other countries, it may not be economically or socially acceptable and their vaccination is carried out.
5. Where the disease is not endemic the policy of quarantine, slaughter, and disinfection of infected premises has proved efficient and economical.
6. Inactivated vaccines containing serotypes predominant in the geographical areas are available commercially.
7. Vaccines may be monovalent, bivalent, trivalent or polyvalent.
8. To establish a satisfactory level of immunity it is usual to give a primary course of two inoculations, 2-4 weeks apart, followed by revaccination every 4-12 months.
9. In young animals maternal antibodies may last for 3-6 months and can interfere with immunization.
10. To avoid a gap in protection, countries recommend first vaccination at ages ranging from 2-6 months.
11. For calves usually first vaccination is given at the age of 4 months, followed by a booster at 2-4 weeks intervals, revaccination every 6 months, or 4-12 months once.
12. Sheep and pigs vaccinated at 6 months of age. The dosage of the vaccine in sheep is one-third of that of cattle.
13. The first vaccination leads to immunity in ruminants for about 3-6 months. Subsequent vaccinations may give protection for a year in cattle but only about 6 months in sheep.
14. In the areas where the greatest risk of infection is likely, ruminants are vaccinated three times a year. With a medium risk, animals are vaccinated twice a year.
15. In countries where the infection is low ruminants are vaccinated twice the first year and subsequently annually. The choice of strains of FMDV to use in the vaccine is important.