FOOT-AND-MOUTH DISEASE: AN OVERVIEW

BURUNDI FMD TRAINING

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OVERVIEW

- Introduction
- Aetiology
- Properties of the virus
- History
- Economic Impact
- Transmission
- Clinical Signs
- Diagnosis and Treatment
- Prevention and Control
FMD is an extremely acute, highly contagious viral disease of both domesticated and wild cloven-hoofed animals characterized by fever and vesicular eruptions in the mouth, nares, muzzle, feet and on the mammary glands which later become erosions.

This leads to lameness, salivation and unwillingness to feed, high fever, and sometimes a fatal myocarditis in juveniles.

It is associated with productivity losses like reduced milk production, loss of weight and sometimes death of young stock.

It also poses a serious problem for commercial trade with FMD-free countries.
AETIOLOGY

- The causative agent of FMD is Foot and Mouth Disease Virus (FMDV)
- **Family** Picornaviridae and **genus** Aphthovirus.

- **Size**: Small non-enveloped 27 nm virus, genome consists of a single stranded positive sense RNA
- **Shape**: Roughly spherical exhibiting icosahedral symmetry
- Virion consist of 70% protein and 30% RNA and small quantity of lipids
- Globally, there are **seven** immunologically distinct serotypes of FMDV: O (Oise), A (Allemagne), C (Island Riems), SAT1, SAT2 and SAT3 (South African Territories) and ASIA-1
- Within each one of these serotypes, there are a large number of strains
- No cross protection at all between serotypes, therefore recovery from one or vaccination against one serotype does not confer immunity against another or may not confer immunity within the same serotype
PROPERTIES OF THE VIRUS

- Highly contagious
- Inactivated at a pH below 6.5 or above 9 (acidic or very basic conditions).
- The pH drop that occurs in muscle tissue post-mortem will inactivate the virus.
- Can survive in milk and milk products, frozen bone marrow, and lymph glands with stability increasing at lower temperatures.
- It can remain active on surfaces for days to weeks and survives drying if it is in serum.
DISINFECTION

- Effective solutions include
  - 2% sodium hydroxide (lye)
  - 4% sodium bicarbonate (soda ash)
  - 5.25% sodium hypochlorite (household bleach)
  - 0.2% citric acid

- Areas must be free of organic matter
FMD VIRUS
HISTORY OF FOOT-AND-MOUTH DISEASE

- The first written description of FMD occurred in 1514, when Fracastorius described a similar disease of cattle in Italy.
- About 400 years later, 1897, Loeffler and Frosch demonstrated that a filterable agent caused FMD (The first demonstration that a disease of animals was caused by a filterable agent and ushered in the era of virology).
- In the past the importance of FMD was not recognized by livestock owners since the acute phase of the disease last only a short time and mortality is low.
- Its only at the beginning of the last century that full economic importance of the disease received proper consideration.
Its endemic in South America, Africa, Asia and parts of Europe.

New Zealand has never had FMD, the disease appeared in Japan in year 2000 after 92 years of absence, UK after 24 years absence it emerged in 2001 and 2007. Australia has been free for over 100 years and North American continent free since 1953.
GEOGRAPHICAL DISTRIBUTION

- O.I.E reports indicate worldwide distribution and with exception of New-Zealand outbreaks have been reported in almost every livestock containing region of the world.
- The disease is currently enzootic in all continents except Australia and North America.
- Africa harbours almost all the serotypes except Asia 1.
- These serotypes show some regionality, and the O serotype is most common.
GLOBAL DISTRIBUTION MAP
Countries recognised by the OIE as foot and mouth disease free countries where vaccination is not practised
(According to the provisions of Chapter 2.1.1 of the OIE International Animal Health Code)
ECONOMIC IMPORTANCE (1)

- FMD ranks highly among the most economically devastating animal diseases in the world
- Direct losses include loss of milk production, loss of cart power, growth retardation, abortion in pregnant animals and death in calves piglets and lambs
- Indirect losses are attributed to the disruption of trade of animals and their products
- Taiwan had been free from FMD for 68 years in 1997 but an outbreak led to slaughter of 38% of pig population estimated at U.S. $ 6 billion and loss of disease free status thus loss of pork export market.
- In the year 2000 outbreak in South Korea having been free for 100 years, the disease appeared in Japan in year 2000 after 92 years of absence, UK after 24 years absence it emerged in 2001 and again 2007
- All these outbreaks were related on sequencing and so was the outbreak in South Africa in 2000- caused by Pan –Asian type O.
- Pandemic spread to Great Britain in 2001 to Ireland, France and Netherlands losses were estimated at U.S. $ 29 billion.
- Mortality rates in adults are low but disease has debilitating effects while in young animals mortality is high.
ECONOMIC IMPACT (2)

- 1997 Taiwan outbreak roughly $15 billion.
- Great Britain outbreak of 2001 cost the country £3.1 billion,
- Most recently, Sept. 2007
- The 2001 outbreak was due to the pan-Asian type O which also caused outbreaks in Japan, South Korea, and South Africa countries which had been free from FMD for some years
- Worldwide concern as a biological weapon
- Terrorist attacks in the US - possibility they can target the $100 billion/year U.S. livestock industry using FMDV.
HOST RANGE

- The virus affects more than 70 species of cloven-hoofed animals both domesticated and wild.

- These include cattle, pigs, sheep, goats and wild animals such as buffalos, deer and antelopes.

- Cattle and pigs are more susceptible and show greater severity of signs than sheep and goats.

- Though FMD is believed to be zoonotic very few cases of human infections have been described—usually mild short-lived and self-limiting disease. If and when they occur are associated with severe epidemics and contact with infected animals or animal products.
TRANSMISSION AND PATHOGENESIS

- FMDV is spread either direct or indirect.
- Direct by contact between animals excreting the virus and susceptible animals.
- Infrequently indirectly by objects or materials contaminated with virus containing secretions, excretions and tissues or by animal products such as milk or by air currents in which virus containing aerosols are suspended.
- Airborne, especially temperate zones (up to 60 km overland and 300 km by sea)
- People, animals, vehicles and birds may serve as mechanical transmitters of infection
- Domestic pigs are the most efficient excretors of FMDV into the environment
- Incubation period 3-14 days
- Acquisition of infection other than in pigs in which it is generally oral usually occurs by inhalation
- Initial virus multiplication occurs mainly in pharyngeal area of the throat and lungs
## ANIMAL TRANSMISSION

<table>
<thead>
<tr>
<th>Species</th>
<th>Host</th>
<th>Carrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep Goats</td>
<td>Maintenance</td>
<td>Pharyngeal tissue 4-6 months</td>
</tr>
<tr>
<td>Pigs</td>
<td>Amplifier</td>
<td>No</td>
</tr>
<tr>
<td>Cattle</td>
<td>Indicator</td>
<td>Pharyngeal tissue 6-24 months</td>
</tr>
</tbody>
</table>
# Differential Diagnosis

<table>
<thead>
<tr>
<th>Clinical Signs by Species</th>
<th>Foot &amp; Mouth Disease</th>
<th>Vesicular Stomatitis</th>
<th>Swine Vesicular Disease</th>
<th>Vesicular Exanthema of Swine</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cattle</strong></td>
<td>Oral &amp; hoof lesions, salivation, drooling, lameness, abortions, death in young animals, &quot;panthers&quot;; <em>Disease Indicators</em></td>
<td>Vesicles in oral cavity, mammary glands, coronary bands, interdigital space</td>
<td>Not affected</td>
<td>Not affected</td>
</tr>
<tr>
<td><strong>Sheep &amp; Goats</strong></td>
<td>Mild signs if any; <em>Maintenance Hosts</em></td>
<td>Rarely show signs</td>
<td>Not affected</td>
<td>Not affected</td>
</tr>
<tr>
<td><strong>Horses, Donkeys, Mules</strong></td>
<td>Not affected</td>
<td>Most severe with oral and coronary band vesicles, drooling, rub mouths on objects, lameness</td>
<td>Not affected</td>
<td>Not affected</td>
</tr>
</tbody>
</table>
CLINICAL SIGNS - CATTLE

- After an incubation period of 2-8 days there is fever, loss of appetite, depression and a marked reduction in milk production.
- Within 24 hrs drooling of saliva commences vesicles develop on the tongue and gums.
CATTLE CONT...

- Animal may open and close mouth in a characteristic smacking sound and teeth grinding
- Vesicles may also be found in the inter-digital skin and coronary band of feet and the teats.
- Lameness, disinclination to stand, serous nasal discharge
Morbidity is high and young calves up to 6 months of age may die before the appearance of clinical signs due to virus infection of the developing heart muscle and the production of a severe myocarditis.

However, most animals recover within two weeks (8-15 days).

Mortality in adults is low but cattle may abort as a consequence of fever.

Affected animals become non productive or poorly productive for a long period of time.

Complications: tongue erosions, superinfection of lesions, hoof deformation, mastitis and permanent impairment of milk production, myocarditis, abortion, death of young animals, permanent loss of weight, loss of heat control ('panters')
LESIONS

- Appear particularly at the tip and/or the dorsal surface of the tongue and on the feet (not invariable)

- May occur on the lips, gums, dental pad, hard palate and even muzzle. Unusual on the ventral part of tongue thus distinguishing FMD from Rinderpest

- On the teats and mammary gland of female animals

- Myocarditis and heart muscle necrosis in juveniles which appears grossly as whitened streak-like areas
LESIONS

- Vesicles soon rupture producing large denuded ulcerative lesions.

- Those on the tongue heal within a few days but those on the feet and in the nasal cavities often become secondarily infected with bacteria resulting in lameness and mucopurulent nasal discharge.
MOUTH LESIONS
FOOT LESIONS
SWINE

- Lameness often the first sign
- May develop severe foot lesions that may be sufficiently painful to prevent the pig from standing particularly when housed on concrete.
- Denuded areas infected with bacteria - suppuration and some cases loss of claw and prolonged lameness
- Vesicles in mouth less common than in cattle although large vesicles develop on the snout which quickly rupture.
- High mortality in piglets a frequent occurrence
SWINE FOOT LESION
Usually the clinical disease is milder than in cattle.

Foot lesions may go unrecognised.

Lesions in dental pad of sheep.

Agalactia in milking sheep and goats is a feature and death of young stock.
CONTROL OF FOOT-AND –MOUTH DISEASE

- In developing countries, control by eradication too costly, hence, in most of African countries FMD control is mainly through **regular vaccination** in conjunction with the **control of animal movement**.

- the vaccines used must contain the representative strains of the serotype in circulation

- Vaccines used world wide are inactivated with aziride compounds usually binary ethyleneimine (BEI) and adjuvunated with aluminium hydroxide and saponin. This works well for ruminants and not pigs

- Pig vaccines use oil-based adjuvants

- Mass vaccination campaigns usually involve a bi-annual or annual vaccination and more regularly where there’s higher turnover of animals e.g pig farms
END

Thank you