

Foot and Mouth Disease- A Brief Review

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Running Title: Review of Foot and Mouth Disease

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Summary

Foot-and-mouth disease (FMD) is a noteworthy restraint to global trade in live animals and animal products. The most significant features of the epidemiology of the disease are the rapid growth of the virus, its stability under diverse conditions and the survival of asymptomatic carriers. There are 7 immunologically distinct serotypes of FMD virus. Vaccination against FMD is a key element in the control of the disease in addition to slaughter and movement restrictions. The review approaches the epidemiology, pathogenesis and control of FMD.

Keywords: Foot-and-mouth disease, FMD diagnosis; FMD pathogenesis, FMD virus.

1. Introduction

Foot-and-mouth disease (FMD) is a highly frightful viral disease of the cloven-hoofed animals and considered as a serious threat to the livestock production worldwide (Rodriguez and Gay, 2011; Verma et al., 2012a; Ding et al., 2013; Xu et al., 2013). The main apprehension of many countries is to prevent the introduction of the virus and to rapidly eradicate it should an outbreak occur. A critical problem in this respect is the episode of carrier animals and the risk they pose in transmitting the virus (Alexandersen et al., 2002; Anderson, 1986; McVicar and Suttmoller, 1969; Salt, 1994, Moonen, 2004). It has been documented as a considerable epidemic disease threatening the cattle industry since the sixteenth century and till date it is a major international animal health problem (Neeta et al., 2011). FMD usually involves mortality rates below 5%, but still so it is considered the most important disease of farm animals since it causes huge losses in terms of livestock productivity and industry. Although FMDV rarely causes death in adult animals, the virus can cause severe lesion in the myocardium of young animals, leading to high mortality rates (Domingo et al., 1999; Woodbury E. L, 1995; Sharma P. K. and Das, 1984; Neeta et al., 2011).

2. Foot and Mouth Disease:

2.1. The virus

FMDV belongs to the genus Aphthovirus in the family Picornaviridae and possesses a single strand of positive-sense, non -enveloped RNA genome having 22 to 30 nm diameter. It has a high mutation rate because the viral RNA-dependent RNA polymerase lacks proofreading ability, (Gelagay, 2009). There are 7 immunologically distinct serotypes of FMD virus: FMDV-A, FMDV-O, FMDV-C, FMDV-ASIA1, FMDV-SAT1, FMDV-SAT2, and FMDV-SAT3. Also, more than 60 subtypes of the virus exist (AVMA, 2008). The FMD is considered as a notifiable disease of animals as per World Organization for Animal Health (Office International des Epizooties (OIE) because of its high rate of transmissibility and imposition of international trade restrictions (Kumar et al., 2011). In young calves, lambs, kids, and piglets FMDV-induced myocardial demolish may lead to death prior to development of any vesicle (Singh et al., 1992; Chakraborty et al., 2014). The genome of FMDV, which is over 8000 bases in length, is covalently bound at its 5'-terminus to a 23/24 amino acid residue genome-linked protein, 3B (Jackson et al., 2003). The genome contains a single long open reading frame (ORF), that has two different initiation sites, and the encoded polyprotein can be practiced into over a dozen well- illustrated mature polypeptides as well as a variety of partial cleavage intermediates (Grubman et al., 1984; Robertson et al., 1985; Rueckert and Wimmer, 1984; Mason et al., 2003).

2.2. Transmission

The most frequent method of spread of FMD virus is by contact between an infected and a vulnerable animal. An infected animal produces a large amount of virus in exhaled breath, at the same time as cattle and sheep are particularly susceptible to infection by the aerosol route (Kitching et al., 2005). Foot and mouth disease (FMD) has been eradicated by many wealthy countries, but remains endemic in most of the world. When FMD outbreaks arise in disease free countries and zones that produce livestock for export the economic impact is clear to see; however, the impact of the disease in endemic countries is more controversial, mainly when compared to diseases that causes greater mortality (Knight and Rushton 2013).

2.3. Epidemiology and Distribution

The disease is enzootic in parts of Europe, Africa, the Middle East, India, the Far East and South America. North America, Australia, New Zealand and many countries in Western Europe are free of the disease and have stringent regulations preventing the introduction of the virus. The FMD was once prevalent all over the world, but strict control and eradication measures adopted by developing countries have resulted in its lower prevalence. Worldwide, 70 countries are officially recognized by the OIE as FMD free irrespective of

vaccination, while India along with around 100 other countries are still considered as endemic or sporadic zones (OIE, 2009).

2.4. Pathogenesis

Incubation period depends on the dose of the virus, portal of entry, animal husbandry practices and animal species involved (Alexandersen and Mowat, 2005); in cattle it varies from 2-14 days in pigs it is usually 2 days (or more) but can be even shorter (18-24 hours) and in sheep normally it is 3-8 days (Chakraborty et al., 2014). FMDV produces an acute, systemic vesicular disease, which requires a differential diagnosis from other vesicular diseases (Sutmoller P., 1992). In natural infection, the main route of virus entry is the respiratory tract. The initial virus multiplication usually takes place in the pharynx epithelium, producing primary vesicles, or “aphthae” (Burrows et al., 1981). The clinical outcome of the disease may vary among the host species considered and the infecting virus strain. In cattle and pigs, fever and viraemia usually start within 24–48 hour after epithelium infection, leading to viral spread into different organs and tissues and the production of secondary vesicles preferentially in the mouth and feet. The acute phase of disease lasts about 1 week and declines gradually coinciding with the emergence of a strong humoral response (Salt J. S., 1993). In sheep and goats, symptoms are frequently less severe and may make the detection of the disease difficult (Knowles et al., 2001).

2.5. Clinical Sign

The disease is more severe in cattle and pigs, but the sheep and the goats may even some time undergo undiagnosed. Anorexia and fever (up to 41°C) may develop in the cattle as well as in pigs. The clinical signs appear within 2 to 3 days after FMDV exposure and may last for 7-10 days. Fever and vesicles on the feet, between the toes as well as on the heels, around the mouth, particularly in lips as well as tongue and palate and on the mammary glands are noteworthy, but characteristic lesions are observed in interdigital space and coronary bands of hooves (Alexandersen et al., 2003; Teifke et al., 2012; Verma et al., 2012a; Yoon et al., 2012).

2.6. Treatment and control of the disease

There is no specific cure for foot and mouth disease. Depending on the clinical manifestations symptomatic treatment may be provided. Potassium permanganate mixed antiseptic mouth wash, sodium carbonate, boric acid and glycerin may be applied over the wound (Gakuya et al., 2011). There are two approaches to controlling or eradicating FMD: slaughter and vaccination (Zinna and Woking, 2002). FMD can be controlled successfully by vaccination. However, there are seven distinct serotypes (O, A, C, Asia 1, SAT 1, SAT 2 and SAT 3) and many subtypes have also been described (Grubman and Baxt, 2004; Doel T, 2003). Vaccination against one serotype produces little or no protection against other

serotypes. Thus, it is essential that the correct vaccine is chosen for the control of each outbreak (Graham et al., 2011).

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