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FOOT AND MOUTH DISEASE AS A ZOONOTIC EMERGING DISEASE OF LIVESTOCK WITH SPECIAL REFERENCE TO ITS PUBLIC HEALTH HAZARDS IN EGYPT (A REVIEW ARTICLE)

BY

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ABSTRACT

FMD (Foot-and-mouth disease) or hoof-and-mouth disease (Aphtae epizooticae) is an infectious and sometimes fatal (contagious) viral disease that affects cloven-hoofed animals including domestic and wild bovids. The virus causes a high fever for two or three days followed by blisters inside the mouth and on the feet that may rupture and cause lameness. Foot-and-mouth disease virus (FMDV) is one of the most contagious viruses of animals and is recognized as the most important constraint to international trade in animals and animal products **(Kwatra, et al. 1999).** Foot-and-mouth disease is a severe plague for animal farming since it is highly infectious and can be spread by infected animals through aerosols through contact with contaminated farming equipment, vehicles, clothing or feed and by domestic and wild predators **(Martinez-Salas, et al. (2008).** Two fundamental problems remain to be understood before more effective control measures can be put in place. These problems are the FMDV (carrier state) and the short duration of immunity after vaccination which contrasts with prolonged immunity after natural infection **(Hutber, et al. 1998).** Its containment demands considerable efforts in vaccination, strict monitoring, trade restrictions and quarantines and occasionally the elimination of millions of animals. Susceptible animals include cattle, water buffalo, sheep, goats, pigs, antelope, deer, and bison. It has also been known to infect hedgehogs, elephants, llama, and alpaca may develop mild symptoms, but are resistant to the disease and do not pass it on to others of the same species **(Murugavel and Veerapandian 1998).** In laboratory experiments, mice and rats and chickens have been

successfully infected by artificial means, but it is not believed that they would contract the disease under natural conditions. Humans are very rarely affected **(Reid,et al. 2003).**

History and Epidemiology of the Disease:

FMD occurs throughout much of the world and whilst some countries have been free of FMD for some time, its wide host range and rapid spread represent cause for international concern. FMD is a highly transmissible disease, and a limited number of infective particles can initiate host infection. Contaminated animal products, non-susceptible animals, agricultural tools, people, vehicles, and airborne transmission can contribute to the mechanical dissemination of FMDV. The epidemiology of FMD is complex, and it is affected by different viral, host, and environmental factors, among them, variations in virus virulence (severity of lesions, amount, and duration of virus release), particle stability in different microenvironments, and chances of long-term persistence. FMDV multiplication and spread also depend on the host species, nutritional and immunological status, population density, animal movements, and contacts between different domestic and wild host species and animals capable of mechanical dissemination of the virus. The environment can provide geographical barriers to virus dissemination or, alternatively, can promote virus transmission when appropriate atmospheric conditions prevail. In this multifactorial scenario, the high potential for FMDV variation and adaptation has modeled complex evolutionary patterns that are being revealed by molecular epidemiology analyses, mostly based on nucleotide sequencing of capsid protein genes.

Geographic Distribution:

Foot-and-mouth disease is endemic in parts of Asia, Africa, the Middle East and South America. In parts of Africa, virus persistence in wild African buffalo makes eradication unfeasible. North America, New Zealand, Australia, Greenland, Iceland and most of Europe are free of this disease. Sporadic outbreaks have occurred in disease-free countries, with the exception of New Zealand, Greenland, Iceland and the smaller islands of Oceania. The last U.S. outbreak occurred in 1929.

Etiology and Molecular Organization of the Virus:

The virus responsible for the disease is a picornavirus, the prototypic member of the genus Aphthovirus. Infection occurs when the virus particle is taken into a cell of the host. The cell is then forced to manufacture thousands of copies of the virus, and eventually bursts,

releasing the new particles in the blood. The virus is highly variable which limits the effectiveness of vaccination. Foot-and-mouth disease (FMD) is perhaps the most infectious disease known to human and veterinary medicine. This article is written with the practitioner in mind, concentrating on early recognition, epidemiology, occurrence around the world, and sampling and diagnostic methods. The article stresses that there are numerous FMD viruses, and not all behave in a similar fashion. The practitioner must be acute in his or her herd inspection of animals in which vesicular disease is suspected and knowledgeable as to differential diagnosis **(Bahnemann 1975).** There are at least 7 genotypes of serotype Asia 1. **(McKERCHER, et al. 1980).** The foot-and-mouth disease virus (FMDV) is a member of the genus *Aphthovirus* in the family Picornaviridae. There are seven immunologically distinct serotypes (O, A, C, SAT1, SAT2, SAT3 and Asia1 - and over 60 strains within these serotypes. New strains occasionally develop spontaneously. FMDV serotypes and strains vary within each geographic region. Serotype O is the most common serotype worldwide. Cross-protection against other strains varies with their antigenic similarity. Man's susceptibility to the virus of foot- and-mouth disease (FMD) was debated for many years. Today the virus has been isolated and typed (type O, followed by type C and rarely A) in more than 40 human cases. So no doubt remains that FMD is a zoonosis. Considering the high incidence of the disease (in animals) in the past and in some areas up to date, occurrence in man is quite rare **(Bauer 1997).** All reports before 1897, the year of the discovery of the virus of FMD by Loeffler and Frosch , were not of course confirmed either by isolation of the virus or by identification of immunoglobulins after infection. Nevertheless the successful self-infection reported by Hertwig in 1834 most likely seems to have been FMD in man: each of three veterinarians drank 250 ml of milk from infected cows on four consecutive days. The three men developed clinical manifestations. The diseases most often confused with FMD are infections with several viruses of the Coxsackie A group (this infection is referred to as "hand and mouth disease"), herpes simplex and sometimes vesicular stomatitis. Beginning in 1921 up to 1969 at least 38 papers were published, which described clinically manifest FMD in man in more than 40 proven cases. One further reported described an asymptomatic infection with FMD in man **Farag, et al. (1999).** Criteria for establishing a diagnosis of FMD in man are the isolation of the virus from the patient and/or identification of specific antibodies after infection. Laboratory tests for diagnosis of human FMD are the same as for animals. Proven cases of FMD in man have occurred in several countries in Europe, Africa and South America. The type of virus most frequently isolated man is type O followed by type C and

rarely A. The incubation period in man, although somewhat variable, has not been found to be less than two days and rarely more than six days **(Callis and Mckercher 1977).**

Transmission:

The foot-and-mouth disease virus can be transmitted in a number of ways, including close contact animal-to-animal spread, long-distance aerosol spread and fomites or inanimate objects, typically fodder and motor vehicles. The clothes and skin of animal handlers, such as farmers, standing water, and uncooked food scraps and feed supplements containing infected animal products can harbor the virus as well. Cows can also catch FMD from the semen of infected bulls. Control measures include quarantine and destruction of infected livestock, and export bans for meat and other animal products to countries not infected with the disease **(McKERCHER and CALLIS 1983).** Just as humans may spread the disease by carrying the virus on their clothes and bodies, animals that are not susceptible to the disease may still aid in spreading it. Some animals carry FMDV for prolonged periods after recovering from acute disease. Animals with natural or vaccine-induced immunity can also become carriers if they are later exposed to virus; these animals can remain asymptomatic. FMDV can persist for up to nine months in sheep and up to four months in goats. Most cattle carry this virus for six months or less, but some animals remain persistently infected for up to 3.5 years. Individual African buffalo have been shown to be carriers for at least five years, and the virus can persist in a herd of African buffalo for at least 24 years. There is limited information on the survival of FMDV in the environment, but most studies suggest that it remains viable, on average, for three months or less. In very cold climates, survival up to six months may be possible. Virus stability increases at lower temperatures; in cell culture medium at 4°C (39°F), this virus can remain viable for up to a year. It can also remain viable for approximately two months on wool at 4°C, with significantly decreased survival when the temperature increases to 18°C (64°F), and for 2 to 3 months in bovine feces. Organic material protects the virus from drying, and enhances its survival on fomites. Virus survival is also enhanced when FMDV is protected from sunlight. FMDV is inactivated at pH below 6.5 or above 11. This virus can persist in meat and other animal products when the pH remains above 6.0, but it is inactivated by acidification of muscles during rigor mortis. It can survive for long periods in chilled or frozen lymph nodes or bone marrow **(Burrows 1972).** In humans, FMDV may be carried in the nasal passages for a period of time. In one study, this virus was detected in the nasal passages of one of eight people 28 hours after exposure to

infected animals, and from none of the eight at 48 hours. More recent studies have found that FMDV is not transmitted by people when personal hygiene and biosecurity protocols are followed, and suggest that nasal carriage of the virus may be unimportant. The discrepancy between these studies remains to be resolved **(Burrows 1972).**

Incubation Period:

The incubation period for foot-and-mouth disease virus has a range between 2 and 12 days. In cattle, the incubation period varies from two to 14 days, depending on the dose of the virus and route of infection. In pigs, the incubation period is usually two days or more, but can be as short as 18-24 hours. The incubation period in sheep is usually 3 to 8 days. Incubation periods as short as 24 hours and as long as 12 days have been reported in this species after experimental infection **(Burrows 1972).**

Clinical Signs:

Foot-and-mouth disease is characterized by high fever that declines rapidly after two or three days; and vesicles (blisters) on the feet, in and around the mouth, and on the mammary gland. Occasionally, vesicles may occur at other locations including the vulva, prepuce or pressure points on the legs. Vesicles often rupture rapidly, becoming erosions. Pain and discomfort from the lesions leads to a variety of symptoms including depression, anorexia, excessive salivation, lameness and reluctance to move or rise. Lesions on the coronary band may cause. Blisters inside the mouth that lead to excessive secretion of stringy or foamy saliva and to drooling; and blisters on the feet that may rupture and cause lameness. Adult animals may suffer weight loss from which they do not recover for several months as well as swelling in the testicles of mature males, and in cows, milk production can decline significantly. Though most animals eventually recover from FMD, the disease can lead to myocarditis (inflammation of the heart muscle) and death, especially in newborn animals. Some infected animals remain asymptomatic, but they nonetheless carry FMD and can transmit it to others **(Burrows 1972).** Hand, foot and mouth disease is a common, mild illness caused by a type of virus called an enterovirus. It is usually caused by the coxsackie A virus, but in some cases can be caused by the coxsackie B or the enterovirus 71 virus. Hand, foot and mouth disease gets its name from the non-itchy rash that develops on the palms of your hands and soles of your feet. It can also cause ulcers in your mouth and make you feel generally unwell, although some people have no symptoms.

Foot-and-mouth disease infecting humans:

Humans can be infected with foot-and-mouth disease through contact with infected animals, but this is extremely rare. Some cases were caused by laboratory accidents. Because the virus that causes FMD is sensitive to stomach acid, it cannot spread to humans via consumption of infected meat, except in the mouth before the meat is swallowed. In the UK, the last confirmed human case occurred in 1966 **(McVICAR 1977 and Northumberland Report 1969)** and only a few other cases have been recorded in countries of continental Europe, Africa, and South America. Symptoms of FMD in humans include malaise, fever, vomiting, red ulcerative lesions (surface-eroding damaged spots) of the oral tissues, and sometimes vesicular lesions (small blisters) of the skin. According to a newspaper report, FMD killed two children in England in 1884, supposedly due to infected milk **(Obiaga 1986).** Another viral disease with similar symptoms, hand, foot and mouth disease, occurs more frequently in humans, especially in young children; the cause, Coxsackie A virus, is different from FMDV. Coxsackie viruses belong to the Enteroviruses within the Picornaviridae. Because FMD rarely infects humans, but spreads rapidly among animals, it is a much greater threat to the agriculture industry than to human health. Farmers around the world can lose huge amounts of money during a foot-and-mouth epizootic, when large amounts of animal capital is destroyed, and revenues from milk and meat production go down.

Vaccination:

Like other viruses, the FMD virus continually evolves and mutates, thus one of the difficulties in vaccinating against it is the huge variation between and even within serotypes. There is no cross-protection between serotypes (meaning that a vaccine for one serotype will not protect against any others) and in addition, two strains within a given serotype may have nucleotide sequences that differ by as much as 30% for a given gene. This means FMD vaccines must be highly specific to the strain involved. Vaccination only provides temporary immunity that lasts from months to years **(Doel TR. 2003).**

FMD SITUATION IN EGYPT AND LIBYA:

The current situation concerns the confirmation of foot and-mouth disease (FMD) serotype SAT2 outbreaks in both Libya and Egypt between February and March 2012. In addition to this, endemic serotypes A and O continue to circulate in both countries. This represents for Egypt the first report of outbreaks related to this serotype, while for Libya a re-

introduction of serotype SAT2 nine years since it was last reported in 2003. This is particularly critical given the large ruminant populations at risk in a region where SAT2 vaccination is not consistently used, and SAT1 entry to the Near-East in the 1960s, which resulted in spread over large areas and required international assistance for its containment to prevent spread to Europe and Asia. Libya officially confirmed outbreaks due to FMD serotype SAT2 to the OIE on 27 February 2012 in association with newly introduced feedlot cattle in Benghazi, Eastern Province. The results of genotyping of this current FMD strain indicate that the serotype is similar to that from a previous FMD outbreak in Sudan in 2007 and SAT2 viruses identified in Nigeria in 2007. In addition to SAT2, serotype O was also confirmed from samples collected in January 2012 **(Blaian and Callis 1991).**

CONCLUSION:

An outbreak of a foreign emerging animal disease such as FMD has serious, extensive and long-lasting consequences for the affected country's critical infrastructure. When FMD rapidly infected UK farms in 2001, various critical infrastructure sectors were required to dedicate funds, resources and extreme efforts to eradication activities. Transportation was affected when roads and footpaths were closed, road closures prevented utility companies from performing maintenance on facilities and assets. Since the FMD outbreak of 2001, affected sectors in the UK have worked to learn from the experience, which has served to strengthen the infrastructure from a similar outbreak in the future.

Recommendations:

Based on the review of the literature contained in this report and to prevent the accidental introduction of FMD into any country, the following measures (statements/recommendations) can be made:

- FMD should not be considered a public health concern. There is virtually no risk of infection to the general public should an outbreak occur in livestock.
- Current pasteurization methods using minimum required temperatures and times are sufficient to prevent human or animal infection with FMD as a result of consuming pasteurized milk.
- UHT methods eliminate the risk of infection, since studies have demonstrated the complete elimination of virus in milk using this technology.

- Risk communication messages may need to be designed differently based on the stakeholders addressed. Suggested stakeholders are discussed in the review.
- Avoid farms, sale barns, stockyards, animal laboratories, packing houses, zoos, fairs or other animal facilities for five days prior to travel.

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مرض الحمى القلاعية كمرض مشترك طارئ يصيب الماشية مع الإشارة إلي خطورته علي الصحة العامة في مصر

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** أستاذ الأمراض المشتركة بكلية الطب البيطري جامعة المنصورة – مصر

مرض الحمى القلاعية Foot and Mouth disease هـو مـرض فيروسـي شـديد العـدوى والانتـشار ويـصيب الأبقار والخنازير وأيضا الماعز والأغنام وحيوانات أخرى كالفيلة والفئران أما الخيول لا يصابوا بهذا المرض ومن الممكن أن يصيب الإنسان لأنه مرض مشترك. وهذه العدوى سببها تواجد الفيروس المسبب للمرض بكميـات كـبيرة جـدا في لعاب وبول وإفرازات المواشي المصابة ونتيجة لتواجد القطيع وبكميات كـبيرة في مكـان واحـد فـإن سـرعة انتـشار المرض تكون كبيرة جدا ويتميز هذا المرض بانتـشاره الجغـرافي الواسـع في العـالم. يـسبب مـرض الحمـى القلاعيـة فـيروس ذو حمـض نـــووي RNA أحـادي ذا شـحنة موجبـة يتبـع لجنـــس أفثوســفايرس Aphthosvirus مـن فـصيلة بكورنافيريدي Picornaviridae حجمه من ٢٥ إلى ٣٠ نانومتر. يوجـد من هـذا الفـيروس سـبعة أنواع مصـلية مصنفة مناعـيا إلى: Asie-1 , SAT-3 SAT-2 , SAT-1 , C , A , O وتظهر هذه الأنواع المصلية بصفات مختلفة حسب المناطق. كـذلك يوجـد أنواع فرعية (Subtypes) من هذا الفـيروس ففـي بيربرايـت (Pirbright) في بريطانيـا حيـث يوجد المركز الدولي لحفـظ الأنمـاط جمع حتى عام ١٩٧٣ أكثر من ١٤٠ نمط مختلف وصنف حتـى الآن أكثـر مـن ٦٠ نمطا فرعيا وتنتج هذه الأنماط العديدة بسبب الطفرات الجينية غير المحددة للفـيروس . وتنتقـل العـدوى عـن طريـق الرذاذ المحمل بالفيروس أو عن طريق الجماد الملوث بالفيروس من إفرازات الحيوانات المصابة (قئ أو لعـاب) أو عـن طريـق السائل المنوي وخاصة في الأبقار ويمكن أن تنقل الحيوانـات المفترسـة والأليفـة المـرض وهـي لا يظهـر عليهـا أعـراض واضحة للمرض فقط تحمل الفيروس كما يمكن للإنسان أن يساهم في نقل المرض من المنـاطق المـصابة إلى المنـاطق أخرى عن طريق حمل الفيروس على الملابس أو الجلد وهذا المرض يصيب الإنسان وهو عبارة عن أعراض مرضـية تظهـر على الأيدي والأرجل أحيانا وبالتالي نجد أن الفيروس (FMDV) قد يصيب الإنسان ولكن لا يظهر أي أعراض مرضية قوية كما في الحيوانات الأخرى