

Commentary

Eradication of foot-and-mouth disease: a foot in mouth proposition

Foot-and-mouth disease (FMD) is the most contagious disease of cloven-hoofed animals. The disease is highly infectious and is characterized by rapid transmission, a sequel to the rather explosive growth cycle of the causative virus, FMDV (an aphthovirus; Picornaviridae). As few as 10–25 virus particles can establish air-borne infection in domestic ruminants and pigs. The latter emit the greatest amounts of virus as aerosols. In unvaccinated herds mortality can be high, particularly in young cattle and pigs. Milk production ceases and animals used for traction can become useless. Internationally agreed policy dictates that once a country has adopted an eradication strategy, all animals on affected farms must be destroyed. In areas where the disease occurs, trade of livestock and animal products must be blocked, and a wide range of agricultural products may be banned from export to other countries.

FMDV is a positive strand RNA virus whose genomic RNA is embedded in 60 copies of each of the four viral structural proteins, VP1–4. The surface of the virus has several parts of VP1, VP2 and VP3 as revealed by monoclonal antibody binding studies and X-ray crystallography. The three capsid proteins have similar tertiary structures and form an eight-stranded *b*-barrel. Parts of the loops between the *b*-strands are exposed at the surface of the virus particle and contribute to the antigenic site. One of the loops in VP1, the so-called FMDV loop (residues 140–160), forms a major antigenic site. There are seven serotypes of FMDV: A, O, C, Asia 1 and the South African types SAT 1, 2 and 3. The classical European serotypes are types A, O and C which have spread to other continents, probably due to importation of European cattle. Serotype A viruses are the most variable viruses, having more than 30 subtypes. Some of them are strongly divergent and vaccines made against one subtype may only protect against the others after repeated vaccinations (Barteling and Vreeswijk 1991). Chemically inactivated and adjuvanted virus grown in cell culture (viral antigens) can be used to generate vaccines which induce sufficient levels of virus-neutralizing antibodies. The immunizing moiety in FMD vaccine is the intact 140S particle. Immunological protection against FMD correlates with the presence of antibodies in the serum which neutralize virus infectivity.

Since the end of 1960s, Western Europe has been virtually free of FMD. Occasional outbreaks have occurred locally. North and Central America, Australia, New Zealand, Japan, Indonesia and some Asian countries are free of the disease. FMD is still a major problem in West Asia, in Southeast Asia, in Africa and on the South American continent with the exception of Chile. In recent months, FMD has created havoc in Great Britain. According to information released by the UK Government in April 2001, the total number of animals slaughtered or identified as being for slaughter is around 1.2 million and more than 1000 animals have been confirmed to have the disease (MAFF; <http://www.maff.gov.uk>).

The magnitude of this mass slaughter of animals in the wake of an outbreak raises several issues. Firstly, there is nothing like 'total eradication' of any disease from a given country or region, if the virus is lurking in any form at any remote corner of the world. The virus movement could gain greater momentum with increased mobilities of people and speed of transportation of animals from endemic areas. Given the complexities of the evolution of RNA viruses and their survival strategies, the time has come now to question the policy of banning vaccination. The country which is opting to slaughter all suspected animals, a policy which could be termed 'inhuman', could have made a national policy of vaccination as the protection mechanism against FMD. However, vaccination is not a policy of any EU member state or the European Commission; the UK government too is not prepared to be removed from its so-called "disease-free status", which is just what vaccination would be taken to imply. The loss of disease-free status is expected to cripple exports currently worth more than 1.3 billion pounds per year.

This brings to focus the second influence on human logic – greed. Each developed nation competes with another for having an upper hand on the global market. The economics of world trade seems to be driving governments and policy makers to stop vaccination and declare their country free of a particular animal disease. Under these circumstances, it appears that new generation vaccines (without any virus particles) have to be developed and these have to totally protect vaccinated animals. This could eventually lead to the acceptance of emergency vaccination of susceptible animals instead of mass killing.

References

Barteling S J and Vreeswijk J 1991 Developments in foot-and-mouth disease vaccines; *Vaccine* **9** 75–88

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