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Popular Article

Challenges in the Eradication of FMD

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Abstract

The foot-and-mouth disease virus has a wide host range, seven serotypes, and over 100 serosubtypes, a high proportion of genetic variation, and significant antigenic changes. Cross protection is not present in this serotype. Additionally, only a limited level of cross protection between various subtypes within the same serotype is reported. Failure to vaccinate, a break in herd immunity, FMDV persistence in recovered animals, maternally derived antibody inhibition, and a short duration of protective immunity are all obstacles to FMD eradication.

Keywords: Carrier, FMD, Herd immunity, Serotype, Vaccine

Introduction

Foot and mouth disease (FMD) is a highly contagious disease that affects livestock and is caused by the genus Aphthovirus. It has a significant detrimental impact on farmers as well as the national economy. FMDV (family Picornaviride; genus Aphthoviridae) consists of seven immunologically unique serotypes: A, O, C, Asia 1, SAT 1, SAT 2, and SAT 3. India currently has a high prevalence of the serotypes O, A, and Asia 1. Serotype C has never been spotted in India since 1995, whereas SAT serotypes have not been found. Serotype O is most frequently responsible for outbreaks in countries in Southern Asia, followed by serotypes A and Asia 1. FMD is a persistent threat to India's 192.4 million cattle, causing annual losses of between 14,000 and 20,000 crores. Chemically inactivated vaccinations are more expensive to employ, which is a significant issue in developing nations. Additionally, using chemically weakened or killed vaccines does not tackle the problem of disease reservoirs in wild animals. India is currently on the FAO/OIE progressive control pathway at Stage 3 (PCP).

Problem in FMD Eradication

1. Failure to Vaccinate:

Due to administrative or technological reasons, a sizable segment of the populace is still unvaccinated despite vaccination initiatives. Lack of vaccination can occur for a number of reasons, such as a lack of vaccine availability, poor shipment of vaccines (a breach in the cold chain), a lack of skilled employees for vaccination, or a few animal owners' anti-vaccine attitudes.

2. Vaccination Failure:

After receiving recommended vaccination, if animal show clinical signs of FMD referred as vaccination failure. Even though vaccination failure is a rare occurrence. Following are the possible reason of vaccination failure.

a. Matching of Vaccine Strain with Circulating Virus:

To confer protective immunity against all strains of virus and understand the epidemiology of disease, vaccine strains should be antigenically close to circulating viruses. Variations in strain can prevent vaccination from providing protection against the divergent field strains because of the high pace of viral mutation. The vaccine strain must be antigenically related to the viruses that are currently circulating in order to provide protective protection.

b. Duration of Protective Immunity:

A primary round of immunization often provides protection for 4-6 months, depending on the vaccine's potency. Animals are therefore re-vaccinated based on the epidemiological state of the nation. It has been shown in India that rapid antibody degradation in immunized animals, particularly against serotype O, might result in a breach in herd immunity with an infection window at 5 to 6 months after immunization.

c. Break in the Herd Immunity:

When a substantial portion of a population develops immunity to an infection, herd immunity enables indirect protection from infectious disease, hence giving some level of protection for individual animals who are not immune. If we are unable to re-vaccinate susceptible animals after 4-6 months due to short-duration immunity, that means we are providing a window period for opportunistic pathogens. For the identification of low levels of herd immunity, we can use post-vaccination sero-monitoring of that area. The two key elements in achieving the appropriate degree of herd immunity towards FMD in the field are vaccine efficacy and vaccination coverage. During a vaccination drive, calves less than 4 months old and pregnant animals in the third trimester are not immunized. A decline in herd immunity could result in the dissemination of the virus infection due to the significantly longer FMD carrier status (>8 months) and the short duration of vaccination protection.

Gap Between an Ideal and a Conventional FMD Vaccine

S.No.	Feature	Ideal Vaccine	Traditional FMD Vaccine (Inactivated Vaccine)
1.	Long-lasting immunity	Yes	No, The inactivated vaccine provides only 4-6 months of protection.
2.	Sterile immunity	Yes	No, Only prevent from clinical infections
3.	Carrier status	No	Yes, animal become carrier after vaccination also
4.	Maintenance of the cold chain	No	Yes, Thermostability is an issue in the FMD vaccine
5.	Differentiated infected from vaccinated animal (DIVA)	Yes	Non-structural protein may be present in vaccine because purification is sometimes incomplete.
6.	Requirement of multiple doses	No	Yes, due to the short duration of immunity
7.	Multivalent and protects against serotypes, even subserotypes	Yes	No, lack of cross protection
7.	High level biosecurity is required for the formulation of vaccines	No	Yes, because due to handling of live virus
8.	Interference with maternal-derived antibody	No	Yes, young calves hamper vaccine efficacy due to the presence of maternal antibodies
9.	Safe	Yes	Vaccine may cause outbreaks due to incomplete inactivation
10.	Rapid onset of immune response	Yes	No, it will take time

d. FMDV Persistence in Recovered Animals:

Animals are regarded as FMDV carriers if they have shed the virus in oropharyngeal fluid for longer than 28 days following infection. In endemic situations with vaccination, the detection of antibodies against FMDV structural and non-structural proteins makes little sense because the serological profiles of carriers and infected animals are identical. Even on farms where animals have received vaccinations, a small fraction of animals may still be carriers, able to release FMDV into the surroundings

despite showing no signs of the disease.

e. Impaired Immune Response to Vaccine:

Animal species differ from one another and within their own families in their immunological reactions to inactivated FMD vaccinations, which could be attributed to a number of causes. It is challenging to design an appropriate laboratory model for the assessment of potency because various animals exhibit antibody diversification in fundamentally different ways.

f. Virus Circulation in Other Ruminant Species:

The FMDCP programme targets only cattle and buffalo, but other ruminants like sheep and goats are randomly vaccinated. Swine are not vaccinated under this plan, but swine can amplify the virus to a large extent.

Conclusions

The fight against FMD in India needs to be intensified in order to control and eradicate it. There are remarkable tales about the management and ultimate removal of FMD in Latin American and European nations by using inactivated vaccines. It was apparent that before they could be put into practise, the FMD control rules introduced in European nations needed to be altered to fit the circumstances in India. India's large ruminant population complicates the epidemiology of FMD. The majority of outbreaks are attributed primarily to a failure to vaccinate. To prevent financial losses, the Indian government launched the FMD Control Programme (FMD-CP). Under this plan, every cow and buffalo must receive two doses of the trivalent FMD vaccine each year. FMD has a wide host range, but this plan only includes cows and buffalo, so there is a good chance of breaking herd immunity.

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