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Original Article

Determination of the best vaccination age of calves in the presence of maternal antibodies to foot and mouth disease under natural conditions

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ABSTRACT

The first vaccination against foot and mouth disease (FMD) has long been carried out when the calves reach 4 months of age in Turkey. But, it is believed that this strategy creates a gap in herd immunity because almost fifteen percent of the cattle population consists of animals younger than 4 months old. Fifty-four calves aged 9 to 114 days were used in this study. The calves were divided into 5 groups. All of the animals were bled on day 0. Oil adjuvant FMD vaccine, containing the O1/Manisa, A22/Iraq and Asia-1/Shamir strains, was administered twice to Groups I-IV with a one-month interval between administrations. Group V was not vaccinated to monitor maternal antibody titer changes. The maternal antibody levels decreased in all strains in Group-V in a manner dependent on time. Antibody titers against strains O and Asia-1 increased after the first vaccination in Groups III and IV but decreased in Groups I and II. However, in all groups, the mean antibody levels continued or started to increase after booster vaccination. It was concluded that in endemic countries, calves that are born to vaccinated dams and that receive colostrum during the first hours of life should be vaccinated at 2 to 2.5 months of age, and a booster vaccination should be implemented for better protection.

1. Introduction

Foot and mouth disease (FMD) is an extremely contagious viral disease of cloven–hoofed animals that has caused great economic losses because of international trade sanctions and loss of production. Four main strategies are used around the world: culling; culling and vaccination; quarantine; and quarantine and vaccination. In Turkey, the quarantine and vaccination strategy has been used in Anatolia, and the culling and vaccination strategy has been used in the Thrace region. There are some factors that have made it difficult to combat this disease, such as the number of serologically distinct types and subtypes with no cross-reactivity with each other, illegal animal movements and the animal product trade [1]. Another important issue in combatting the disease is animals that cannot be vaccinated because of late gestation periods or younger ages at the time of vaccination campaigns. High mortality in young animals can cause great economic losses. Hence, the effective protection of young animals is very important. In Taiwan, it was reported that 40% of piglets died in two outbreaks [2]. In another study, the case fatality rates were reported at 40% to 45% and 94% in two outbreaks in lambs [3]. The case fatality rate is generally low in adult animals [4].

In general, vaccination of animals older than 4 months is recommended in vaccination campaigns because the maternal antibodies in young animals can interfere with protection [5]. However, there have been some reports of decreased efficacy of oil adjuvant vaccines in calves younger than 4 months old with maternal antibodies [6,7]. Transfer of specific immunoglobulins from dam to calf post-partum is possible by the vaccination of dams pre-partum. This type of strategic vaccination has been commonly used for the protection of calves [8].

Non-vaccinated animals or animals that do not have protective levels of immunity can create an opportunity for the entrance of diseases into a population. Even with the $3PD_{50}$ vaccine, only 60–80% vaccine effectiveness can be achieved [9]. Hence, as many animals as in a population must be vaccinated. In vaccination campaigns with 6-month intervals, it is likely that some young animals will not be vaccinated and will remain susceptible until the subsequent campaign.

The aim of this study was to evaluate the effectiveness of oil adjuvant FMD vaccines in calves younger than 4 months old born to vaccinated cows. Generally, fifteen percent of the population

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consisted of animals younger than 4 months old. According to the results, a new vaccination strategy could be suggested to protect animals younger than four months old, and more effective disease control could be possible with the help of this new strategy.

2. Materials and methods

2.1. Vaccine

Conventional $3PD_{50}$ double oil emulsion (DOE) adjuvanted trivalent FMD vaccine, produced at the Şap Institute, Ankara, Turkey, were used in this study. The vaccine contained O1/Manisa, A22/Iraq and Asia-1/Shamir strains and was formulated in Montanide ISA 206 (Seppic SA, Puteaux, France).

2.2. Experimental design

A total of 54 calves (9 to 114 days old), born to cows vaccinated several times with trivalent (O, A and Asia-1) oil adjuvant vaccine and maintained at the State Dairy Farm, Eskişehir, Turkey, were included in the study. All experimental procedures were approved by the Ethical Committee of Animal Experimentation of the Sap Institute.

The calves were divided into 5 groups (Table 1). Group-I comprised 9 calves ranging in age from 31–45 days. Group-II consisted of 10 calves aged 48–54 days. Group-III constituted 8 calves of 60–75 days of age. Group-IV comprised 15 calves with ages from 105–114 days, and Group-V included 12 animals aged 9–28 days. Calves in Groups I–IV were vaccinated with the trivalent FMD vaccine subcutaneously at the manufacturer's recommended dose. Group-V acted as an unvaccinated control and was not vaccinated to observe the decay of maternal antibody. Vaccinated calves were given the primary vaccine dose on day zero, and the booster inoculation was carried out on day 30 post-primary vaccination.

Table 1
Experimental design, immunization and bleeding schedules.

Subgroups	*n*	Age-range at 0 of study	Vaccinations schedule	Bleeding schedule
Group-I	9	31–45 days	2 (0, 30 dpv[a])	0, 30, 60 dpv
Group-II	10	48–54 days	2 (0, 30 dpv)	0, 30, 60 dpv
Group-III	8	60–75 days	2 (0, 30 dpv)	0, 30, 60 dpv
Group-IV	15	105–114 days	2 (0, 30 dpv)	0, 30, 60 dpv
Group-V	12	9–28 days	NV[b]	0, 30, 60 dac[c]

[a] dpv: days post-vaccination.
[b] NV: not vaccinated.
[c] dac: days after commencement.

The calves were bled on days 0, 30 and 60 post-primary vaccination by puncture of the jugular vein. Serum samples were obtained and stored at −20 °C until analyzed.

2.3. Serology

All of the serum samples were titrated against FMDV serotypes O, A and Asia-1 using liquid phase blocking ELISA as described in the OIE Manual of Diagnostic Tests and Vaccines [1]. The test was performed using reagents supplied by the Pirbright Institute,

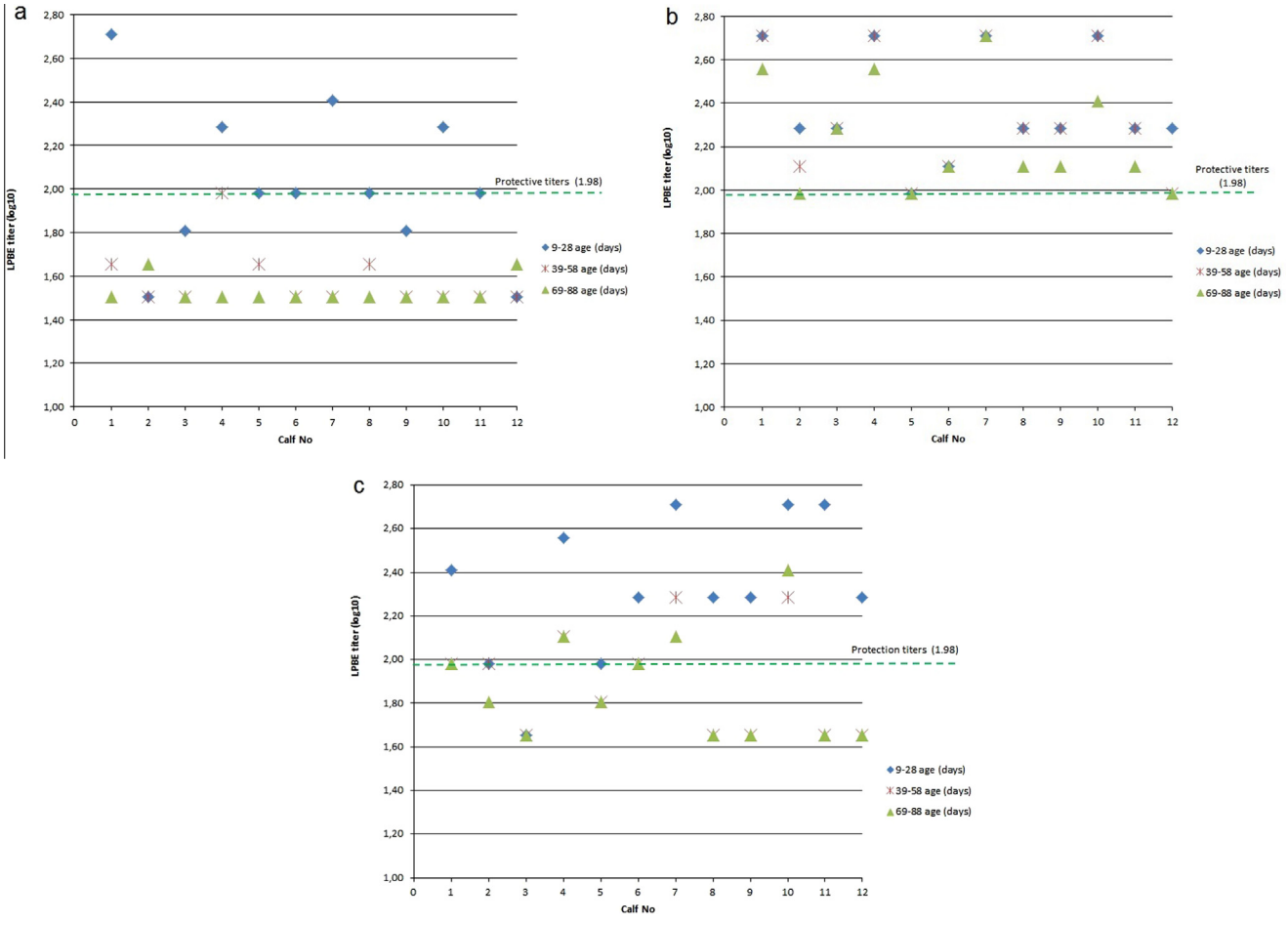

Fig. 1. Changes in maternal antibodies in Group-V. (a) O1/Manisa. (b) A22/Iraq (c) Asia-1/Shamir.