Epidémiol. santé anim., 1997, 31-32

EVALUATION OF THE VACCINATION CAMPAIGN AGAINST FOOT AND MOUTH DISEASE IN THE OVINE POPULATION IN TUNISIA

Hammami S.[1], Mackay DKJ.[2], Seghaier C.[1], Aouina Th.[1], Tlatli A.[1,3], Sanaa M.[3]

L'objectif de cette étude était d'évaluer la stratégie de vaccination contre la fièvre aphteuse en Tunisie. Soixante cinq troupeaux d'ovins ont été tirés au sort parmi les élevages ovins du secteur étatique. Dans chaque troupeau, 10 animaux par catégorie d'âge (≤ 1 an,]1,3[, et ≥ 3 ans) ont été tirés au sort. Les sérums collectés à 0, 30, 90 et 180 jours après la vaccination ont été analysés par la technique ELISA pour déterminer le taux d'anticorps anti-aphteux (virus type O1 Manisa). Un titre supérieur ou égal à 1:100 a été considéré comme protecteur. On a observé un pourcentage d'animaux avec un titre protecteur de 43% à J0, de 72% à J30 puis une diminution progressive jusqu'à 59% six mois après la vaccination. Le pourcentage d'animaux avec titre protecteur varie entre les troupeaux. A J0, ce pourcentage était compris entre 0% et 100%, avec une médiane de 40%. Après la vaccination, le pourcentage d'animaux avec un titre > 1:100 augmente globalement mais la disparité entre les troupeaux restait importante (pourcentage varie entre 25% et 100% avec une médiane de 70% à J30 ; 15% et 100% avec une médiane de 57% à J180). L'âge des animaux montre une influence sur le pourcentage d'animaux protégés et son évolution au cours du temps. L'analyse des différents facteurs associés à l'élevage a révélé les résultats suivants : pour les animaux âgés de moins d'un an, l'effet était significatif pour le bain antiparasitaire, la supplémentation en concentré et la vaccination au cours des derniers 6 mois. Pour les animaux âgés de 2 à 3 ans, l'effet était significatif pour la tonte et le drogage réalisés au printemps ainsi que pour la vaccination précédente au cours des 6 derniers mois. Enfin, pour les animaux d'un âge supérieur à 3 ans, l'effet était significatif pour le bain antiparasitaire, effectué au printemps, la supplémentation en concentré, et la vaccination au cours des 6 derniers mois.

INTRODUCTION

The last epizootic of foot-and-mouth disease in Tunisia in 1989 caused heavy economic losses. The disease affected mainly small ruminants and the virus isolated was FMD virus serotype 0. The losses due to mortality reached 55.000 for small ruminants and 79 bovines (El Hicheri K., Hammami S., 1993). The total direct and indirect losses were estimated at $6,4 millions. The strategy adopted to control this epizootic was based on annual mass vaccination against FMD of all susceptible species (6.5 millions) (1). Since 1989, 5 outbreaks were recorded. The aim of the present study was to assess the success of the current strategy for FMD vaccination of sheep in Tunisian state farms.

MATERIAL AND METHODS

Sixty five sheep flocks were randomly selected from 430 flocks in state farms situated across the country. In each flock, 10 animals were randomly selected in each of the following age groups: 6-12months,]1-3 [years and ≥ 3 years. The animals were identified, and data were recorded concerning their age, their sex, the geographical location and others parameters related to husbandry and care of the animals . Sera were collected from each animal at 0, 30, 90 and 180 days post vaccination (dpv) and stored at -20°C until use. These sera were examined to FMDV type 01 Manisa by ELISA (Hamblin et al, 1986) at the OIE and FAO World Reference Laboratory for FMD for antibody. A database was generated using Microsoft Excel and the statistical analysis was performed using SAS (SAS Institute inc., 1992).

RESULTS:

In cattle, an ELISA titre of approximately 1:100 is considered protective (Hamblin et al, 1987). There is no comparable figure for sheep, but it is a reasonable assumption that the same titre can be considered protective in sheep. Titres have therefore been classified either protective (>1:100) or not (<1:100). Based on these criteria, the percentages of animals with protective titres measured at the various times after vaccination in different age groups are shown in table I. As expected, the proportion of animals with protective titres increased from 43% at 0 dpv to reach a maximum of 72% at 30 dpv. These figures then fell to 64% at day 90 and 59 at 180 dpv. The exception was one farm with one flock having poor protection levels (<60%).
Unexpected titres were observed on some farms. One farm had flocks with 100% at 0 dpv with titres >1:100. The majority of these animals belonged to age group 2 with titres > 1:1000. The analysis of the data after their stratification by age revealed interesting results (table I) . At day 0, only 7% of animals which were one year old or less had protective titres. For this age group, titres rose following vaccination , but still only a maximum of 32% of animals had protective titres at 30 dpv. At 90 and 180 dpv, 25% and 25% had protective titres, respectively. The percentage of animals with protective titres increased with age at time of vaccination. In

1 Institut de la Recherche Vétérinaire de Tunisie (IRVT), Rue Djebel Lakhdhar, 1006 La Rabta-Tunis, Tunisie
2 OIE and FAO World Reference Laboratory for FMD, Pirbright, Great Britain
3 Laboratoire d'Epidémiologie et de gestion de la santé animale, Ecole nationale Vétérinaire d'Alfort, France

animals older than 3 years, vaccination appeared particularly effective in that more than 93% of animals had protective titres 30 dpv and more than 79% were still protected 6 months after vaccination.

Table I
Percentage of animals in different age groups with protective titres at different times after vaccination

Age	Day 0	Day 30	Day 90	Day 180
1	7	32	25	25
2	40	82	70	67
3	74	93	88	79
P	=0,0001	=0,0001	=0,0001	=0,0001
Total	43	72	64	59

* age group 1 : ≤1 year, age group 2 :]1,3[years, age group 3 : ≥ 3 years

A better understanding of the effect of vaccination is obtained when the percentages of new protected animals for each age group were determined (table II). The highest percentage of newly protected animals was observed at 30 dpv for all age groups. These percentages decreased rapidly at 180 dpv. This decrease was dramatic for animals 3 years of age or older; the percentage of protected animals for this age group decreased from 80% at 0 dpv to reach 2% at 180 dpv. The calculated mean titre for age group 1 is well below the protective level for 30 dpv.

Table II
Percentage of new animals in different age groups with protective titres at different times after vaccination

Age	Day 30 - day 0	Day 90 - day 30	Day 180 - Day 90
1	29	15	9
2	72	11	25
3	80	26	2

The analysis of the data stratified by flock was also performed at various times post vaccination. At 0 dpv, 50% of the flocks have only 40% of their animals protected with two flocks with 0 animal protected. At 30 dpv, 50% of the flocks had 70% of their animals protected. This percentage of protected animals by flock decreases to reach 55% at 180 dpv. The data were analysed for each age group at various times post vaccination ; the results are shown in table III.

Table III
Percentage of animals with protective titres by flock and age group at different days post vaccination

Age		Day 0	Day 30	Day 90	Day 180
1	min,med, max*	0,0,50	0,30,90	0,10,100	0,11,80
2	min,med, max	0,30,100	0,89,100	0,67,100	0,64,100
3	min,med, max	0,80,100	50,100,100	50,100,100	30,100,100

* minimum, median, maximum.

The variability of Log(base 2) of the titre was tested at 30 dpv in relation to the following factors: farm, date of shearing and of treatment against internal parasites (spring or summer), treatment against external parasites (spring or summer), supplementation with feed concentrate (yes or no), dates of previous vaccination (vaccination 6 months before day 0 or no vaccination), vaccinators (veterinarian, technician), vaccine (monovalent O1, trivalent OAC) and transhumance (yes or no). The response of animals to vaccination cannot be considered independent since all the animals in one flock live under similar husbandry conditions. The SAS procedure MIXED allows to take in account the dependence of the data if we add the factor flock as random. Also since we have an interaction between age and the factors tested, we conducted a stratified analysis by age category. For age group 1, treatment against external parasites (treatment in the summer has positive impact p=0.0001), supplementation with concentrate (p=0.0003) and previous vaccination at day -180 had positive impacts on the effectiveness of vaccination (p=0.0001). For age group 2, shearing (in the spring p=0.004), treatment against internal parasites (in the spring p=0.001) and the vaccinator (the veterinarian p=0.0001) had significant positive impact on the effectiveness of vaccination. For age group 3, treatment against external parasites (in the spring p=0.0001), supplementation with concentrate (p=0.011) and the vaccinator (the veterinarian p=0.0002) had significant positive impact on the effectiveness of vaccination.

DISCUSSION

In cattle, it is generally considered that protective immunity in 85% of susceptible animals is sufficient to prevent the spread of FMD. Suitable figures for sheep are not available as the epidemiology of the spread of FMD within and between flocks of sheep is less well studied. However, it is likely that a lower overall level of immunity is required to prevent spread of FMD in sheep due to lower morbidity in this species and the extensive husbandry systems under which sheep are normally kept.

In the current study, only flocks from state farms were included. This population is not representative of the overall population of sheep in the country; but only in these type of flocks are the animals identified and the data concerning the animals recorded and available. It is also likely that the overall results in these flocks reflect the most favourable conditions for an effective vaccination.

In view of the above points, at 0, 30, 90 and 180 dpv, the percentages of flocks with at least 85% of the animals protected are respectively 5%,20%,19% and 6%. However, the fact that 59% of sheep in the current study had protective titres for at least 180 dpv suggests that the current vaccination regime is effective, at least on the type of state farm included in this survey. The factor which had the most effect both on the percentage of animals protected and on the response to vaccination was the age of the animal at vaccination. The great majority of animals less than one year old were susceptible to infection even after their first vaccination. It was not until after animals had received a second vaccination at 2 years of age that the percentage of animals protected reached an acceptable level (83% at 30 dpv). After one or more vaccinations over 60% of 3 and 4 year old animals still had protective titres one year after the last vaccination (i.e. at 0 dpv). This finding suggests that annual vaccination is sufficient to maintain an acceptable level of immunity in animals of this age. An alternative explanation for the high proportion of animals positive at high titre in the oldest age group is that these animals had previously been infected either clinically or sub-clinically during or after the 1989 epizootic. Whilst possible, this is unlikely as few of the animals sampled would have been old enough (≥7years old) to have been born before the 1989 epizootic.

Rises of titres not associated with recent vaccination were observed in some flocks. Unless, unrecorded vaccination was taking place this can be explained by infection with FMD virus. As no clinical signs of disease were reported on any of the farms during the survey infection must have been sub-clinical.

In view of the above results we can conclude that 1) vaccination of sheep against FMD should continue due to the continuing threat of re-entry from neighbouring countries and the indirect evidence from this survey that FMD virus continues to circulate sub-clinically; 2) young animals less than two years of age are most at risk of catching FMD and sustaining circulation of the virus. For this reason, it is recommended to vaccinate young animals twice with an interval of approximately 3 months between vaccinations. The first vaccination should be given soon after 6 months of age by which time titre of maternal antibody should have waned (table I, group 1, Day 0) ; 3), the epidemiological reasons for the poor responses in some flocks and of continued virus circulation in others, requires further investigation.

BIBLIOGRAPHY

El Hicheri K., Hammami S., 1993. La fièvre aphteuse, données épidémiologiques. Bulletin Epidémiologique et d'Information Vétérinaire 2, 1-5.

Hamblin C., Barnett I.T.R., Crowther J.R., 1986. A new enzyme-linked immunosorbent assay for the detection of antibodies against foot-and-mouth disease virus. I. Development and method of ELISA. Journal of Immunological Methods 93, 115-121.

Hamblin C., Kitching R.P., Donaldson A.I., Crowther J.R., Barnett I.T.R., 1987. Enzyme-linked immunosorbent assay (ELISA) for the detection of antibodies against foot-and-mouth disease virus. III. Evaluation of antibodies after infection and vaccination. Epidemiology and Infection 99, 733-744.

SAS Institute inc., 1992. SAS Technical Report P-229, SAS / STAT Software: changes and enhancements, Release 6.07, Cary, NC: SAS Institute inc., 620 pp.