Epidémiol. santé anim., 1997, 31-32

SOME EPIDEMIOLOGICAL CHARACTERISTICS OF BOVINE HERPESVIRUS 1 (BHV1) INFECTIONS AS DETERMINED BY BULKMILK TESTING OF ALL DUTCH DAIRY HERDS

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Tous les élevages bovins laitiers (n=33636) ont fait l'objet d'un prélèvement de lait de mélange (LM) en Novembre 1994 qui a été analysé pour la présence d'anticorps anti BHV1 au moyen d'un test ELISA gB bloquant.
Seize pour cent des élevages se sont révélés BHV1 LM négatifs. Il y avait une décroissance linéaire de la probabilité d'un élevage d'avoir un statut BHV1 LM négatif ou faiblement positif avec un accroissement de la taille de l'élevage.
Les élevages purement laitiers avaient une probabilité moindre d'avoir un statut BHV1 LM négatif ou faiblement positif avec un accroissement du nombre d'animaux achetés. Les élevages ayant seulement des vaches laitières avaient 1,9 fois plus de chance d'avoir un statut BHV1 LM négatif ou faiblement positif. Les élevages au sein des régions de faible densité d'élevage avaient 1,5 fois plus de chance d'avoir un statut BHV1 LM négatif ou faiblement positif. La densité animale dans une région n'avait aucune influence significative.

INTRODUCTION

BHV1, a herpesvirus of cattle, causes several clinical diseases, for example infectious bovine rhinotracheitis (IBR) and infectious pustular vulvovaginitis (IPV). Since several countries, like Switzerland and Danmark, have eradicated BHV1, attention has been focused on eradication of BHV1 in the European Union (EU). Switzerland and Danmark were able to eradicate BHV1 by test and removal procedures for sero-positive animals due to the low prevalence at the start of the eradication programme. In countries with a high prevalence, eradication is only economically feasible by prevention of new infections combined with increased removal of infected animals. Virus transmission is not completely prevented after vaccination with the novel marker vaccines for BHV1 (Bosch et al.,1996). Management measures to prevent virus transmission within and between herds, will be necessary for an effective eradication of BHV1. To determine some of the potential risk factors, epidemiological characteristics of BHV1 infections in dairy herds in the Netherlands have been studied. The results are reported in this paper.

MATERIAL AND METHODS

Bulk-milk test for antibodies against BHV1

In the Netherlands all dairy herds are bulk milk (BM) sampled every fortnight to measure the BM quality. From the Milk-Control-Station the samples were sent on to the Animal Health Service (AHS). All Dutch dairy herds (n=33,636) were BM sampled in November 1994 and tested for the presence of BHV1 antibodies with a gB-blocking ELISA (Kramps et al., 1994). A blocking percentage of < 10 in the ELISA was considered as a negative BHV1 BM status, a blocking percentage between 10 - 50 was classified as weak-positive, blocking percentages > 50 were considered positive.
In january 1998 the Netherlands will start a compulsory BHV1 eradication programme. In the framework of making farmers aware of their BHV1 status, all herds in the Netherlands were BM sampled and tested for BHV1 antibodies.

Epidemiological characteristics

The Netherlands have a cattle Identification & Registration (I&R) system. All animals are identified by eartags on which a unique 9-digital number is printed. The animals are registered in the I&R computer and all movements are registered in this computer using information from the breeder, seller, buyer or slaughterhouse. Information on purchased animals at the herd level is directly available over the past 15 months, thereafter it is stored in a historical database.
The following information available from the AHS information systems was used: number of purchased animals, herd size, farm type (dairy herd or dairy+beef), herd density (herds/km^2 per two-digit postal code area) and animal density (cattle/km^2). No information was available on vaccination status of herds, on housing, farm management and contact of animals at shows, markets or cattle gathering-centres for export.

Statistical analysis

In our study the BHV1 BM status was measured on an ordinal scale (negative, weak positive and positive). The LOGISTIC procedure in SAS (1996) is able to fit a common slopes cumulative model, with the ordinal scaled BHV1 BM status as response variable. For the log-odds scale, the cumulative logit model is often referred to as the

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proportional odds model. However in our study the score chi-square for testing the proportional odds assumption indicated lack of support for this assumption (χ^2 = 34.4, 6 df, p=0.0001). We therefore subdivided the analysis into two parts:

1. herds with a negative BHV1 BM status versus herds with a weak positive or positive status
2. herds with a negative or weak positive BHV1 BM status versus herds with a positive status.

The BHV1 BM status was modelled with categorical and continuous independent variables that were available from the AHS in a multivariate logistic model: purchased stock, herd size, farm type, and herd- and animal density. Biological plausible two-way interaction terms were included in the final model, linearity of the regression estimates for the continious variables was checked graphically. If lack of linearity was observed, continious variables were categorized. The results were two almost identical tables indicating to the proportional odd model. We than realised we were dealing with 33,000 herds, not merely to be called a "sample" and used the results of the proportional odds model.

A total of 32,955 (98%) dairy herds with complete information on the available potential risk factors and BHV1 BM status were used in the statistical analysis to calculate Maximum Likelihood Estimates (β) for the continious variables, and Odds Ratios (OR) for the categorical variables. MLE's represent the change in the logit for a change of one unit in the independent variable. By exponentiating the regression coeficients (e^{β}) an OR can be calculated. OR's are estimators of the true relative risk of a factor in a population for an event. The estimation is fairly accurate when the prevalence of the event is low. The prevalence of a positive BHV1 BM status in the Netherlands is very high (Wuijckhuise et al., 1993). We therefore modelled the potential risk factors for a negative or weak positive BHV1 BM status.

RESULTS

In the Netherlands there were around 3.8 million cattle. Aproximately 1,2 million were dairy cows. There were 71,008 farms of which 33,636 were dairy herds. The average number of dairy cows per herd was 55 (range 8 - 607). The mean number of cattle herds per km^2 in the postal code areas was 1.99 (range 0.23 - 4.16).

Sixteen percent of the herds had a negative BHV1 BM status, whereas 14.5% of the herds had a weak-positive status.

There was a linear decrease in probability of herds to have a negative or weak positive BHV1 BM status with an increase in herd size (Table I). An increase in herd size of 10 animals ($e^{10 * - 0.0169}$) decreased the probability of a negative or weak positive BHV1 BM status with a factor 1.2 (1/0.84). Farms with only dairy cows had a 1.9 higher probability of a negative or weak positive BHV1 BM status than dairy units with also beef or veal. Farms in a low herd-density area had an 1.5 higher probability of a negative or weak positive BHV1 BM status than farms in a high herd-density area. Animal density had no significant influence.

Table I

Maximum Likelihood Estimates (MLE) with standard errors (se) and adjusted Odds Ratios (OR) with 95% confidence intervals (CI), for a negative or weak positive BHV1 bulk milk status in dairy herds in the Netherlands

CHARACTERISTIC	MLE	se	OR	CI	P-value
Herd type					
dairy cows			1.9	1.6 - 2.1	< 0.001
diary cows + beef/veal			1.0#		
Herd density (herds/km²)					
< 1			1.5	1.4 - 1.7	< 0.001
1 - 2			1.6	1.5 - 1.7	< 0.001
2 - 3			1.2	1.1 - 1.3	< 0.001
≥ 3			1.0#		
Herd size (no. of cows > 24 months)	- 0.0169	0.00050			< 0.001
Purchase of stock (no. of animals)	- 0.00156	0.00056			0.005
Interaction term*	- 0.0229	0.00138			< 0.001

Reference category

* Interaction term: interaction between farm type and purchase of stock

Purchase of stock was significantly associated with a negative or weak positive BHV1 BM status. However, there was a significant (p < 0.001) interaction term between farm type and purchase of stock: in herds with dairy cows and beef/veal there was a weak association between a negative or weak positive BHV1 BM status and purchase of stock. In pure dairy herds there was a strong and significant (p < 0.001) relationship between BM status and purchase of stock: an increase in purchase of stock of 10 animals ($e^{10 * (- 0.0229 + (- 0.000156))}$) decreased the probability of a negative or weak positive BHV1 BM status with a factor 1.3 (1/0.79).

ACKNOWLEDGEMENT
The laboratory research was financially supported by the Ministry of Agriculture, Nature management and Fisheries. The authors thank the AHS laboratories for all the tests done and P. Zomerdijk, L. Swart, M. Dercksen of the AHS and JM. Winkel of the NRS for the support in collecting the other variables.

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