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Association of herd BHV-1 seroprevalence with respiratory disease in youngstock in Estonian dairy cattle

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ABSTRACT

The associations between herd bovine herpesvirus 1 (BHV-1) seroprevalence, along with other infectious and farm management factors with bovine respiratory disease (BRD) in dairy calves and heifers, were investigated. Serum samples from 103 dairy cattle herds were analyzed for antibodies against BHV-1, bovine respiratory syncytial virus (BRSV), bovine viral diarrhea virus (BVDV), and *Mycoplasma bovis* (*M. bovis*). A questionnaire was used to record herd management practices.

A high occurrence of respiratory disease in unweaned calves was associated with low to moderate and high prevalence of BHV-1 among cows (OR = 14.8, $p = 0.005$ and OR = 19.2, $p = 0.002$, respectively) and positive BVDV status of a herd (OR = 5.1, $p = 0.02$). The presence of BVDV in a herd was related to a high incidence of respiratory disease in heifers 3–16 months old (OR = 4.3, $p = 0.027$). Based on the results of multiple correspondence analysis, holding youngstock separately from cows until pregnancy, introducing new animals and the activities of on-farm employees may contribute to a higher incidence of BRD.

1. Introduction

Respiratory disease is one of the foremost cattle health concerns (Callan and Garry, 2002) and is estimated to cause significant economic losses to the dairy industry, due to increased morbidity and mortality, and negative long-term consequences to herd health and productivity including poor growth, hampered reproductive performance, lower milk production, and reduced longevity (Gay and Barnouin, 2009; Poulsen and McGuirk, 2009; Van der Fels-Klerx et al., 2002a). Bovine respiratory disease (BRD) is usually of multifactorial origin, involving infectious, environmental and management-related factors (Gay and Barnouin, 2009; Lundborg et al., 2005; Van der Fels-Klerx et al., 2000) as well as those related to stress and the immunity of the animal (Gorden and Plummer, 2010). Bovine herpesvirus 1 (BHV-1) is considered an important component of the BRD disease complex in cattle. However, controversial results can be found from previous field studies detecting the role of BHV-1 among calves and dairy youngstock. Some studies have confirmed that BHV-1 did not contribute significantly to the occurrence of respiratory disease in feedlot calves (Martin et al., 1989; Allen et al., 1992), but Penny et al. (2002) ascertained severe multisystemic form of the disease in neonatal beef calves. In endemically infected herds, BHV-1 is presumed to be an uncommon agent causing BRD in young calves due to the high percentage of seropositive dams and the protective effect of colostral antibodies (Mechor et al., 1987), and so BHV-1 is most commonly seen in housed cattle from 6 to 18 months of age (Penny et al., 2002). In calves the significant contributors to the incidence of respiratory disease are bovine viral diarrhea virus (BVDV) and bovine respiratory syncytial virus (BRSV), as has been demonstrated in previous studies (Allen et al., 1992; Elvander, 1996; Fulton et al., 2000; Martin et al., 1989). Recent field studies detecting the role of infectious agents in BRD in young dairy calves have identified that Nordic countries are free of BHV-1 and have a low prevalence of BVDV (Angen et al., 2009; Autio et al., 2007; Lundborg et al., 2005). In Estonia, a high proportion of dairy herds are endemically infected with BHV-1 (Raaperi et al., 2010) and also with BVDV (Viltrop et al., 2002). Consequently the etiology of BRD can differ in different regions due to dissimilar epidemiological situations. Thus the first aim of the study was to clarify the role of BHV-1 in the incidence of BRD in calves as well as in older youngstock in Estonia, taking into account the impact of other respiratory pathogens such as BRSV, BVDV and *Mycoplasma bovis.*

Several environmental and management factors also influence the development and the severity of disease during infections (Gulliksen et al., 2009). Previous studies have mainly involved factors related to calving management (Svensson et al., 2003), characteristics of the calf pen (Van der Fels-Klerx et al., 2002b; Lundborg et al., 2005; Svensson et al., 2003), microclimate (Assie et al., 2009; Van der Fels-Klerx et al., 2000) and colostrum feeding

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strategies (Virtala et al., 1999; Svensson et al., 2003). Herd level variables such as larger herd size (Assie et al., 2009; Gulliksen et al., 2009) and the purchase and introduction of new cattle into a herd (Van der Fels-Klerx et al., 2000) have been found to be significant risk factors for acute respiratory disease in young calves. The second aim was to evaluate the impact of factors related to general farm practices in Estonia on the incidence of respiratory disease in pre-weaning dairy calves and older youngstock.

2. Materials and methods

2.1. Study design

The target population in this study was Estonian commercial dairy cattle herds of more than 20 cows. A detailed description of the method of herd selection and sampling of animals has been described in Raaperi et al. (2010) Sections 2.2 and 2.3. Briefly, a stratified random sample of non-vaccinating BHV-1 antibody-positive and negative herds was selected from amongst herds of different size categories. Thereof herds' infection statuses were first defined based on the results of a prior bulk tank milk (BTM) survey from the year 2004; however, results of individual samples collected during the present study was used to define the herd true infection status. In each of the selected herds, serum samples from a number of randomly selected cows, and youngstock older than 6 months, were analyzed for BHV-1 antibodies. The sample size for prevalence estimation in BHV-1 BTM-positive herds was calculated at a 95% confidence and a 5% error level assuming 75% prevalence among cows and 50% in youngstock. Freedom from BHV-1 antibody carriers in BHV-1 BTM-negative herds was determined at 5% prevalence and 95% confidence level. The numbers of BHV-1-positive and negative herds in the different size categories included in this study are presented in Table 1.

For additional information, a questionnaire to record herd-level data was completed for every herd. The information requested included herd size, farm management and biosecurity practices and vaccination history. In addition, questions relating to the history of the incidence of respiratory disease in the previous two years, among calves up to 3 months of age and 3–16 months old youngstock, were asked. All samples and questionnaires were collected between September 2006 and April 2008.

2.2. Sample analysis

Blood was collected from the coccygeal vein of each animal by using disposable needles and 9 ml vacuum tubes containing clotting activator (Vacuette, Austria). After collection, serum samples were stored in room temperature for 24 h and transported to the National Veterinary and Food Laboratory for immediate serology.

All serum samples were tested for BHV-1 antibodies using a commercial BHV-1 gB ELISA test kit, HerdChek* (IDEXX, Switzerland). Suspicious antibody test results were considered as positive in the data analysis. In each of the herds certain number of animals was tested additionally for BVDV, BRSV and *M. bovis* antibodies. Thereby a random subsample amongst BHV-1 tested animals was selected for analysis.

The herd BVDV status was established by testing up to 10 serum samples from randomly selected animals, at ages from 6 months up to age at first calving, for BVDV antibodies as recommended by Houe et al. (2006). This sample size enabled detection of a minimum prevalence of 20–28% depending on herd size at a 95% confidence level. The PrioCheck BVDV Ab test kit (Prionics AG, Switzerland) was used for analysis.

The herd BRSV status was established by testing up to 20 (depending on herd size) randomly selected serum samples from heifers for BRSV antibodies to allow detection of at least a 15% prevalence of BRSV antibody carriers in the herd at a 95% confidence level assuming 94.6% sensitivity and 100% specificity of the test. For BRSV antibodies, the Svanovir ELISA test (Svanova Biotech AB, Sweden) was used.

Depending on herd size up to 25 heifers and 10 cows were tested for *M. bovis* antibodies in each herd. This enabled to detect the prevalence of at least 15% among heifers and 27% among cows with 95% level of confidence. BIO K 260 ELISA test (Bio-X Diagnostics, Belgium) was used to measure *M. bovis* antibodies.

2.3. Description of the models and variable coding

In Model I the dependent variables were related to the history of respiratory disease incidence in calves of up to 3 months old. In Model II the aim was to clarify the risk factors for a high prevalence of respiratory disease in 3–16-month-old heifers. Four dependent variables (general disease, nasal discharge, signs of respiratory distress, and lacrimation) were used (Table 2).

On each farm the veterinarian or farm manager was questioned about the occurrence of clinical signs of respiratory disease, including general signs (fever, inappetence, dullness), nasal discharge (''red nose''), respiratory signs (cough, dyspnoea), and lacrimation, in two age groups (calves 0–3 months old and youngstock 3–16 months old). The respondents were asked to evaluate the prevalence of the signs described above among animals of each age group during periods of the highest incidence of respiratory disease the previous two years. The scales used in the estimation were as follows: 1 – no signs or only single case; 2 – up to 10%; 3 – 10–30%; 4 – over 30%. All four dependent variables in each model were dichotomized. The 10% cut-off point was used for 0–3-month-old calves while for older youngstock the herd was considered to be in the ''high frequency'' group if more than just a single animal showed the mentioned signs concurrently (Table 2).

As all the respiratory disease signs were found to be highly clustered from multiple correspondence analysis (MCA) (discussed in Section 3), one summary variable describing the level of incidence of respiratory disease for each age group was created to be used in logistic regression analysis. The herd was considered to be in a group of ''high frequency of BRD in calves'' (BRDCAL = 1), if at least two of the four variables indicating respiratory disease signs among calves were in the ''high frequency'' category. For older

Table 1
Number of herds in Estonia in 2007 and study sample size.

Herd size	Number of herds in Estonia in 2007	Study sample (BHV-1 antibody-positive herds)	Study sample (BHV-1 antibody-negative herds)	Study sample in total
20–49	255	9	17	26
50–99	110	7	9	16
100–199	85	14	5	19
200–399	83	18	6	24
⩾400	59	17	1	18
Total	592	65	38	103