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Effect of vaccination against bovine herpesvirus 1 with inactivated gE-negative marker vaccines on the health of dairy cattle herds

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ABSTRACT

The aim of this study was to estimate the effect of the bovine herpesvirus 1 (BHV-1) vaccination on herd health and production in BHV-1 infected Estonian dairy cattle herds. Seven herds vaccinated with inactivated gE-negative BHV-1 marker vaccines and seven matched non-vaccinated herds were selected. In vaccinated herds the calving interval was on average 7.01 days shorter compared to that in the non-vaccinated herds (coef = −7.01, 95% CI = −11.98, −2.03, p = 0.008) during the study period (2007–2012). In non-vaccinated herds the insemination index had an increasing trend (coef(log scale) = 0.03, 95% CI = −0.003, 0.06, p = 0.054) and the first service conception rate decreased (coef = −2.19, 95% CI = −3.91, −0.47, p = 0.015), whereas no significant changes occurred in vaccinated herds. Average yearly milk yield per cow increased (coef = 145.30, 95% CI = −6.11, 296.71, p = 0.065) and length of the dry period decreased in BHV-1 vaccinated herds (coef(log scale) = −0.02, 95% CI = −0.04, 0.004, p = 0.056) compared to non-vaccinated herds during the study years. Youngstock and the cow culling rate due to respiratory disease was significantly lower in vaccinated herds compared to non-vaccinated herds (coef = −0.29, 95% CI = −0.47, −0.11, p = 0.003 and coef = −0.15, 95% CI = −0.29, −0.007, p = 0.043, respectively). These results suggest that vaccination against BHV-1 is associated with herd health and productivity.

1. Introduction

Bovine herpesvirus 1 (BHV-1) is an important cattle pathogen causing infectious bovine rhinotracheitis (IBR), infectious pustulous vulvovaginitis/balanoposthitis (IPV/IPB), abortions as well as systemic illness in young calves. BHV-1 establishes life-long latency following acute infection and can reactivate under unfavourable conditions for the virus-carrier animal (Kaashoek et al., 1996; Jones and Chowdhury, 2007).

Several countries and larger districts of a few countries are to date recognised as IBR-free. European Commission-approved eradication programmes are ongoing in some countries and regions to which the additional guarantees for IBR apply (2011/674/EU). In addition to negative influences on animal health, IBR has become a limiting factor in livestock trade (64/432/EEC Article 9).

Eradication programmes relying entirely or partly on BHV-1 DIVA vaccines (syn. marker vaccines) are currently running in several countries. A DIVA vaccine carries at least one antigenic protein less than the corresponding wild-type virus. After infection, but not after vaccination, it is possible to detect an antibody response for the specific protein with a companion diagnostic test (van Oirschot, 1999). To date, only glycoprotein E-deleted virus

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vaccines are in use in the European Union for IBR eradication (Sanco/C3/AH/R20/2000). Continuous vaccination with live or inactivated gE-negative vaccines is reducing the circulation of the virus within a herd (Bosch et al., 1998; Mars et al., 2001; Makoschey et al., 2007; Vilmos et al., 2007; Jacevičius et al., 2008; Ampe et al., 2012; Raaperi et al., 2012a). By limiting the risk of having new BHV-1 gE-positive animals within the herd and by the gradual culling of field virus-infected animals, the herd may achieve IBR-free status (Makoschey and Bielsa, 2007).

Published reports on the impact of BHV-1 infections and outbreaks of BHV-1 on animal health under field conditions have described reduced milk production, an increase of respiratory disease, higher mortality of calves as well as reproductive problems (Allan et al., 1980; Janzen et al., 1980; Wiseman et al., 1980; Greig et al., 1981; Cook, 1998; van Schaik et al., 1999; Holzhauer et al., 2003; Rissi et al., 2008). On the other hand, subclinical spread of BHV-1 in a naive herd has been demonstrated (van Oirschot et al., 1993; Hage et al., 1998; Pritchard et al., 2003). Clinical and pathological effects of BHV-1 infection have been shown in experimental challenge studies (Bitsch, 1973; Miller and Van der Maaten, 1987; Belknap et al., 1994). Several studies showed associations between the prevalence of BHV-1 serum antibodies and impaired health and performance in cattle herds (Biuk-Rudan et al., 1999; Waldner, 2005; Mineo et al., 2006; Raaperi et al., 2012b,c; Roshtkhari et al., 2012). Most of the experimental and observational studies have followed an epidemic of IBR in a previously naive herd in order to estimate losses. In countries where BHV-1 infection is endemic, a number of herds are permanently infected and clinical manifestations of the BHV-1 infection may not be as obvious as that following the first introduction of the virus. Due to overlapping clinical manifestation of several infections causing respiratory and reproductive disorders, contribution of the IBR virus to the overall performance of the animals within the herd is obscure. Concerning BHV-1, implementation of a vaccination protocol may reduce or eliminate the impact of the infection on herd health. Comparing vaccinated herds with those not implementing any control measures against BHV-1, enables evaluating the actual role of IBR infection in herd health in real farm conditions. Asking the farmer's opinion about the change in herd health during vaccinating years would allow evaluation of whether the changes are recognisable to the farmer.

The objective of this study was to estimate the impact of BHV-1 infection on health and performance of dairy cattle herds via the evaluation of the effect of vaccination with inactivated gE-negative marker vaccines.

2. Materials and methods

2.1. Study design

2.1.1. Herd selection

After the prevalence study of Raaperi et al. (2010), control programmes were composed for seven dairy cattle herds aiming to eradicate the virus from the herds. Characteristics of those herds are given in Table 1 (V+ herds). In those herds, inactivated gE-negative marker vaccines were used for all animals over three months of age twice a year. Rispoval IBR Marker inactivatum (Pfizer Animal Health) (V+ I, II, III, IV, V and VII) and/or Bovilis IBR marker inac. (Intervet International) (V+ V and VI) were used (Raaperi et al., 2012a). Herds started with the vaccination between April 2007 and November 2008.

Also, seven non-vaccinated dairy herds were selected and matched individually with vaccinated herds based on the information available from BHV-1 prevalence study conducted from 2006 to 2008 (Raaperi et al., 2010). Matching criteria were: similar herd size, milk productivity, breed, animal keeping system, BHV-1 prevalence before vaccination and herd bovine viral diarrhoea virus (BVDV) status. None of the participating herds had vaccinated against BHV-1 or BVDV before (Raaperi et al., 2010). Description of the herds included in this study is given in Table 1.

2.1.2. Data collection

Herd health data for the years 2007–2012 were received from the Estonian Animal Recording Centre (EARC). For the two herds that started IBR vaccination in 2008, data of five years (2008–2012) were included and consequently also for the two non-vaccinated herds. In five herds the vaccination programme was initiated in 2007 and therefore six study years (2007–2012) were included for those herds as well as for the five non-vaccinated herds. The dataset contained 80 records in total. An internet questionnaire was composed for all vaccinating farms and completed by the farmer or farm manager. A pre-testing of the questionnaire was accomplished by sending the questionnaire to one farmer not participating in the study. After completion the author had a discussion with the test farmer to discover if any of the questions were confusing. All the comments of the test farmer were taken into account to improve the questionnaire.

The questionnaire was composed to collect information about the continuation and regularity of the vaccination programme in order to confirm the suitability of the herd to be included. Specific questions were asked about the change in respiratory disease incidence in calves, heifers and cows, calf mortality, abortion incidence in heifers and cows, reproduction performance of heifers and cows, and milk production and treatment costs (antimicrobial drugs) compared to the pre-vaccination period. For that, multiple-choice questions with pre-defined answer categories ('increased', 'decreased', 'remained the same', 'don't know') were used.

We also questioned farmers from non-vaccinating farms about vaccinations against BHV-1 in the last ten years in order to confirm the suitability of the farm as a 'non-vaccinated herd' in our study.

2.1.3. Data analysis

Linear mixed-effects models were constructed to evaluate the effect of vaccination to herd health and productivity parameters. Outcome variables analysed were 'calving interval', 'average cow milk production', 'average somatic cell count', 'first service conception rate', 'insemination index' (number of inseminations per pregnancy), 'herd average number of lactations', 'days from