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Association of clinical signs after acute Schmallenberg virus infection with milk production and fertility in Swiss dairy cows

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ABSTRACT

Since its first occurrence in August 2011 in Germany and the Netherlands, the Schmallenberg virus (SBV) spread rapidly across Europe, where it caused production losses and abortions in ruminants as well as congenital malformations in the offspring of affected animals. Several studies have investigated the impact of SBV on fertility and production parameters in dairy cows at herd level. However, the impact of clinical disease at the animal level remained undetermined.

This study aimed at estimating the impact of clinical disease during and after an infection with SBV on production and fertility parameters in individual Swiss dairy cows. Sixty-seven case and twenty-four control herds were selected according to whether cows had been showing clinical signs indicative of SBV during the epidemic from July to December 2012 in Switzerland. Of these 91 farms, production and fertility data from 388 cows with clinical signs from case herds were collected over a time period of four years, and compared to data from 932 cows without clinical signs originating from case or control herds. Milk yield, somatic cell count, number of inseminations and non-return at day 56 were analysed by means of hierarchical multivariable regression analysis.

A significant drop in milk yield was observed in all groups during the SBV epidemic compared to the time before the infection, which amounted to 1.9 kg per test day for clinical animals, 1.1 kg for non-clinical animals from case herds and 0.6 kg for non-clinical animals from control herds. A prolonged effect on milk yield was observed in clinical cows for about one year, suggesting that animals with clinical disease might not return to their previous milk production level in the current lactation after an acute infection with SBV. Clinical animals showed a significantly higher somatic cell count during the epidemic compared to the time before the infection. The number of inseminations per cow and production cycle was higher for clinical animals during the epidemic compared to the time periods before and after, but not significantly higher than for non-clinical animals from case and control herds. No difference regarding non-return at day 56 was found. Although the overall impact of the SBV epidemic in Switzerland was limited, the consequences could be substantial in farms with a high prevalence of clinical disease.

1. Introduction

In August 2011, the first cases of a new disease with acute clinical signs consisting of fever, drop in milk yield and diarrhoea were reported in cattle in Germany and the Netherlands. In November 2011, a novel causative virus was identified as an Orthobunyavirus of the Family Bunyaviridae and was named Schmallenberg virus (SBV) after the place of its first occurrence (Hoffmann et al., 2012).

Schmallenberg virus is transmitted by *Culicoides* midges (De Regge et al., 2012; Elbers et al., 2013) and affects domestic and wild ruminants. Besides acute clinical signs in adult ruminants (fever, reduction in milk production and diarrhoea) and depending on the time of infection, the virus can cause abortion, stillbirth and congenital malformations in offspring (Bayrou et al., 2014; van den Brom et al., 2012). The latter has been shown to be relatively rare in cattle as compared to small ruminants (Afonso et al., 2014; Veldhuis et al., 2014a; Wüthrich et al., 2016).

When it was recognized that the virus would spread rapidly across

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Europe, the Swiss Veterinary Services intensified their passive surveillance in February 2012 to ensure early detection of the virus in Switzerland (Schorer et al., 2012). The initial surveillance consisted of testing stillborn ruminants and new-born ruminants with malformations for SBV. In June 2012, these measures were extended to testing blood samples from animals with acute clinical signs suggestive of SBV infection. If several cows within a herd were showing acute clinical signs like fever, diarrhoea or a drop in milk yield, blood samples were tested with PCR and ELISA for virus and antibodies, respectively. The first cases in Switzerland were detected on 18 July 2012, when serum samples of four cows from two different herds in the canton of Berne tested positive for SBV (Schorer et al., 2012).

As expected, the virus spread rapidly throughout Switzerland thereafter. A representative nationwide survey of bulk tank milk samples testing for antibodies against SBV in Swiss dairy farms revealed that the herd level seroprevalence was already 19.7% in July 2012 and increased further to 99.5% until December 2012 (Balmer et al., 2014). These results are similar to findings in Belgium and the Netherlands, where the herd level seroprevalence was found to range between 95 and 100% in cattle after one vector season (Méroc et al., 2013; Veldhuis et al., 2013).

The herd level impact of the SBV epidemic on milk production and fertility parameters in dairy cows has been studied in detail before (Toson et al., 2015; Veldhuis et al., 2014a, 2014b; Wüthrich et al., 2016). Veldhuis et al. (2014a) and Wüthrich et al. (2016) both performed a case-control study to assess the impact of clinical signs on production and fertility parameters by comparing herds with typical clinical disease manifestation and herds without clinical disease following an infection with SBV. Results showed a limited, yet statistically significant impact on milk production and fertility parameters. As both studies were performed at herd level, the impact of clinical disease on milk production and fertility parameters at individual cow level may have been diluted by the performance of cows without clinical signs. The objective of the present study was to investigate whether and to which extent Swiss dairy cows with and without clinical signs had altered milk yield, somatic cell counts and reproductive performance during and after an acute infection with SBV.

2. Materials and methods

2.1. Study design and data collection

The present animal level investigation was based on a subsample of the study described by Wüthrich et al. (2016). In that study, health and productivity parameters of Swiss dairy cattle herds with animals having presented acute clinical signs during the SBV epidemic in the second half of 2012 (case herds) were compared to those of herds without animals with acute clinical signs (control herds). Case herds were recruited from a list of dairy farms that had reported acute clinical disease and had serum samples analysed at the Swiss reference laboratory (Institute of Virology and Immunology, IVI, Mittelhäusern, Bern). The local veterinarians were then asked to identify potential control farms in the vicinity of the case farm, and with similar average milk yield, breed and housing system. In close conformity with the definition of the European Food Safety Authority (EFSA, 2012), a herd was classified as a case herd if at least one animal was present with at least two of the following clinical signs during the SBV epidemic in Switzerland (July to December 2012): Fever, diarrhoea, milk loss or abortion. If abortion was the main symptom, at least two cows of the herd had to have aborted and shown at least one other clinical sign indicative of SBV infection (i.e. fever, diarrhoea or drop in milk production) to classify the herd as a case herd. Moreover, the herd had to have been confirmed infected with SBV in 2012 by the use of ELISA or PCR. Control herds should not have had any cows with suspicious clinical signs indicative of SBV (Wüthrich et al., 2016). At the end of 2012, over 99% of Swiss cattle herds tested positive for antibodies to SBV (Balmer et al., 2014). Therefore, a seronegative status of the herd was not applicable for control herds.

Recruitment of farms for the herd level analysis was performed by phone calls, carried out by two study veterinarians between October 2012 and April 2013 (Wüthrich et al., 2016). At that time, information on clinical signs observed in individual cows was collected in order to confirm whether the farm complied with the case definition. Between May and December 2013, all farms were visited once, and details on clinical signs were registered during face-to-face interviews with the farmers. Furthermore, treatment records and veterinary bills were collected. In combination with the farmers' reports and available results from the reference laboratory (SBV PCR and/or ELISA), the records were manually evaluated to assign individual cows to either the clinical or the non-clinical group, depending on the nature and number of clinical signs. Cows with at least two typical clinical signs (fever, diarrhoea, milk loss or abortion) were assigned to the group of clinical animals, whereas animals with no or only one of these clinical signs were assigned to the non-clinical group.

By definition, animals in control herds had not shown clinical signs of SBV infection (Wüthrich et al., 2016). Yet to avoid any misclassification bias on the animal level, non-clinical animals were only included in the study if non-clinical status could be verified by farm records provided on the animal level. The inclusion criterion for the present investigation at animal level was thus good quality records on the presence or absence of clinical signs during the SBV epidemic for the individual animal. In addition, production and fertility data had to be available for the individual animal.

It must be noted that both clinical and non-clinical animals were likely to be seropositive due to the extensive spread of SBV in the second half of 2012 (Balmer et al., 2014).

The study design, including the number of investigated herds and animals, is illustrated in Fig. 1. From the 77 case and 84 control herds

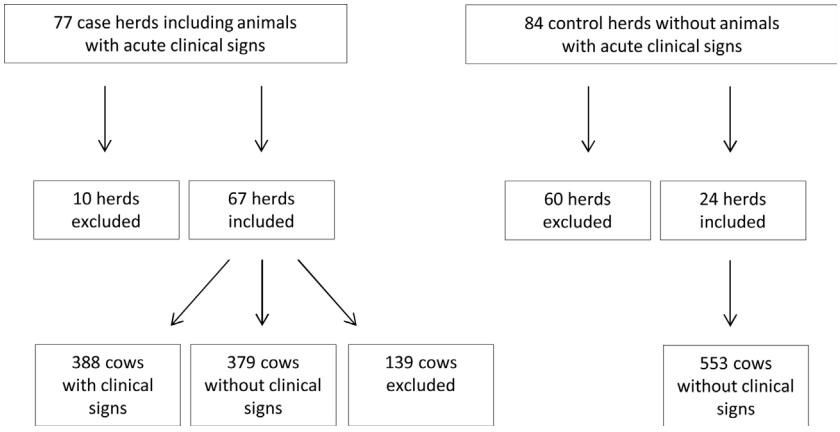

Fig. 1. Selection of animals with and without clinical signs to assess the association between clinical signs and fertility and production parameters after acute Schmallenberg virus infection in Swiss dairy cows; herds and animals were excluded based on lack of reliable production data and/or uncertain clinical status.