Preventive Veterinary Medicine 126 (2016) 54–65

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

A case–control study to estimate the effects of acute clinical infection with the Schmallenberg virus on milk yield, fertility and veterinary costs in Swiss dairy herds

M. Wüthrich[a], I. Lechner[b], M. Aebi[a], A. Vögtlin[c], H. Posthaus[d], G. Schüpbach-Regula[b], M. Meylan[a,*]

[a] Clinic for Ruminants, Vetsuisse Faculty, University of Berne, Bremgartenstrasse 109a, 3012 Berne, Switzerland
[b] Veterinary Public Health Institute, Vetsuisse Faculty, University of Berne, Schwarzenburgstrasse 155, 3097 Liebefeld, Switzerland
[c] Institute of Virology and Immunology, Sensemattstrasse 293, 3147 Mittelhäusern, Switzerland
[d] Institute of Animal Pathology, Vetsuisse Faculty, University of Berne, Länggassstrasse 122, 3012 Berne, Switzerland

ARTICLE INFO

Article history:
Received 5 October 2015
Received in revised form 22 January 2016
Accepted 25 January 2016

Keywords:
Schmallenberg virus
Dairy cattle
Clinical signs
Financial losses
Switzerland

ABSTRACT

Schmallenberg virus (SBV) was first detected in Switzerland in July 2012 and many Swiss dairy farmers reported acute clinical signs in dairy cattle during the spread of the virus until December 2012. The objectives of the present study were to investigate the effects of an acute infection with SBV on milk yield, fertility and veterinary costs in dairy farms with clinical signs of SBV infection (case farms), and to compare those farms to a matched control group of dairy farms in which cattle did not show clinical signs of SBV infection.

Herd size was significantly ($p < 0.001$) larger in case farms (33 cows, $n = 77$) than in control farms (25 cows, $n = 84$). Within case herds, 14.8% (median) of the cows showed acute clinical signs. Managers from case farms indicated to have observed a higher abortion rate during the year with SBV (6.5%) than in the previous year (3.7%). Analysis of fertility parameters based on veterinary bills and data from the breeding associations showed no significant differences between case and control farms. The general veterinary costs per cow from July to December 2012 were significantly higher ($p = 0.02$) in case (CHF 19.80; EUR 16.50) than in control farms (CHF 15.90; EUR 13.25). No differences in milk yield were found between groups, but there was a significant decrease in milk production in case farms in the second half year in 2012 compared to the same period in 2011 ($p < 0.001$) and 2013 ($p = 0.009$). The average daily milk yield per cow (both groups together) was +0.73 kg higher ($p = 0.03$) in the second half year 2011 and +0.52 kg ($p = 0.12$) in the second half year 2013 compared to the same half year 2012. Fifty-seven percent of the cows with acute clinical signs ($n = 461$) were treated by a veterinarian.

The average calculated loss after SBV infection for a standardized farm was CHF 1606 (EUR 1338), which can be considered as low at the national level, but the losses were subject to great fluctuations between farms, so that individual farms could have very high losses (>CHF 10,000, EUR 8333).

1. Introduction

In the summer of 2011, a new disease entity was reported in dairy cattle in North Rhine-Westphalia, Germany, and in the Netherlands. The short-lived acute clinical signs in adult cattle included fever, drop in milk production, and watery diarrhea (ProMed-Mail, 2011). In November 2011, a novel virus was isolated from a blood sample of a cow with acute clinical signs of this new disease entity. This new virus, belonging to the genus Orthobunyavirus of the family Bunyaviridae (Simbu serogroup), was designated as Schmallenberg virus (SBV) after the city in Germany where the affected cow originated from. Members of the Simbu serogroup had not been detected in Europe before (Hoffmann et al., 2012). In the following months, farmers in the Netherlands observed an outbreak of malformations in lambs, and SBV RNA was detected in brain tissue from 22 out of 54 examined lambs, as well as in malformed calves and kids. The main malformations were arthrogryposis, ankylosis, torticollis, scoliosis, kyphosis, brachygnathia inferior, hydrocephalus, and hydranencephaly (Van den Brom et al., 2012; Bilk et al., 2012; Herder et al., 2012).

* Corresponding author. Fax: +41 31 631 26 31.
E-mail address: mireille.meylan@vetsuisse.unibe.ch (M. Meylan).

http://dx.doi.org/10.1016/j.prevetmed.2016.01.021
0167-5877/

Susceptible species include wild and domestic ruminants, and the virus is transmitted by biting midges, especially Culicoides (Elbers et al., 2012; Linden et al., 2012; Goffredo et al., 2013). In infected animals, viremia lasts only for three to five days, and antibodies can be detected two weeks after infection (Wernike et al., 2013). While malformations have been reported in newborn calves, lambs, and kids, with the highest incidence in lambs (Afonso et al., 2014), acute clinical signs were mainly observed in adult cows (European Food Safety Authority, 2012a).

In Switzerland, veterinarians and farmers had been instructed in February 2012 to submit malformed and dead calves for testing for Schmallenberg virus and specific antibodies. In order to ensure early virus detection, testing was extended to adult cattle with fever, diarrhea, and reduced milk production in June 2012 (Schorer et al., 2012; Balmer et al., 2014). Since the first virus detection in mid-July 2012 in cows on two different farms in the canton of Berne (Schorer et al., 2012), SBV spread rapidly throughout Switzerland; as of December 2012, the herd seroprevalence had reached 99.5% compared to 19.7% in July 2012. Some farmers observed the typical clinical signs of acute infection in adult cattle, but animals were mainly found to have seroconverted without showing clinical signs of acute infection (Balmer et al., 2014). In 2012, several other countries reported cases of SBV infection, and all of Europe had been infected by the end of the year (Doceul et al., 2013).

The rapid spread of SBV and the presence of malformations in newborn ruminants have induced extensive research activity on this new infectious disease. At first, many studies were focused on virus detection and epidemiology of the disease, mainly based on seroprevalence studies (Elbers et al., 2012; Bouwstra et al., 2013). Further studies then addressed the impact of SBV infection on fertility, milk production and animal welfare, and revealed substantial losses in affected farms (Martinelle et al., 2012; Veldhuis et al., 2014b).

The aims of the present study were to estimate the effects of an acute infection with SBV on animal health, fertility and milk production in farms with clinically affected dairy cows, and to compare these parameters with those of matched farms where the animals had not been observed to be clinically ill. A further aim was to assess the financial losses resulting from reduced milk production, reduced fertility, and calf death or malformations, and to calculate the therapy costs associated with the acute phase of the disease in farms with clinically affected animals. For this purpose, selected production parameters relative to milk yield and fertility were compared over time, i.e. for the time periods immediately before, during and after the outbreak of acute SBV infection in the summer and fall of 2012.

2. Materials and methods

2.1. Farm selection and sample size

The present study was designed as a matched case–control study. Case farms were selected from a list of the Swiss reference laboratory for viral diseases (Institute of Virology and Immunology, IVI, Mittelhäusern, Berne) which had analyzed all samples from animals suspected of being infected with SBV in Switzerland in 2012. A dairy farm was regarded as a case farm if at least one cow in the herd had been observed with at least two clinical signs suspicious of SBV infection (fever, diarrhea, decreased milk yield) in the summer or fall of 2012, and had been confirmed as positive by ELISA or RT-qPCR for SBV RNA in 2012. If abortions had been the main clinical sign in a case herd, at least two cows had to have aborted and shown at least one other classical clinical sign of acute SBV infection in 2012 in addition of being ELISA or RT-qPCR positive. The managers of potential case farms were first contacted by phone and invited to participate in the project. They were briefly interviewed by the investigator to verify that all inclusion criteria were fulfilled, and they were asked to provide an overview of farm characteristics and of the observed clinical signs. When the farm manager agreed to participate, the local veterinarian was asked to identify potential control farms. These had to fulfill the following criteria to be matched to case farms: close location (maximal distance: 10 km), similar average milk yield, housing system, and breed, no suspicious clinical signs of SBV in adult cattle in the summer and fall 2012, and no noticeably elevated occurrence of abortions in 2012.

A sample size of 76 case and 76 control farms was calculated using WinEpiscope 2.0 software (Thrusfield et al., 2001) in order to detect a difference in mean milk production between case and control farms of 0.25 times the standard deviation with 80% power and 90% confidence (one-tailed test). This sample size was large enough to allow the detection of differences in the mean incidence of stillbirth between case and control farms with the same power and confidence if 0.5% of control farms and 7% of case farms had stillbirths. A total of 175 farmers were recruited between October 2012 and April 2013, and results from 161 (77 case and 84 control) farms were included in the analyses. Fourteen farmers (7 per group) were lost to follow-up during the study because of changes in the farm structure or because they were not willing to make the effort of providing the requested data.

2.2. Farm visits and questionnaire

Case and control farms were visited once between May and December 2013, and a questionnaire was filled in, which included questions about general farm characteristics (geographic localization, herd size, housing system, animals, welfare label, milk yield, milking system, feeding, disease control measures, fertility), the farmers' knowledge about SBV (epidemiology, clinical signs), and questions to investigate possible risk factors for the occurrence of acute clinical signs of SBV infection (climate, housing, pasturing, summer alpine pasturing, animal movement, breeding methods—artificial insemination vs. mating-, insect control, presence of standing water around the farm, density of wild ruminants on the premises). The questionnaire had been previously tested with four farmers. For case farms, additional questions were asked about the clinical signs observed for each affected cow, as well as the farmers' self-estimated loss of production (reduced milk yield, abortion, stillbirths, reduced reproductive efficiency—number of inseminations per cow-, culling), and treatment costs due to acute disease following SBV infection.

2.3. Data collection

In addition to the questionnaire, veterinary bills, veterinary treatment records, and data from the respective Swiss breeding associations (swissherdbook, Braunvieh, and Holstein) were collected for the time frame between January 2011 and December 2013 to assess the impact of SBV infection on veterinary costs, milk yield, and fertility. Data for milk yield and fertility were missing for 19 farms (7 case and 12 control farms) which were not members of a breeding association.

All farmers gave written permission for accessing their data on the Swiss animal movement database (Tierverkehrsdatenbank, TVD) and the breeding associations' databases. The TVD was used to complete missing data regarding calving dates.

2.4. Serology and necropsies

During the farm visits in 2013, blood samples were collected from five cows per herd. Schmallenberg virus is known to produce a high within-herd prevalence in infected herds (Elbers et al.,