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Evaluation of a protocol to reduce the incidence of neonatal calf diarrhoea on dairy herds

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ABSTRACT

Calf diarrhoea causes substantial economic losses in cattle herds worldwide. Neonatal calves are particularly sensitive to infections with enteropathogens. The present study focused on prevention against the main infectious causes of neonatal calf diarrhoea i.e. *Escherichia coli*, rota- and coronavirus, and *Cryptosporidium parvum*. Dairy herds ($n = 24$) with a high percentage of neonatal calves scouring (>10%) were included and calves were sampled for the presence of these four enteropathogens. To decrease diarrhoea problems among neonatal calves, a standard protocol was tested on 13 herds (treatment group) where both *C. parvum* and either *E. coli* or rota- or coronavirus were identified as being involved, the other 11 herds served as control group. The protocol consisted of 2 points of action: preventive vaccination of dams against *E. coli*, rota- and coronavirus, and preventive administration of halofuginone lactate to newborn calves. The average percentage of calves suffering from neonatal diarrhoea (39.7% versus 14.3%, $P < 0.01$) and the average percentage of faecal samples positive for *C. parvum* (34% versus 11%, $P < 0.05$) differed significantly between control herds and treatment herds after implementation of the protocol. No significant differences between control and treatment group were observed in the percentage of calves excreting *E. coli*, rotavirus and coronavirus, both before and at the end of the trial. Furthermore, risk factors potentially associated with the development of neonatal calf scours were determined. Non-significant results were obtained for the effect of the protocol on duration of diarrhoea and the effect of the colostral IgG quantity on the risk of diarrhoea. Passive immunity transfer status of the calves, measured both before the onset and at the end of the study, were non-significant between groups.

1. Introduction

Neonatal calf diarrhoea (NCD) is one of the major health challenges in both beef and dairy cattle herds (De la Fuente et al., 1999; USDA, 2010). The prevalence and incidence risk for NCD has recently been reported to be 19.1 and 21.2%, respectively (Bartels et al., 2010; Windeyer et al., 2014). In the USA, diarrhoea in neonatal calves accounts for more than 50% of unweaned dairy heifer deaths (USDA, 2010). Economic losses are also due to reduced growth rates, treatment costs and time spent caring for the affected calves (Anderson et al., 2003; Ok et al., 2009). Moreover, NCD creates a problem in terms of animal welfare and farmer distress (Lorenz et al., 2011; Smith, 2012). The herd veterinarian is the most adequate person to advice farmers how to treat and how to prevent NCD (Smith, 2012).

Diarrhoea in neonatal calves is a complex, multifactorial and dynamic disease with the balance between

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the host's resistance (i.e. active and passive immunity) and the pathogen pressure being cardinal (Lorenz et al., 2011). Enterotoxic *Escherichia coli*, rota- and coronavirus and *Cryptosporidium parvum* are the four most important enteropathogens causing NCD worldwide (Santín et al., 2004; Trotz-Williams et al., 2007; Gulliksen et al., 2009; Bartels et al., 2010; Silverlås et al., 2010). Rotavirus and *C. parvum* are most frequently identified in faecal samples from calves with NCD: prevalence in calves with diarrhoea ranges from 2.6 to 45.1%, 17.7 to 79.9%, 3.1 to 21.6% and 27.8 to 58.5%, for *E. coli*, rota- and coronavirus and *C. parvum*, respectively (Geurden et al., 2008; Ok et al., 2009; Bartels et al., 2010; Izzo et al., 2011). The simultaneous or consecutive presence of more than one of these pathogens often causes an increased morbidity and mortality rate (Blanchard, 2012).

Each strategy to prevent NCD should begin with a confirmed diagnosis and the setup of a farm interview. The herd anamnesis addressing young stock management creates a list with potential critical control points. Key questions in this anamnesis should focus on: colostrum management, housing and hygiene, feeding of the calves, periods of stress, and drugs used (Blanchard, 2012; Smith, 2012).

The main objective of the present study was to evaluate the effect of a 2-step approach on the incidence of neonatal calves scouring and on the excretion of *E. coli*, rota- and coronavirus and *C. parvum*. This protocol consisted of vaccinating dams against *E. coli* and rota- and coronavirus and administering halofuginone lactate to newborn calves during their first seven days of life.

The secondary objectives were (1) to determine risk factors for developing NCD, (2) to evaluate the effect of this 2-step preventive approach on duration of diarrhoea and mortality, (3) and to evaluate the influence of the total ingested amount of colostral IgG within the first 6 and the first 12 h after birth on the risk for developing diarrhoea.

2. Materials and methods

2.1. Herds and data collection

In total, 79 veterinarians of Flanders and the Netherlands were asked to provide dairy herds with ≥ 50 calving's per year in which >10% of the calves between 0 and 14 days of age were suffering from neonatal scours and no measures to prevent NCD had been taken yet. To be included in the study, herds had to be positive for both *C. parvum* and either *E. coli* or rota- or coronavirus, in order to justify the protocol used (i.e. vaccination of the dams and halofuginone lactate treatment of all calves). A total of 75 dairy herds were provided by 13 veterinarians of which 24 herds met the inclusion criteria. These herds were subsequently randomly assigned to either the control group ($n = 11$) or treated group ($n = 13$). The study was carried out from February 2011 until July 2012.

Each farmer was interviewed on several aspects related to colostrum management, feeding practices, hygiene, current diarrhoea problems and preventive and curative treatment of NCD. All interviews were performed by VM. Part of the questionnaire is presented in Table 1.

On each of these herds, both before inclusion and at the end of the study, faecal samples of 5 randomly selected calves between 0 and 14 days of age were analysed with an ELISA (Rainbow Calf Scour 4, Bio-X Diagnostics, Jemelle, Belgium) to test for the presence of *E. coli*, rota- and coronavirus, and *C. parvum*. This ELISA kit detects *Cryptosporidium* spp., but as data worldwide show that *C. parvum* is the most common species found in calves of this age (Geurden et al., 2007; Langkjær et al., 2007; Xiao et al., 2007), we presumed the species to be *C. parvum*. Also, on each of these herds, both before and at the end of the study, blood samples of 5 randomly selected calves between 2 and 5 days old were collected for the determination of the serum IgG concentration using a commercial radial immunodiffusion kit (Bovine IgG Test Kit, Triple J Farms, Bellingham, USA). The herd status for failure of passive immunity transfer (FPT) was defined as: (1) FPT_{10} being the % of calves with a serum IgG content of <10 g/l and (2) FPT_{15} being the % of calves with a serum IgG content of <15 g/l.

Once included in the study, all herds (treatment and control) were asked to closely monitor the first 20 newborn calves during their first 14 days of life and to daily fill in a form per calf including information on: timing and amount of colostrum ingested, physical appearance of the faeces, appetite, morbidity, demeanour, eventual curative treatments, and mortality. Diarrhoea was defined as faeces with a physical appearance of score 2 or 3 with scores being: 0 = normal firm faeces, 1 = normal soft faeces, 2 = runny faeces, 3 = watery faeces. Duration of diarrhoea was defined as the number of days that a calf had faecal score 2 or 3. Mortality was defined as the percentage of calves that died while having diarrhoea.

Of each dam, a colostrum sample (1.5 ml, mixed four quarter sample) was frozen for later determination of the IgG content using a commercial radial immunodiffusion kit (Bovine IgG Test Kit, Triple J Farms, Bellingham, USA). The IgG data from these colostrum samples were used to estimate the total amount of IgG given to each calf.

2.2. Protocol

In the treated herds, extra preventive measures were taken, i.e.:

(1) vaccination of the dams of the first 20 newborn calves against *E. coli* and rota- and coronavirus with one dose (2 ml IM) of a vaccine specific for *E. coli*, rota- and coronavirus (Rotavec-Corona®, MSD) at 3 months to 3 weeks before the expected calving date;
(2) administration of halofuginone lactate (Halocur®, MSD, Boxmeer, The Netherlands) to the first 20 newborn calves at a dosage of 100 micrograms/kg per day (=2 ml/10 kg) during the first 7 days of life in the milk as a metaphylactic treatment against *C. parvum*.

2.3. Protocol efficacy evaluation

Protocol efficacy was assessed by:

(1) comparing the incidence and duration of diarrhoea and the mortality between control and treated herds (after

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