Preventive Veterinary Medicine xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

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

Occurrence of *Mycobacterium avium* subspecies *paratuberculosis* and *Neospora caninum* in Alberta cow-calf operations

M. Pruvot[a,*], S. Kutz[b], H.W. Barkema[a], J. De Buck[a], K. Orsel[a]

[a] *Department of Production Animal Health, Faculty of Veterinary Medicine, University of Calgary, 3330 Hospital Drive NW, Calgary, Alberta, Canada T2N 4N1*
[b] *Department of Ecosystem and Public Health, Faculty of Veterinary Medicine, University of Calgary, 3330 Hospital Drive NW, Calgary, Alberta, Canada T2N 4N1*

ARTICLE INFO

Article history:
Received 20 January 2014
Received in revised form 25 August 2014
Accepted 5 September 2014

Keywords:
Mycobacterium avium subspecies *paratuberculosis*
Neospora caninum
Ranch management
Biosecurity
Bayesian prevalence estimate
Risk factors
Beef cattle

ABSTRACT

Mycobacterium avium subsp. *paratuberculosis* (MAP) and *Neospora caninum* (NC) are two pathogens causing important production limiting diseases in the cattle industry. Significant impacts of MAP and NC have been reported on dairy cattle herds, but little is known about the importance, risk factors and transmission patterns in western Canadian cow-calf herds. In this cross-sectional study, the prevalence of MAP and NC infection in southwest Alberta cow-calf herds was estimated, risk factors for NC were identified, and the reproductive impacts of the two pathogens were assessed.

Blood and fecal samples were collected from 840 cows on 28 cow-calf operations. Individual cow and herd management information was collected by self-administered questionnaires and one-on-one interviews. Bayesian estimates of the true prevalence of MAP and NC were computed, and bivariable and multivariable statistical analysis were done to assess the association between the NC serological status and ranch management risk factors, and the clinical effects of the two pathogens.

Bayesian estimates of true prevalence indicated that 20% (95% probability interval: 8–38%) of herds had at least one MAP-positive cow, with a within-herd prevalence in positive herds of 22% (8–45%). From the Bayesian posterior distributions of NC prevalence, the median herd-level prevalence was 66% (33–95%) with 10% (4–21%) cow-level prevalence in positive herds. Multivariable analysis indicated that introducing purchased animals in the herd might increase the risk of NC. The negative association of NC with proper carcass disposal and presence of horses on ranch (possibly in relation to herd monitoring and guarding activities), may suggest the importance of wild carnivores in the dynamics of this pathogen in the study area. We also observed an association between MAP and NC serological status and the number of abortions. Additional studies should be done to further examine specific risk factors for MAP and NC, assess the consequences on the reproductive performances in cow-calf herds, and evaluate the overall impact of these pathogens on cow-calf operations.

* Corresponding author. Tel.: +1 403 210 6683; fax: +1 403 210 6693.
E-mail address: mpruvot@wcs.org (M. Pruvot).

http://dx.doi.org/10.1016/j.prevetmed.2014.09.003
0167-5877/

1. Introduction

Mycobacterium avium subspecies *paratuberculosis* (MAP) and *Neospora caninum* (NC) are two important production-limiting pathogens of cattle (Chi et al., 2002). MAP is responsible for a chronic infection of the digestive tract of ruminants (Nielsen and Toft, 2009), often silent during a latent period ranging from 2 to 10 years (Whitlock and Buergelt, 1996). The clinical stage of the disease, known as Johne's disease, is characterized by chronic enteritis, diarrhea and active shedding in cattle (Behr and Collins, 2010). Johne's disease has a high economic impact due to its consequences for milk production (Kudahl et al., 2004), premature culling and reduced slaughter value (Benedictus et al., 1987; McKenna et al., 2006). It was estimated that MAP infection cost US dairy industry US$200–250 million annually (Ott et al., 1999). In Georgia (USA), MAP infection cost beef producers US$1.8–4.9 million in 2000, assuming a loss of US$75–100 per infected adult beef cow in the herd (Pence et al., 2003). Control of MAP infection usually involves reducing the risk of introduction to the herd, test-and-cull strategies, and ranch management practices related to hygiene at calving, reduction of feed and water contamination, and manure management (McKenna et al., 2006; Canadian Animal Health Coalition, 2009; Roussel, 2011). Alberta has the highest reported prevalence in dairy cattle across Canada (Tiwari et al., 2006) with a cow-level prevalence of 8% and a herd-level prevalence of 27% as determined by serum ELISA (Sorensen et al., 2003). There are only a few reports of Johne's disease in beef cattle in Alberta, indicating a lower cow-level prevalence (1.5%) than in dairy herds and providing little information on risk factors in cow-calf herds (Scott et al., 2007). Given the impact on production, together with the potential correlations between MAP infection and Crohn's disease in humans (Behr and Kapur, 2008; Hermon-Taylor, 2009; Barkema et al., 2010), and the high incidence and prevalence of Crohn's disease in North America and more specifically in Alberta (Molodecky et al., 2012), it is essential to better assess the status of the beef cattle production system regarding MAP infection in the province.

Neosporosis, caused by the protozoan parasite *N. caninum*, is another important production limiting disease of dairy and beef cattle. The estimated cost of NC infection in beef cattle herds in Texas (USA) was estimated at US$23–35 per head or US$978–1479 per 42-head infected herd with a 20% prevalence of NC infection (Kasari et al., 1999). This parasite is found as tachyzoites or tissue cysts in muscles, nervous tissues and reproductive tracts of infected ungulates, and can cause infertility, abortion and birth of weak or chronically infected calves (vertical transmission) (Dubey, 1999). Wild and domestic carnivores, definitive hosts of this parasite, are infected by consumption of tachyzoites or tissue cysts from infected intermediate hosts (Rosypal and Lindsay, 2005; Dubey et al., 2007). The parasite reproduces sexually in the gastrointestinal tract of the carnivore and releases oocysts in the feces. These oocysts sporulate in the environment and can infect cattle through oral exposure (horizontal transmission) (Dubey and Lindsay, 1996). Therefore, horizontal transmission between definitive and intermediate hosts is associated with a predator–prey lifecycle and often related to the presence on farm of dogs (Dijkstra et al., 2002) and wild carnivores (Wapenaar et al., 2006; Dubey et al., 2011) having access to infected tissues and abortion material. In contrast, vertical transmission (from dam to fetus) involves other herd management risk factors such as the purchase of replacement heifers and control measures such as culling of infected cows (Dubey et al., 2007). Presence of NC was previously reported in beef cattle in the province (Waldner et al., 2001; Scott et al., 2007; Waldner and Kennedy, 2008), but it was suggested that more information about the risk factors, the relative importance of horizontal or vertical transmission, and impact of NC was required in the different provinces of Canada (Haddad et al., 2005). With a high density of cow-calf herds, wild ungulates and wild carnivores, southwestern Alberta is a particularly interesting area to investigate the occurrence, transmission patterns and risk factors of NC (Morehouse and Boyce, 2011; Pruvot et al., 2014).

The objectives of this cross-sectional study were to describe the prevalence of MAP and NC infection in southwest Alberta cow-calf herds, identify risk factors associated with NC, assess their reproductive impact, and report on ranch management practices relevant to NC, MAP, and the occurrence of infectious diseases in cow-calf operations.

2. Materials and methods

2.1. Herd selection and sampling

Cow-calf operations maintaining more than 100 adult cattle were selected in the municipal districts of Pincher Creek, Crowsnest Pass, Willow Creek, and Cardston, Alberta, Canada. Among 54 operations initially identified by local veterinarians and preliminary ranch visits, 30 agreed to participate. Because the incubation period of MAP is long (Whitlock and Buergelt, 1996), cows of second parity or greater were selected to increase the probability of detection of MAP. Thirty such cows from each ranch were selected by systematic sampling during handling operations in Fall/Winter 2011 (1 sample every *N* cows, with *N* being the total number of cows meeting the selection criteria divided by 30, the first cow being randomly picked among the *N* first cows using a random number table). From each sampled cow, a fecal sample was collected from the rectum and a blood sample from the coccygeal vein. This sample size allowed for the detection of a percentage of positive individuals of at least 10% with 95% confidence. At sampling, the following individual cow data were recorded: animal ID, sex, age, breed, origin (born on ranch or purchased), pregnancy status (if a pregnancy diagnosis was performed by the veterinarian), parity, and history of abortion. The protocol of this study was reviewed and approved by the Animal Care Committee of the University of Calgary under the certification file M09123.

2.2. Ranch management data collection

Previously published risk factors for the introduction, intra-herd transmission, and maintenance of MAP and NC

Please cite this article in press as: Pruvot, M., et al., Occurrence of *Mycobacterium avium* subspecies *paratuberculosis* and *Neospora caninum* in Alberta cow-calf operations. PREVET (2014), http://dx.doi.org/10.1016/j.prevetmed.2014.09.003