Fatal *Trichuris* spp. infection in a Holstein heifer persistently infected with bovine viral diarrhea virus

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Abstract — Whipworms (*Trichuris* spp.) were identified in the colon of a recently purchased, 10-month-old dairy heifer that died suddenly. A skin test was positive for bovine viral diarrhea virus (BVDV). Signs of BVDV occurred in other heifers in the group, but fecal flotations were negative for whipworm eggs.

Résumé — Infection mortelle à *Trichuris* spp. chez une génisse Holstein infectée de façon continue par le virus de la diarrhée virale bovine. Des trichocéphales (*Trichuris* spp.) ont été identifiés dans le côlon d'une génisse laitière âgée de 10 mois récemment achetée et décédée subitement. Un test cutané s'est avéré positif pour le virus de la diarrhée virale bovine (VDVB). Des signes de VDVB se sont manifestés chez d'autres génisses du groupe mais les flottaisons fécales étaient négatives pour les œufs de trichocéphales.

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Whipworm (*Trichuris* spp.) infestations are rarely of clinical significance in ruminants (1,2). However, persistent infection with bovine viral diarrhea virus (BVDV) may suppress an animal's immune function, allowing *Trichuris* spp. to attach to the mucosa of the cecum and colon. Clinical trichurosis may cause ill thrift, diarrhea, lethargy, weakness, and death. Persistent infection with BVDV is an important health concern in herds that frequently purchase animals, including start-up dairy herds and heifer and veal calf operations. In addition to the more traditional approaches of virus isolation or fluorescent antibody staining of gastrointestinal tissues, immunohistochemical staining may be used to diagnose BVDV infection by observation of the stain in specific locations in sections of skin samples.

A fatal whipworm infection occurred in a 10-month-old Holstein heifer in a custom heifer and veal calf operation in southwestern Ontario in May 2002. The heifer was one of a group of 28 bought from a local cattle dealer 3 wk earlier. Approximately 40 Holstein bull calves were bought at the same time and housed in the same facility. The owner was not aware of the origins of any of the heifers or veal calves. Each group was housed in a large pen in a converted bank barn. There was the possibility of nose-to-nose contact between groups. However, only the heifers had access to an outdoor concrete yard, with exposure to pasture limited to what the animals could reach under the fence. Approximately 3 wk after purchase, the owner requested that his veterinarian perform necropsies on 4 animals (3 heifers and 1 bull calf) that had died the day before. The owner had observed clinical signs of pneumonia in the herd for at least the previous 10 d. On postmortem examination, pulmonary and pleural lesions typical of chronic pleuropneumonia were observed in 1 heifer (H-1) and the bull calf; ulcerative and ischemic lesions, indicative of acute BVDV infection were observed in several organs in another heifer (H-2); the third heifer (H-3) appeared normal, except for serosal congestion in a 15-cm segment of colon. When the segment was opened, many nematodes with the characteristic appearance of whipworms were observed, both attached to the intestinal mucosa and free in the intestinal lumen. Although the owner recalled that H-3 had appeared "unthrifty" since purchase, diarrhea had not been observed.

Standard fecal flotation (1) was performed on feces from all 4 dead animals and from a random sample of 20 other heifers. A large number of bipolar, trichurid-type eggs were observed in the sample from H-3. Small numbers of coccidia oocysts were observed in 3 fecal samples, but no other samples were positive for trichurid eggs. Herd treatment with an anthelmintic, moxidectin, was initiated as a precautionary measure.

Samples of skin, skeletal muscle, thyroid, lung, heart, liver, spleen, rumen, abomasum, small intestine, colon, kidney, and adrenal gland were collected from H-3, placed in 10% buffered formalin, and submitted to the Animal Health Laboratory, University of Guelph (Guelph, Ontario) for histological examination. The laboratory reported mild colitis with crypt cell necrosis and herniation extending into the submucosa of the large intestine. An aggregate of nonmammalian eosinophilic

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cells were found in the colonic lumen in 1 section, but no whipworms were observed attached to the mucosa. Additionally, moderate rumenitis, characterized by single cell necrosis and parakeratosis, was observed. The lungs appeared congested and edematous on histological sections. Tissues from H-3 were submitted for BVDV immunohistochemical staining to rule out the possibility that the animal was persistently infected with BVDV. Although no positive staining was observed in the colon or rumen, a sparse staining pattern in the skin sections was diagnostic of persistent infection with BVDV.

Bovine whipworm infestations are generally thought to be clinically inconsequential (1,2). To the author's knowledge, there have been only 4 reports in the literature of fatal trichurosis in young cattle since 1970, with all cases occurring in eastern Canada or New York state (3–6). Other authors have noted that *Trichuris* spp. eggs are resistant to the extreme cold of winter, making contaminated pastures in these regions susceptible to annual increases in egg burdens (5). Regional differences in BVDV prevalence and type might be a contributing factor to this geographical clustering of trichurosis. It would be unusual for trichurosis to occur in an individual with no access to pasture, as the common route of infection is ingestion of infective eggs from soil (1). However, Smith and Stevenson (6) reported an outbreak of trichurosis in stabled animals, with the presumptive source of infection being the dry manure pack.

As the prepatent period of *Trichuris* spp. is 6 to 8 wk in ruminants (2), and the case herd had been assembled only 3 wk before adult worms were observed in heifer H-3 and trichurid eggs were identified in a fecal sample, the infection must have been acquired either on the premises of the dealer or, more likely, on the farm of origin. It was not possible to contact the heifer's original owner to inquire about relevant disease history or management practices.

Trichuris discolor is the species most often identified in reports of bovine trichurosis (3,5,6). However, *T. ovis, T. globulosa,* and *T. skrjabini* have all been isolated from ruminants (2). In this case, poor preservation of the whipworms did not allow for speciation to be performed.

The immunohistochemical staining technique used in skin samples is highly specific for persistent BVDV infection (7). In persistently infected animals, dark brown granules are observed in the epithelium of hair follicles and adjacent cells in the dermis; in acutely infected animals, staining is limited to the epidermis and cells in the superficial dermis (7). The staining pattern in the skin sample from heifer H-3 was characteristic of persistent BVDV infection.

In previous investigations of bovine trichurosis, concomitant infection with *Trichuris* spp. and BVDV had not been observed (5), and attempts to diagnose BVDV infection were not made (3,4,6). Concurrent trichurosis and persistent BVDV infection is unusual, but not entirely unexpected, as animals persistently infected with BVDV are susceptible to a variety of diseases and secondary infections, most notably respiratory diseases (8). The high prevalence of respiratory disease in this group of cattle at the time of investigation may have been due, in part, to the presence of 1 or more persistently infected animals in the herd. The many immunosuppressive effects of BVDV infection include several deficits that result in markedly decreased mobilization and localization of monocytes and macrophages in response to an antigen (8). This effect might be very significant in diminishing immunologic protection of the intestinal mucosa against opportunistic pathogens, such as *Trichuris* spp. In this case, BVDV was not identified in the intestinal mucosa, making it less likely that mucosal damage associated with BVDV infection permitted establishment of an opportunistic secondary infection with *Trichuris* spp.

The risk factors for clinical trichurosis include overstocked pastures, suboptimal anthelmintic programs, prolonged use of a pasture over many years, and heavy fecal contamination, especially by mature animals, in areas where young stock are pastured. Although control of whipworm infection is usually not the basis of bovine anthelmintic programs, a deworming regime for major gastrointestinal nematodes that incorporates the use of a macrocyclic lactone anthelmintic (ivermectin, dorimectin, or moxidectin) should result in acceptable whipworm control (9).

Control of BVDV infection is based on identifying and eliminating BVDV-shedding animals from the herd, following an appropriate vaccination schedule against BVDV infection, and avoiding introduction of animals persistently infected with BVDV into the herd. The latter step is particularly difficult for start-up operations, herd expansions, and custom heifer and veal operations. Whenever possible, new additions to a herd should come from herds with a historically low incidence of BVDV infection and a record of an appropriate vaccination history against BVDV infection in the animals to be purchased.

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