Article

A pilot study of *Coxiella* seroprevalence in occupationally exposed individuals in the Peace River region of Alberta and British Columbia

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Abstract — A pilot seroprevalence study was performed among asymptomatic occupationally exposed individuals in June, 2016 in the Peace River region of Alberta and British Columbia. Five of 40 subjects — 3 of 24 small ruminant producers, 1 of 14 abattoir workers, and 1 of 2 veterinarians had evidence of *Coxiella* exposure. More systematic surveillance and more active promotion of biosecure husbandry methods should be considered.

Résumé — Étude pilote sur la séroprévalence de *Coxiella* chez les personnes exposées en milieu de travail dans la région de la rivière de la Paix en Alberta et en Colombie-Britannique. Une étude pilote sur la séroprévalence a été réalisée parmi les personnes asymptomatiques exposées en milieu de travail en juin 2016 dans la région de la rivière de la Paix en Alberta et en Colombie-Britannique. Cinq des 40 sujets — 3 de 24 producteurs de petits ruminants, 1 de 14 travailleurs d'abattoir et 1 de 2 vétérinaires, présentaient des signes d'exposition à *Coxiella.* Une surveillance systématique accrue et une promotion plus active de méthodes d'élevage biosécuritaires devraient être considérées.

(Traduit par Isabelle Vallières)

Can Vet J 2018;59:770–772

Introduction

Coxiella burnetii, the cause of Q fever, infects a wide range of mammalian hosts worldwide. It usually causes sporadic infections in humans following exposure to herd animals, particularly small ruminants, although large outbreaks have been described (1). In contrast with other pathogenic agents associated with animal husbandry, *Coxiella* is rarely transmitted to humans through milk or meat products, but is most often acquired *via* airborne transmission of the environmentally hardy spores. Producers rather than consumers are likely to be at greatest risk of infection but other risk groups include abattoir workers, in whom the disease was first recognized, and veterinarians or other individuals in proximity to parturient small ruminants, may also be exposed (2). Birth products are the most infectious source, which implies an opportunity for reduction of transmission risk by focusing on interventions or precautions during lambing or kidding. Human infection is most commonly asymptomatic, but can result in a symptomatic self-limiting febrile illness, pneumonia, hepatitis, or less commonly, endocarditis which is associated with a high case fatality rate in the absence of prolonged antimicrobial therapy.

In small ruminant production, the main problematic outcome of Q fever infection is abortion, so the disease is thought to be most often recognized in a herd following an "abortion storm." However, as transmission through milk or meat is not commonly recognized, it has not been a priority for public health or food safety in Alberta.

Infectious disease physicians in Edmonton see sporadic human cases of this infection, usually in association with sheep or goat husbandry. The infection is reportable in humans in Alberta under The Public Health Notifiable Disease Management Guidelines. To our knowledge, there has never been any form of systematic surveillance of this infection in humans or small ruminants in Alberta, although relatively high estimates of prevalence have been found in producers and veterinarians in small studies in Ontario and Nova Scotia (3–5) and seroprevalence was 14.7% among 2363 sheep on 72 Ontario farms (6).

Following a severe case of human infection that required hospitalization, biopsy of the liver, and weeks of disability, associated with exposure to a lambing barn in the Peace River area, we received a request for information from local producers. We were unable to provide local prevalence data, so in discussion with the producers, we agreed to carry out a pilot survey among individuals likely to be at risk of exposure in the region.

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Table 1. Characteristics of seropositive subjects.

Case number	Session	Gender	Comments	Laboratory results
6	Abattoir worker	F	Involved in slaughter, estimated 100/year over 5 years. Not involved with lambing/kidding.	Phase II 1:64 Phase I 1:64
15	Producer meeting 1	F	Directly involved in lambing: 150 head, lambed out 225/year in barn. Slaughter 1/year.	Phase II 1:32 Phase I < 1:32
21	Producer meeting 1	M	Contact with small ruminants outside Alberta. Average herd size 100. Estimated number of kids 200/year both in barn and outside.	Phase II 1:32 Phase I < 1:32
22	Producer meeting 1	F	Veterinarian. Not producer. Involved in lambing/kidding. Not involved in slaughter or processing.	Phase II 1:128 Phase I 1:32
32	Producer meeting 2	F	Average herd size 150, reporting 200 to 300 lambed out/year in barn.	Phase II 1:128 Phase I < 1:32

Ethics approval was obtained from the University of Alberta Research Ethics Board, and each volunteer provided signed, informed consent.

Materials and methods

In June 2016, blood samples were collected from volunteers at 2 local meetings of small ruminant producers in the Peace River region of northern Alberta (AB) and British Columbia (BC) (each of which was also attended by 1 local veterinarian) and from employees at 1 abattoir. Participants filled out a questionnaire detailing their history of exposure to small ruminants, including their involvement with animal husbandry and production, slaughter, or birthing activities in the region.

Serum was tested by both immunofluorescence antibody assay (IFA) and enzyme-linked immunosorbent assay (ELISA) at the National Laboratory for Microbiology in Winnipeg. Serum samples were tested using the Focus Diagnostics Q fever IFA IgG kit (Bio Nuclear Diagnostics, Toronto, Ontario) and the Panbio *Coxiella burnetii* (Q fever) IgG ELISA (Alere, Ottawa, Ontario) as recommended by the manufacturers. Samples were screened at a titer of 1:32 by the IFA to both phase I and II antigens (Nine Mile strain) and titered to endpoint. The wells of the Panbio ELISA plates are coated with phase II antigen only (strain not specified). Samples with a titer of $\geq$ 32 to phase II antigen by the IFA were considered seropositive — all of these samples also tested positive on the ELISA (Panbio units of $>$ 11).

Results

Forty volunteers participated in this pilot study: 10 and 16, respectively from the 2 meetings of producer groups in the Peace River region, in Tower Lake BC and Rycroft AB; and 14 from an abattoir in Grande Prairie that processes sheep and goats.

Twenty-two producers reported raising sheep only, 8 sheep and goats, and 1 producer raised goats only. Sixteen of the 24 who raise goats and/or sheep reported using barns for kidding/lambing. Nine participants reported contact with small ruminants outside of AB or BC: 4 from Ontario, 2 from Hawaii, 1 from Manitoba, 1 from Germany and 1 from both Manitoba and Ontario.

Thirteen samples tested positive or equivocal by ELISA, but only 5 [12.5%; 95% confidence interval (CI) 4.2 to 26.8) of these samples also tested positive on the IFA, which is considered the gold-standard for the detection of antibodies to *Coxiella burnetii.*

The 5 subjects which were positive by both IFA and ELISA, indicating past exposure to *C. burnetii,* comprised 1 of 14 abattoir workers (who did not report lambing/kidding exposure), 1 of 2 veterinarians (who had exposure to lambing and kidding but not slaughter and was not a producer), and 3 of 24 producers. All 3 producers with positive serology reported lambing/kidding indoors. None reported being tested for Q fever previously (Table 1).

All seropositive subjects were contacted by phone to be informed of their test results and none gave a history concerning for the presence of chronic Q fever. The serologic pattern of response to phase 1 and 2 antigens was not suggestive of chronic infection in any patient. None of the patients had a history of valvular heart disease. Where permission was given, the results were also shared with their family doctor.

Discussion

In the province of Alberta, there has been an average of fewer than 3 reported human cases of *Coxiella* per year over the last 15 y, with considerable year-to-year variation (7). By contrast, based on our relatively small sample, evidence of *Coxiella*

exposure appears to be common among individuals with occupational exposure risk in the Peace region of northern Alberta and British Columbia. Of note, positives were found at each of the 3 locations visited and in producers and appendicular industry workers (1 abattoir worker, 1 veterinarian), suggesting that the infection is not limited to 1 geographic area or occupation. This apparent discrepancy between our findings and the numbers of reported cases may be explained by the high proportion of infections which are unrecognized because they are asymptomatic or self-limited, and by under-diagnosis of symptomatic illness due to lack of awareness on the part of both patients and doctors. While it is less likely that the diagnosis of rare, life-threatening manifestations of Q fever would be missed, our findings suggest a substantial level of transmission and a significant burden of unrecognized morbidity (8,9).

In conversation with participants at the 2 producer meetings and at the abattoir, there appears to be relatively little awareness of Q fever among individuals at risk of exposure. Misunderstandings involved not only lack of awareness of the predominant airborne route of transmission, but also unjustified concern about the possibility of government imposed herd health interventions analogous to those applied for *Mycobacterium bovis* or *Brucella.*

One limitation of this study was the small number of samples and the convenience sampling of self-selected volunteer participants that was used. Also, due to a miscommunication with the microbiology laboratory and the logistic constraints of blood collection in rural, non-institutional settings, specimens were hemolyzed. The National Microbiology Laboratory estimated that the presence of hemoglobin in the samples is likely to have reduced the sensitivity of testing, potentially by half. Finally, laboratory diagnosis of Q fever is dependent on *Coxiella* serology and results of microimmunofluorescence assays have been found to be subject to variation among different laboratories (10).

Current knowledge of the status of human *Coxiella* infection in Alberta is rudimentary at best. Since producers are likely to be the group at greatest risk, expanded, more systematic surveillance of this group would be a logical next step. Interest on the part of producer groups and collaboration with provincial health ministries would be critical to an effective surveillance strategy. Decisions regarding more systematic surveillance in herd animals will be affected by the perceived priority on the part of veterinary and agricultural services.

Education, perhaps delivered through producer organizations and local veterinary services, to raise awareness of the importance of biosecurity measures, including personal protective equipment, hygiene practices and enhanced ventilation if lambing or kidding is taking place indoors, and in slaughterhouse environments, could contribute to reduced occupational exposure. Producers should be encouraged to notify local veterinary services if increased abortions are noted in their flock, to enable testing of birth products (placenta and fetuses) by the veterinary reference laboratory. Antibiotic therapy is not effective for reducing shedding in infected animals; however, an effective vaccine (Coxevax; CEVA Animal Health, Lenexa, Kansas, USA) is available for import to Canada under a special Biological Import Certificate. Raised awareness of this infection among individuals with occupational exposure and their physicians could lead to a higher rate of recognition of symptomatic illness episodes and timely diagnosis and treatment. Q fever exemplifies the need to adopt a One Health approach. CVJ

References

1. Hackert VH, van der Hoek W, Dukers-Muijrers N, et al. Q fever: Single-point source outbreak with high attack rates and massive numbers of undetected infections across an entire region. Clin Infect Dis 2012;55:1591–1599.
2. den Brom RV, Schimmer B, Schneeberger PM, Swart WA, van der Hoek W, Vellema P. Seroepidemiological survey for *Coxiella burnetii* antibodies and associated risk factors in Dutch livestock veterinarians. PLoS ONE 2013;8:e54021.
3. Meadows SL, Jones-Bitton A, McEwen SA, et al. Prevalence and risk factors for *Coxiella burnetii* seropositivity in small ruminant veterinarians and veterinary students in Ontario, Canada. Can Vet J 2017;58:397–399.
4. Marrie TJ, Fraser J. Prevalence of antibodies to *Coxiella burnetii* among veterinarians and slaughterhouse workers in Nova Scotia. Can Vet J 1985;26:181–184.
5. Meadows S, Jones-Bitton A, McEwen SA, et al. *Coxiella burnetii* (Q Fever) seropositivity and associated risk factors in sheep and goat farm workers in Ontario, Canada. Vector Borne Zoonotic Dis 2016; 16:643–649.
6. Meadows S, Jones-Bitton A, McEwen S, Jansen J, Menzies P. *Coxiella burnetii* seropositivity and associated risk factors in sheep in Ontario, Canada. Prev Vet Med 2015;122:129–134.
7. Snedeker KG, Sikora C. Q fever in Alberta, Canada: 1998–2011. Zoonoses Public Health 2014;61:124–130.
8. Deyell MW, Chiu B, Ross DB, Alvarez N. Q fever endocarditis: A case report and review of the literature. Can J Cardiol 2006;22:781–785.
9. Stokes W, Janvier J, Vaughan S. Chronic Q fever in Alberta: A case of *Coxiella burnetii* mycotic aneurysm and concomitant vertebral osteomyelitis. Canadian J Infect Dis Med Microbiol 2016, Article ID: 7456157, 3 p.
10. Healy B, van Woerden H, Raoult D, et al. Chronic Q fever: Different serological results in three countries — Results of a follow-up study 6 years after a point source outbreak. Clin Infect Dis 2011;52: 1013–1019.