Evaluation of the Prevalence and Risk Factors for *Dictyocaulus viviparus* Infection in First-lactation Cows: A Sero-Epidemiological Survey

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Introduction

Lungworm disease has classically been described in young calves and occasionally yearlings, with rare occurrences of a re-infestation syndrome in adults. The condition, like other nematode-induced disorders, has decreased in incidence among dairy herds with the widespread use of endectocides in replacement stock. However, in the last decade in Eastern Canada, anecdotal reports from practitioners and articles in farming journals give the impression that the incidence of lungworm disease in adult lactating cattle is higher than usual. At the same time, pasture management methods are changing in some of the dairies where grazing of replacement stock and/or lactating cows is still practiced. Bovine practitioners lack information on actual prevalence of the parasite and risk factors that predispose a herd to infection.

The reference diagnostic test for lungworm disease, Baermann coprology, has relatively low sensitivity, particularly in adult animals where larvae are often absent in the feces. A variety of immunological tests have been used in Europe for screening or diagnostic purposes. Recently, a very promising ELISA test using purified *Dictyocaulus viviparus* antigen has been developed at the University of Missouri in Columbia. One of the main features of this assay is that it greatly limits cross-reactivity with other nematode antigens, which has often been the problem with other tests.

A randomized cross-sectional survey was conducted to establish the prevalence of herds with *Dictyocaulus viviparus* (D.v.) infected first-lactation cows in the province of Quebec and to evaluate risk factors associated with herd infection.

Material and Methods

A total of 1040 cows were sampled from 208 herds in all 7 regions of the province. Individual blood and fecal samples were collected from the 5 most recently calved first-calf heifers on each farm during a single summer season (July-August). Individual fecal samples were submitted to a Wisconsin double-centrifugation test for gastro-intestinal nematode (gin) egg numeration and a pooled fecal sample for each herd was submitted to a Baermann test for D.v. in order to identify a certain number of herds with guaranteed biological infections. Serum samples were submitted to an ELISA test in Columbia, Missouri to detect the presence of antibodies directed against D.v. A questionnaire on pasture management practices was sent by mail to all participating farms and herd owners answered each question by telephone, with a copy in hand.

From the original random sample, six farms where D.v. was identified by Baermann coprology and ten farms where animals had never been outside and had no fecal gin eggs were chosen respectively as positive and negative gold in order to chose a « herd ELISA cutoff » for infection of first-lactation cows by *Dictyocaulus viviparus*. A herd cutoff was chosen in terms of number of animals positive to the individual serum ELISA (at a pre-defined individual cutoff) among the 5 sampled. Prevalences were calculated for each region and for the province. Risk ratios were calculated for exposure of heifers and cows to pasture. Other risk factors were evaluated by logistic regression, considering the three following sub-samples 1) farms where cows and heifers are exposed to pasture, 2) all farms where cows are exposed to pasture and 3) all farms where heifers are

exposed to pasture.

Results and Discussion

When using a threshold of 3 positives out of the 5 cows sampled to declare a herd positive the test had an accuracy of 81% and predictive values for positive and negative results of 80% and 81% respectively. The likelihood ratio for infestation of a herd given a positive result (at the 3/5 cutoff) was 4.09 and given a negative result of 0.22. This cutoff corresponds to a test specificity of 90% and sensitivity of 67%. These values do not qualify the ELISA test itself, but the use that was made of it. A greater sample size per herd and individual Baermanns would probably have allowed the selection of a better cutoff, however, to evaluate prevalence this cutoff was considered the best.

The weighted provincial prevalence was 31% (95% C.I.:16%-46%) and variations were noted between regions ($F = 2.61$ $p = 0.02$). Exposure of heifers to pasture was associated with infection of first-lactation cows in herd with a risk ratio of 2.21 ($p= 0.06$), the association with exposure of lactating cows to pasture was stronger (risk ratio= 2.72, $p < 0.01$). Other important risk factors (see Table 1) were: mechanical mowing of heifer pasture (increased risk), number of lactating cows in herds greater than 70 (increased risk), all-summer access to same paddock for heifers (increased risk), complete paddock changes during summer for heifers (decreased risk) and co-grazing of heifers with dry cows (increased risk). Proportion of heifer diets derived from pasture and intensive pasture rotation were not significantly associated with infection.

Table 1. Risk factors for infection of first-lactation cows with *Dictyocaulus viviparus* in herd.

	Farms where heifers and cows are pastured		Heifers are pastured (whether or not cows are)		Lactating cows are pastured (whether or not heifers are)	
Number of farms	122		154		139	
	Odds Ratio[1]	p-value	Odds Ratio	p-value	Odds Ratio	p-value
Heifer's pasture mowed	2.9	$p < 0.05$	2.2	$p < 0.05$	—	—
Heifers = complete paddock changes during summer	0.2	$p < 0.05$	0.2	$p < 0.1$	—	—
Heifers = all-summer access to same paddock	2.2	$p = 0.1$	2.2	$p < 0.1$	—	—
More than 70 cows in herd	4.9	$p < 0.1$	3.8	$p < 0.1$	3.6	$p = 0.1$
Heifers grazed with dry cows	2.0	$p < 0.1$	NS[2]	NS	NS	NS
Cows exposed to pasture	—	—	5.2	$p < 0.05$	—	—
Heifers exposed to pasture	—	—	—	—	3.9	$p < 0.1$

[1] When an Odds Ratio is superior to 1, the risk factor is associated to an increased risk and when it is below 1, it is associated to a decreased risk.
[2] NS = Not statistically significant at the $\alpha = 0.1$ level.

The results of this study indicate that the prevalence of herds where first-lactation cows are infected with D.v. is relatively high in Québec. The infection is more prevalent in larger herds. The fact that the association of infection with lactating cow exposure to pasture is stronger than the association with heifer exposure to pasture seems to indicate that at least some of the adult infections are acquired by adult grazing cows. Mechanical mowing of pastures seems to increase the risk of infection, which may be explained by the fact that D. viviparus infective larvae are much less mobile than other nematode infective larvae and have a limited autonomous dispersion capacity, which could be improved by a practice such as mowing. The results also suggest that in the absence of a commercially available vaccine and of no-withdrawal lactating cow treatment, prevention for young cows could be based on heifer treatment and some aspects of heifer pasture management, when pasture is used.