

Cow-level analysis of bovine leukemia virus infection and milk production in Michigan dairy cows

Bo Norby, DVM MPVM PhD¹; Paul C. Bartlett, MPH DVM PhD¹; Todd M. Byrem, PhD²; Ron J. Erskine, DVM PhD¹

¹Department of Large Animal Clinical Sciences, Michigan State University, East Lansing, MI 48824

²Antel BioSystems, Inc., Lansing, MI 48909

Introduction

Enzootic bovine leukosis is a chronic infectious disease of cattle caused by bovine leukemia virus (BLV), a deltaretrovirus. The main route of BLV transmission among cattle appears to be hematogenous transfer of infected B cells. A persistent lymphocytosis (PL) phenotypic state is observed in approximately 30% of infected cattle. Cattle that do not become PL remain aleukemic (AL) with normal lymphocyte counts. About 0.1 to 10% of BLV-infected cows progress to develop lymphoma. Little has been done to limit the spread of BLV in the US dairy herd. In a 1996 National Animal Health Monitoring System (NAHMS) survey of dairy herds in the US, the herd-level prevalence was 89%. A similar herd-level prevalence of 83.9% based on bulk-tank testing was reported in the 2007 NAHMS dairy study, and in a 2010 study of 113 Michigan dairy herds, the mean within-herd prevalence was 32.8%. Bovine leukemia virus infection has been shown to reduce milk production at the herd level. The direct losses associated with BLV infections to the dairy industry and consumers have been estimated to be in excess of \$500 million yearly. The objective of this paper was to determine the association between the predicted 305-day mature equivalent (ME305) milk of cows in their lactation following BLV milk-ELISA testing and BLV status.

Materials and Methods

Dairy herds in Michigan (n=105) that averaged ≥ 120 cows for the previous 12 months were stratified into equally-sized cohorts of 119 small-sized herds (120-174 cows), 119 medium-sized herds (175 to 295 cows), and 119 large herds (296 to 6,492 cows). We enrolled approximately 40 herds from each cohort. Within each herd, we selected up to 10 cows each from the first, second, third, and > fourth lactations that were the most recently calved. Milk was collected from the selected cows for submission to the laboratory for milk ELISA testing for BLV antibodies. The association between BLV status and ME305 was tested using mixed linear models, also adjusting for lactation number categories, herd size,

“warm” versus “cold” season, and herd size. Two variables reflecting BLV status were used in separate models. The first variable was based on milk-ELISA status (BLVSTATUS; negative: OD < 0.1, positive: ≥ 0.1), and the second variable represented 4 BLV OD ordinal categories (ODCAT; OD < 0.1, $0.1 \leq OD < 0.25$, $0.25 \leq OD \leq 0.5$, and $OD \geq 0.5$).

Results

A total of 3,789 cows were included in the study, and herd sizes ranged from 116 to 6,492 lactating cows. The mean ME305 milk production across all cows was 25,031 lb (11,354 kg) (95% CI: 11,290-11,419). The BLV herd-prevalence was 85.7% (95% CI: 77.5%-91.8%), and the crude animal-level prevalence was 33.6% (95% CI: 32.3%-35.4%). The within-herd BLV prevalence ranged from 0% to 78.1%. Adjusted for lactation number and calving season, the LSMEAN ME305 milk production in BLV-positive cows was on average 291.9 lb (132.4 kg) (1.1%) less than in BLV-negative cattle ($P=0.052$). Estimating the effect of increasing milk-ELISA OD (ODCAT), cows with an $OD \geq 0.5$ produced 777.8 lb (352.8 kg) (3.1%) less ($P < 0.05$) milk than BLV negative ($OD < 0.1$), 681.4 lb (309.1 kg) (2.7%) less than cows in the OD group $0.1 \leq OD < 0.25$ ($P < 0.05$), and 668.7 lb (303.3 kg) (2.6%) less milk than cows in the $0.25 < OD \leq 0.5$ group ($P < 0.05$). Lost milk associated with BLV infection was greater in older cattle. Results from models excluding first-lactation cows will also be presented.

Significance

Several studies have demonstrated the BLV decreased milk production at the herd level. The present study may be the first to demonstrate an effect of BLV on milk production at the individual cow level. Previous studies conducted at the cow-level failed to demonstrate such an effect. Given the high prevalence in dairy cattle in the US and consumer concerns about animal welfare in BLV-infected cattle and cancerous cells in milk, it may be time for the dairy industry to consider controlling BLV.