

Association between hyperketonemia in early lactation and culling and hyperketonemia in subsequent lactation in Holstein dairy cows

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Introduction

Hyperketonemia (HYK) is an early lactation metabolic disease frequently observed in high-producing dairy cattle and it has been associated with suboptimal reproductive performance, decreased milk yield, increase occurrence of other diseases, and increase in culling. The majority of the reports so far focused on the association of HYK and these outcomes during early lactation, however, the effect of HYK in the whole lactation and following lactations has not been as extensively characterized. Therefore, our primary objective was to evaluate the association of HYK occurring during the first 10 days after calving and culling in Holstein dairy cows throughout an entire lactation. Our secondary objective was to determine the likelihood of the occurrence of HYK in subsequent lactations in Holstein dairy cows.

Materials and Methods

Blood BHB was measured in cows from six herds in Minnesota between 3 and 10 DIM. Cows were followed for their entire lactation, until next calving or culling. Cows that calved in the subsequent lactation had blood BHB measured again between 3 and 10 DIM. Health and performance data were collected from herd management software. Blood samples were collected from the coccygeal vessels and circulating BHB was measured using a cow-side meter (NovaVet Meter, Nova Biomedical, MA). Cows with blood BHB > 1.2 mmol/L were considered positive to HYK (HYK+). Statistical analysis was accomplished using R 3.4.4 software (R. RStudio, Inc., Boston, MA). Cox proportional hazard analysis was performed to analyze time to culling, adjusting for herd and parity. Multi-variable logistic regression models were performed to assess the likelihood of occurrence of HYK in subsequent lactations adjusting for herd and parity. Separate models were created for primiparous and multiparous cows. Disease events and DIM at culling were applied to all models and removed using backward stepwise elimination.

Results

At the beginning of the experiment, blood BHB was measured in 1,570 dairy cows in the first week post-partum (first lactation, n = 419; second lactation, n = 477; third and greater lactation, n = 674). Of those animals, 654 had a second blood BHB measurement within the first week post-partum at the start of their subsequent lactation (second lactation, n = 226; third lactation, n = 233; fourth and greater lactation, n = 195). The overall prevalence of HYK during the first BHB testing was 9.9% (range 3.1% to 20.1%), while the prevalence of HYK in the second BHB testing was 16.9% (range 8.3% to 27.6%). Hazard ratio for culling during the whole lactation was greater for primiparous and multiparous HYK+ cows when compared to HYK- cows (HR = 1.5; 95% CI: 1.10 - 2.13). We also observed that cows that were HYK+ in the first BHB testing had 2.88 times greater odds (95% CI: 1.27 - 6.48) to be identified as hyperketonemic when sampled in their subsequent lactation than HYK- cows. Additionally, cows in their third or greater lactation, at their first BHB testing, had 2.17 times greater odds (95% CI: 1.29 - 3.65) to be identified as HYK+ in the subsequent lactation than cows in their first or second lactation.

Significance

In our study, elevated BHB levels in the first 10 days of lactation increased the hazard of cows being culled during the whole lactation. Additionally, our findings suggest that cows that developed HYK in their previous lactation are more likely to develop HYK in their subsequent lactation and that older cows, independently of their previous lactation levels, are more likely to be HYK+ in their next lactation. Future studies should focus on identifying genetic and management factors to decrease herd HYK prevalence.