Hyperketonemic cows with high liver health index and low NEFA levels at diagnosis respond better to propylene glycol treatment

S. Davis, DVM; M. Dorella, BS; C. Florentino, DVM; M. Ruch, BS; E. Shepley, MSc, Ph ; L. Caixeta, DVM, PhD

Department of Veterinary Population Medicine, University of Minnesota, Saint Paul, MN 55321

Introduction

Prior research has yielded conflicting findings regarding the efficacy of treatments for hyperketonemia (HYK), with the response varying depending on the metabolic status of the cow. Early lactation concentrations of non-esterified fatty acids (NEFA) and liver health index (LHI) – an index associated with the inflammatory response calculated based on plasma bilirubin, albumin, and cholesterol – are used to determine if the cow successfully transitioned to lactation. Our study aimed to assess the effect of propylene glycol on the persistence of HYK in cows with different concentrations of NEFA and LHI at HYK diagnosis.

Materials and methods

In a randomized controlled trial on a single farm in Minnesota, multiparous cows were screened for HYK at 3 ± 1 and at 7 ± 2 DIM using a hand-held device to measure beta-hydroxybutyrate (BHB). Cows with BHB ≥ 1.2 mmol/L were considered as HYK cows and randomly assigned to receive propylene glycol (PG; 300 g orally for 3 consecutive days) (TRT; n = 89) or to not (CON; n = 85). Blood samples were collected again at 3 ± 1 days following initial diagnosis to assess post-treatment BHB levels and HYK status. Plasma samples were analyzed for NEFA, bilirubin, albumin and cholesterol concentrations using a small-scale chemistry analyzer. For statistical analysis, NEFA and LHI were dichotomized into low or high based on a threshold value of 0.57 mmol/L for NEFA and 0.23 units for LHI. The outcomes assessed were the risk of persistent HYK after PG treatment and the numerical difference in BHB levels between diagnosis and follow-up. Separate mixed logistic regression models were used to evaluate the effect of PG on the risk of persistent HYK for cows with high or low levels of NEFA and for those with a high or low LHI. Similarly, 2 mixed linear regression models were used – 1 for NEFA and 1 for LHI - to evaluate the effect of PG on BHB concentrations. All models included the fixed effects of treatment, NEFA or LHI, parity, DIM at diagnosis, BHB at diagnosis, and an interaction term between NEFA or LHI and treatment. Cow ID was added as a random effect for all models.

Results

The probability of high NEFA cows having persistent HYK was 48.6% and 44.3% for CON and TRT cows, respectively (OR: 1.2; 95% CI: 0.58, 2.4; $P = 0.63$). For low NEFA cows, HYK persisted in 57.0% of CON and 7.9% of TRT (OR: 15.4; 95% CI: 1.36, 174.5; $P = 0.03$). High NEFA cows' BHB levels decreased by 0.12 mmol/L in CON and by 0.20 mmol/L in TRT (-0.079 mmol/L; 95% CI: -0.19, 0.35; $P = 0.56$). In low NEFA cows, BHB levels decreased by 0.11 mmol/L in CON and by 0.59 mmol/L in TRT (-0.48 mmol/L; 95% CI: -0.13, 1.09; $P = 0.12$). The probability of high LHI cows having persistent HYK was 46.6% and 25.0% for CON and TRT, respectively (OR: 2.61; 95% CI 0.96, 7.11; $P = 0.06$). For low LHI cows, the probability of HYK persistence was 52.2% in CON and 50.5% in TRT (OR: 1.07; 95% CI: 0.41, 2.81; $P = 0.89$). High LHI cows' BHB levels decreased by 0.22 mmol/L in CON and by 0.42 mmol/L in TRT (-0.19 mmol/L; 95% CI: -0.16, 0.54; $P = 0.27$). In low NEFA cows, BHB levels decreased by 0.02 mmol/L in CON and by 0.15 mmol/L in TRT(-0.13 mmol/L; 95% CI: -0.22, 0.48, $P = 0.45$).

Significance

Cows diagnosed with HYK exhibit varied responses to PG depending on their levels of NEFA and LHI scores at the time of diagnosis. Those with low NEFA levels and high LHI scores had a lower probability of persistent HYK and had a greater decrease in BHB concentration after PG treatment when compared to cows not receiving PG. Conversely, there appears to be little discrepancy in treatment outcomes between cows with high NEFA levels or low LHI, regardless of whether they receive treatment. This suggests cows with elevated NEFA levels and low LHI likely have compromised liver function, hindering their ability to effectively metabolize PG. Conversely, cows with high LHI and low NEFA levels are better equipped to metabolize and utilize PG effectively.

