

Early postpartum calcium dysregulation is associated with acute phase responses in multiparous Holsteins

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Introduction

During the transition into lactation, multiparous Holstein cows commonly experience calcium dysregulation at 4 DIM. This condition, also known as dyscalcemia, has been associated with increased risk of disease, decreased intake and production, and poor reproductive performance. It is also common for early lactation cows to experience systemic inflammation immediately following parturition. More sustained or severe bouts of postpartum inflammation have been associated with suboptimal outcomes, similar to those experienced by dyscalcemic cows. The acute phase response, an important inflammatory process mediated by the liver, can serve as a marker for systemic inflammation, therefore the objective of this study was to explore differences in the acute phase response between cows with and without dyscalcemia. We hypothesized that cows with dyscalcemia would experience more extreme acute phase responses than eucalcemic cows.

Materials and methods

To test this hypothesis, we used a case-control study design. We collected blood from multiparous Holstein cows on 2 farms in central New York, 1 to 3 d before parturition and once every 24 h postpartum through 4 DIM. Serum samples at 4 DIM were analyzed for total serum calcium concentrations (tCa), and cows were classified as dyscalcemic (tCa < 2.2 mmol/L) or eucalcemic (tCa ≥ 2.2 mmol/L). From this cohort, we selected all dyscalcemic cows (n = 17) and matched them with eucalcemic cows (n = 33) such that the final proportion of dyscalcemic cows in the study population would be comparable to the dyscalcemia prevalence on U.S. commercial herds (~35%). Samples from these cows were analyzed at all time points for 3 acute phase proteins (APP): serum amyloid A (SAA), lipopolysaccharide binding protein (LBP) and haptoglobin (HP). Patterns of APP over time were compared using linear mixed effects models including the fixed effects of calcium group, DIM, parity group (2, 3, or ≥ 4), farm, all relevant 2-way interactions, and the random effect of cow.

Results

Dyscalcemic cows experienced elevated concentrations of all APP within the sample period compared to eucalcemic cows. Concentrations of HP and SAA became elevated at 2 DIM (both $P < 0.001$) and maintained high concentrations at 3 (both $P < 0.001$) and 4 DIM (both $P < 0.001$). Dyscalcemic cows exhibited LBP concentrations which increased from 2 DIM to 4 DIM and were statistically higher than the LBP concentrations of eucalcemic cows at 3 and 4 DIM (both $P < 0.001$). Eucalcemic cows had minor numerical increases in all APP at 2 DIM that declined through 4 DIM. Overall, this data suggests that dyscalcemic cows experience a more activated early postpartum acute phase response than their eucalcemic counterparts.

Significance

This is a preliminary investigation; however, our findings support the hypothesis that dyscalcemia and excessive inflammation are associated in early postpartum dairy cows. Furthermore, inflammatory markers are elevated before dyscalcemia diagnosis. This may be evidence that the underlying processes driving dyscalcemia are inflammatory in nature, but whether a causal relationship exists in this system remains to be established. Our data suggest that inflammatory markers might be diagnostically useful for identifying dyscalcemic cows that have become maladapted to the early postpartum period.

