Association of immediate postpartum calcium concentration with clinical diseases, culling, reproduction and milk production in Holstein cows

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Introduction

The objectives of our study were to determine the association of plasma Ca concentration collected within 12 h of parturition with: 1) the risk of clinical diseases (retained placenta [RP], metritis, displaced abomasum [DA], and clinical mastitis) in the first 60 d in milk (DIM), 2) the risk of culling in the first 60 DIM, 3) the risk of pregnancy to first service, and 4) milk production.

Materials and Methods

We conducted a prospective cohort study from February 24 until November 30, 2015 that was part of a larger randomized clinical trial evaluating the effects of calcium supplementation after parturition on health and production outcomes. For this study, only control cows (i.e., no Ca supplementation) with a blood sample collected within 12 h of parturition were included. A total of 1,412 animals (349 primiparous [PP] and 1,063 multiparous [MP] cows) from 5 commercial dairies in New York State were included in the analyses. Plasma samples were sent to the University of Illinois Veterinary Diagnostic Laboratory for total Ca analysis. Multivariable Poisson regression models were used to model the effect of Ca concentration with all binary outcomes (RP, metritis, DA, mastitis, culling, and pregnancy to 1st service), and repeated-measures modeling was used to evaluate the effect of Ca concentration on milk production measured across 9 Dairy Herd Improvement Association (DHIA) test days. Herd was treated as a random effect in all models. Receiver operating characteristic curves were built whenever Ca concentrations in a continuous scale remained meaningful as final effects, and dichotomized accordingly. Primiparous and multiparous stratified models were built separately for each outcome and then modeled jointly if no differential effects of Ca between groups were observed. All statistical analyses were performed in SAS (version 9.4, SAS Institute Inc., Cary, NC).

Results

Calcium concentration within 12 h of parturition was not associated with the risk of RP (P = 0.52), metritis (P = 0.21), or clinical mastitis (P = 0.61) for the first 60 DIM. As only 1 PP animal was diagnosed with a DA during the study, the effect of Ca on the risk of DA diagnosis was only evaluated in MP. Cows with Ca ≤1.85 mmol/L had 2.8 (95% confidence interval = 1.4 to 5.9) times higher risk of having a DA diagnosis when compared to cows with Ca >1.85 mmol/L. Culling within the first 60 DIM was not associated with Ca concentration in PP (P = 0.45) but was important in MP cows (P = 0.07). Calcium concentration was not associated with the risk of pregnancy to 1st service (P = 0.88; PP and MP modeled jointly) and also had no milk production effect on PP cows (P = 0.46). Multiparous cows with lower Ca following parturition had higher milk production across 9 DHIA tests (P = 0.002). After ROC analyses, cows with Ca ≤1.95 mmol/L produced an average of 1.1 kg more milk per d across the 9 DHIA tests when compared to animals with Ca >1.95 mmol/L.

Significance

Calcium concentration in the immediate postpartum period of Holstein cows was not associated with the risk of RP, metritis, or mastitis. Moreover, lower Ca within the 12 h period following parturition was associated with higher milk production in MP cows. Further studies evaluating Ca at different time-points relative to calving are warranted to better define when Ca concentrations are more highly associated with detrimental health outcomes, impaired reproduction and milk production.