Research Summaries 3

Description of the Spontaneous Development of Ketonemia in the Early Postpartum Period

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Introduction

Periparturient ketosis is highly prevalent in the dairy industry and has been associated with a number of health problems, especially displaced abomasum and fatty liver infiltration, as well as decreased productivity and decreased fertility. Despite the importance of ketosis, thorough descriptive studies of naturally occurring periparturient ketosis are lacking. The objective of this observational study was to provide a detailed description of the spontaneous development of ketonemia in Holstein dairy cows in their first two weeks of lactation and to describe the associations between serum beta-hydroxybutyrate (BHBA) levels and other metabolites and milk production.

Materials and Methods

A cohort of 161 Holstein dairy cows from a commercial facility was followed for the first 2 weeks of lactation. Blood samples were collected every other day between 2 and 14 days in milk (DIM), and daily milk production was measured during the same period. The serum samples were analyzed for metabolites of primary importance in the postpartum period: BHBA, non esterified fatty acids (NEFA), glucose and total calcium concentrations. Cows were sorted by their maximum BHBA concentration during the period (peak BHBA), and were stratified in 3 groups of equal size: low, moderate and high peak BHBA. In the first step of the statistical analyses, individual profiles were described separately for each metabolite and milk production, and the average curves by DIM were plotted for each peak BHBA group. For the final step of the analysis, the timing of the peak BHBA was extracted for each individual. A repeated measures mixed model was then fitted for all metabolites and milk production to estimate the difference between the three ketonemia groups in the days leading to, and following, the timing of peak BHBA, after adjustment for parity and DIM.

Results

On average over DIM, high serum peak BHBA levels were associated with higher NEFA, lower glucose and lower total calcium concentrations. Milk production was lower for cows in the groups reaching low and high peak BHBA concentrations, compared to those reaching intermediate levels of BHBA. While the association between DIM and calcium, glucose and milk production was fairly consistent across cows, the timing of the maximum NEFA and BHBA concentrations was more variable within the time frame of observation. Because of the curve alignment issues for NEFA and BHBA, the summary curves by DIM differed noticeably in shape from the individual cow curves, especially for BHBA, and therefore may not provide a clear insight on how ketosis might develop in fresh cows. All variables were related to the extent and timing of the peak BHBA concentration. On average, large differences in NEFA concentrations among peak BHBA groups were observed in the days preceding peak BHBA, but these decreased after it. The difference in milk production between ketonemia groups seen with the curves by DIM was still present, but the timing of peak BHBA itself did not correspond very closely to a concurrent drop in production. Calcium and glucose levels started lower in the high peak BHBA group, decreased further at the time of peak BHBA, after which the difference between ketonemia groups diminished.

Significance

Even if the average concentration of the metabolites differed significantly between peak BHBA groups, there was still an important overlap of the groups at the cow level. Differences in average energy status, based on NEFA and glucose concentrations, were not enough to explain why some cows developed high ketone concentrations and others did not. The short additional drop in calcium and glucose surrounding the peak

BHBA in the high peak BHBA group could be related to short-term drops in dry matter intake, which in turn could be triggered by metabolic or external (non-metabolic) factors. Further studies should aim at finding what those triggers may be, and how their effect could be mitigated.

Concentrations of Serum Non-Esterified Fatty Acid (NEFA) and Beta-Hydroxybutyrate (BHB) through the Transition Period and their Associations with Risk of Clinical Disease

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Introduction

Serum non-esterified fatty acid (NEFA) and Beta-Hydroxybutyrate (BHB) concentrations provide important insight into the metabolic health of transition dairy cows. Previous studies have linked elevated prepartum NEFA and postpartum BHB concentrations with an increased risk of developing displaced abomasum. The objective of this study was to further characterize the relationship of both prepartum and postpartum serum NEFA, and postpartum serum BHB concentrations with clinical disease in transition dairy cows across different regions of North America.

Materials and Methods

A field study was conducted using 56 commercial dairy herds across Canada and the United States. Herds sampled were divided into four geographic regions consisting of the Midwest, Northeast (including Ontario, Canada), Southeast and Western United States. Each herd in the Midwest and Northeast regions had approximately 35 cows per herd enrolled in the study, whereas in the Southeast and Western herds included approximately 60 and 80 cows per herd, respectively. A total of 2403 Holstein cows were enrolled in the study one week prior to calving. A technician visited herds weekly at approximately the same time, after the morning feeding. During each visit a coccygeal vein blood sample was collected from cows in the week before their expected calving date, and again from the same cows in weeks 1, 2, and 3 postpartum. Body condition was scored at week -1. Blood samples were kept cool, allowed to clot and serum was harvested, and stored at -20°C within 8 hours of collection. All serum was shipped to the Animal Health Laboratory at the University of Guelph for measurement of NEFA and BHB using a Hitachi 911 auto-analyzer. The incidence of retained placenta (RP), puerperal metritis, and displaced abomasum (LDA) were recorded.

Results

Results were available from 1771 cows. Considered alone and assuming equal weight on sensitivity and specificity, the optimal cut-points for prediction of LDA were, prepartum: NEFA ≥ 0.5 mEq/L; week 1 postpartum: mol/L (i.e.mNEFA ≥ 1.0; or week 1 or 2 postpartum: BHB ≥1400 subclinical ketosis (SCK)). The 23% of cows with NEFA ≥ 0.5 in week -1 were 2.8 times more likely to subsequently have LDA than cows below this cut-point. The 20.5% of cows with NEFA ≥ 1.0 in week +1 were 4.6 times more likely to develop LDA. The prevalence of SCK and relative risk for affected cows to develop LDA were 14% and 4.4 in week +1, and 16% and