

The relationship between subclinical hypocalcemia and negative energy balance on the return of ovarian function during the voluntary waiting period of dairy cows

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Introduction

Early resumption of ovarian activity has been reported to be an important factor for the reproductive success of dairy cows because of improved uterine health and fertility. However, early lactation is characterized by a period of negative energy balance (NEB) and mobilization of fat reserves, which is highly associated with a longer postpartum anovulatory period. Moreover, the initiation of milk production and excessive utilization of calcium may lead to a subclinical hypocalcemic status that has been linked to deficient fatty acid metabolism in early lactation. Additionally, subclinical hypocalcemia (SCHP) can result in decreased progesterone (P4) and corpus luteum (CL) functionality, which further decreases reproductive performance in high-producing dairy cows. The objective of this study was to determine the influence of SCHP and NEB during the first 2 weeks in milk on the ovarian activity during the voluntary waiting period of dairy cows in herds with automatic milking systems (AMS).

Materials and Methods

In an observational cohort study in 2 herds using AMS in central New York, data was collected from 99 cows starting 1 week prior to the calving date and followed until 55 days-in-milk (DIM). Serum samples were analyzed for calcium concentration at 1, 2, and 3 DIM. Negative energy balance was determined by measurement of non-esterified fatty acids (NEFA) and -hydroxybutyrate (BHB) concentrations at 3, 5, and 7 DIM. The metabolite thresholds were: NEFA \geq 0.7 mEq/L, BHB \geq 1.2mmol/L, and calcium between 6-8 mg/dL. Weekly blood samples were collected between the third and the seventh week in lactation for further analysis of blood P4 concentration by radioimmunoassay; cows having a concentration of serum P4 \geq 1 ng/mL were considered to be cycling and have a functional CL. The effect of several independent variables on return to cyclicity (P4 \geq 1ng/mL) was analyzed by Cox's propor-

tional hazard regression procedure using MedCalc. In addition to SCHP and NEB, variables forced into the model included parity, calving ease, retained placenta, metritis, ovarian structure at examination during the third week of lactation, and total milk production in the first 30 DIM.

Results

Negative energy balance and calcium levels were important factors for resuming of ovarian activity. Animals with normal calcium levels had higher levels of P4 throughout the first 55 DIM. Normocalcemic and hypocalcemic animals (P = 0.01) had P4 concentrations during the third week post-partum of 1.0 ng/mL vs 0.3 ng/mL, respectively (P = 0.01), indicating that the normocalcemic group had P4 levels typical of animals with a functional CL. The same relationship was observed around 42 DIM (3.5 ng/mL vs 2.3 ng/mL, P = 0.04; normocalcemic and SCHP, respectively), suggesting that more responsive structures were present in the ovaries of normocalcemic cows at the time when pre-synchronization protocols were started. Normocalcemic cows resumed cycling quicker than SCHP cows (HR = 2.18; 95% CI = 1.18-4.04; P = 0.01); the other variables considered were not significantly associated with resumption of ovarian cyclicity. At the end of the 55 day period, 98% of the normocalcemic animals had a functional CL, while only 82% of the SCHP counterparts achieved the same status (P = 0.01). When analyzing NEB isolated from blood calcium status, animals that did not undergo NEB were more likely to cycle than the animals that had NEB (HR = 1.72; 95% CI = 0.94-3.16; P = 0.07).

Significance

Animals that maintained normocalcemia in the early lactation period, as well as maintained a favorable energy balance were more likely to resume ovarian activity earlier.