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Associations between subclinical hypocalcemia and postparturient diseases in dairy cows

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ABSTRACT

Dairy cows suffer blood Ca losses as lactation begins and might be affected by hypocalcemia in its clinical (total serum Ca concentration <1.50 m*M*) or subclinical form (total serum Ca concentration ≤2.14 m*M*). Several studies have suggested that hypocalcemia is associated with different health problems of the cow but results from different studies are not consistent. The objective of this study was to assess potential associations between subclinical hypocalcemia (SCHC) and displaced abomasum, intramammary infections, metritis, retained placenta, and ketosis. Also, the associations between SCHC and milk yield and reproductive function were evaluated. After discarding cows (32) with clinical hypocalcemia, a total of 764 cows from 6 different commercial farms were enrolled in this study. Blood samples were collected at 24 to 48 h postcalving and analyzed for total Ca concentration. Odds ratios of the different afflictions potentially associated with SCHC were calculated. Seventy-eight percent of the analyzed cows incurred SCHC. The occurrence of displaced abomasum, ketosis, retained placenta, and metritis was 3.7, 5.5, 3.4, and 4.3 times more likely, respectively, in cows that had SCHC than in cows with normocalcemia. Furthermore, the risk of incurring retained placenta or metritis increased in multiparous cows as serum Ca concentrations decreased compared with that in primiparous cows. Normocalcemic cows, independent of parity, were more likely to show their first estrus sooner after calving than SCHC cows, but no correlation was found between SCHC and other reproductive parameters. Different serum Ca concentration cutoffs were identified for several postpartum afflictions (≤1.93, ≤2.05, ≤2.05, and ≤2.10 m*M* for ketosis, retained placenta, metritis, and displaced abomasum, respectively). In conclusion, SCHC, defined as serum Ca ≤2.14 m*M*, is a frequent illness affecting the majority of the dairy cows with important repercussions on health. However, if SCHC were to be used to predict postpartum disease, different serum Ca cutoff points are likely to be needed because best predictive cutoff values varied among postpartum ketosis, displaced abomasum, retained placenta, and metritis.
Key words: calcium, postcalving disease, risk

INTRODUCTION

Dairy cows experience important physiological changes around parturition. Due to the onset of lactation, leading to increased demand for Ca, blood Ca concentration decreases suddenly in the 2 to 3 d around calving (Quiroz-Rocha et al., 2009), which can overwhelm the homeostatic mechanisms, resulting in insufficient availability of ionized Ca (Horst et al., 1997). The animal is then affected by hypocalcemia, which can be a clinical disease in about 5% of the cows (NAHMS, 2002), or a subclinical disease with an incidence of around 50% in cows with more than 2 lactations (Horst et al., 2003). Despite the fact that the severity of the disease is greater in the clinical cases, subclinical cases are also important because (1) they are far more frequent, (2) they cannot be easily diagnosed, and (3) they may impair the longevity and productivity of the cow (Goff, 2008; Murray et al., 2008).

It is commonly assumed that dairy cows experience subclinical hypocalcemia (**SCHC**) when total serum Ca is <2.0 m*M* (8.0 mg/dL) and clinical hypocalcemia when serum Ca levels are <1.5 m*M* (6.0 mg/dL; Goff, 2008), but other studies apply different ranges to determine the severity of hypocalcemia. For example, Chapinal et al. (2012) defined that a normocalcemic cow would have serum Ca levels >2.20 m*M*, Goff (2008) widened the criterion to a range from 2.12 to 2.50 m*M*, and Martinez et al. (2012) proposed >2.14 m*M* as the cutoff value for normocalcemia.

Previous studies with dairy cattle have reported associations between clinical hypocalcemia and periparturient disorders, such as dystocia, retained placenta, ketosis, and displaced abomasum (Curtis et al., 1983)

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Table 1. Descriptive statistics of herds and cows enrolled in the study

Herd	No. of milking cows	Rolling herd average, kg/d	No. of cows enrolled	Parity distribution (cows enrolled),[1] %	
				PMC	MPC
1	260	36.3	49	33.3	66.7
2	1,820	34.2	342	31.7	68.4
3	220	35.4	41	32.2	67.8
4	420	37.2	76	34.8	65.2
5	840	39.3	156	30.4	69.6
6	720	35.8	132	37.8	62.2

[1]PMC = primiparous cows; MPC = multiparous cows.

as well as hampered fertility, conception, and pregnancy rates (Maizon et al., 2004; Roche, 2006; Martinez et al., 2012). However, literature reports are somewhat contradictory. For instance, Massey et al. (1993) identified SCHC as a risk factor for development of displaced abomasum but others reported no association between these 2 afflictions (LeBlanc et al., 2005; Chamberlin et al., 2013). Similarly, Martinez et al. (2012) found that pregnancy rate and interval between calving and pregnancy were reduced under SCHC, but Chamberlin et al. (2013) reported no differences in the incidence of uterine diseases, services per conception, or days open when comparing normocalcemic with SCHC cows. Reports about the potential association between milk yield and SCHC are also contradictory (Jawor et al., 2012; Martinez et al., 2012). Because of the inconsistency about the possible health consequences of SCHC and the threshold of blood Ca concentration that should be used to define SCHC, the objectives of the current study were to investigate potential associations between SCHC and milk yield, reproductive performance, and the most important postpartum afflictions of dairy cattle.

MATERIALS AND METHODS

Animals

With the aim of monitoring at least 700 cows, during a period of 2 mo (April and May 2013), all cows calving in 6 herds (Table 1) were enrolled in this study. The target of 700 cows was based on an expected incidence of hypocalcemia of 65% (Martinez et al., 2012), and the fact that previous reports describe increased odds of ~2.0 for incurring metritis (which typically occurs at ~30%) when experiencing hypocalcemia (Markusfeld, 1987). Herds were located in the northeast and east of Spain (Catalonia, Valencia, and Aragón) and were randomly selected from a pool of 19 herds accessible to our research group and complied with minimum requirements (i.e., milk meters, pedometers for estrus detection, good record keeping, and willingness to take blood samples, test for ketosis, and follow protocols). Each herd was visited at least fortnightly during the course of the study to collect data and ensure all protocols were followed. Herds maintained the cows under typical Southern European production conditions. Cows were kept in free-stalls and fed TMR. Three herds split the dry cows into far-off (between around 220 and 260 d of gestation) and close-up groups (last 3 wk of gestation) and the other 3 herds had a single dry cow pen. One of the 3 herds (herd 1; Table 1) that split dry cows in 2 groups fed anionic salts during the close-up period.

Blood Sampling, Analysis, Data Collection, and Cow Classification

Blood was collected by venipuncture of the tail vessels using evacuated tubes without additives between 24 and 48 h postcalving from all cows that calved during the study course. Serum was recovered after centrifugation at 2,000 × *g* for 15 min and stored at −20°C until further analysis. Serum Ca concentration was determined using inductively coupled plasma-optical emission spectrometry (**ICP-OES**) using an ICP-OES Perkin-Elmer Optima 4300DV (Perkin Elmer Inc., Waltham, MA) after a 1/20 dilution in an EDTA 0.05% (wt/vol) and NH_3 0.5% (vol/vol) solution. The coefficient of interassay variation of the analyses was as 0.8 to 1.4%.

For each cow, milk yield was recorded daily using electronic milk meters. Also, each cow was sampled within the first 30 DIM by DHIA personnel to determine milk SCC (which were also determined by the DHIA). The occurrence of postpartum disorders (ketosis, displaced abomasum, retained placenta, metritis, and mastitis) was recorded from each herd during the first 30 d postcalving. These diseases were recorded as either present or absent. Ketosis was diagnosed based upon a color change on a KetoStix urine dipstick (Bayer Corporation, Elkhart, IN) performed by farm personnel, on every Tuesday, in all cows within the first