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Effect of oral calcium administration on the cure and reproductive performance of Holstein cows diagnosed with puerperal metritis

Pablo Pinedo,*†[1,2] Juan Velez,‡ Gilberto Solano,‡ Nelson Rodriguez,‡ Julianne Naves,§ Gustavo M. Schuenemann,# and Carlos Risco‖
*Texas A&M AgriLife Research, Texas A&M University System, Amarillo 79106
†Department of Veterinary Pathobiology, College of Veterinary Medicine and Biomedical Sciences, Texas A&M University System, College Station 77843
‡Aurora Organic Farms, Platteville, CO 80651
§College of Veterinary Medicine, University of São Paulo, Pirassununga, SP, Brazil
#Department of Veterinary Preventive Medicine, College of Veterinary Medicine, The Ohio State University, Columbus 43210
‖College of Veterinary Medicine, University of Florida, Gainesville 32608

ABSTRACT

Our objective was to evaluate the effect of oral calcium administration on clinical cure, survival, subsequent presentation of peripartal health disorders, and reproductive performance of Holstein cows diagnosed with puerperal metritis (PM) under certified organic management. A second objective was to evaluate the metabolic status at calving and at the time of PM diagnosis (d 0) in affected and matched healthy cows. Cows diagnosed with PM (n = 200) were assigned randomly to receive 1 of 2 treatments: (1) control received 3.75 mL of Optimum UterFlush [Van Beek Natural Science, Orange City, IA, containing yucca extract, cinnamaldehyde, thymol, and a proprietary blend of carvacrol (4-isopropyl-2-methylphenol, at 0.47 g/mL)] diluted in 117 mL of distilled water by intrauterine infusion, administered every other day for a total of 3 treatments (n = 100); (2) calcium-supplemented (CA) received the same intrauterine treatment plus 6 oral capsules providing calcium ('O' Cal-D Cap, Bio-Vet Inc., Barneveld, WI; 7.5–9.0 g of Ca/capsule) once per day, for 3 consecutive days after diagnosis of PM. All cows received hypertonic saline solution (500 mL of 7.2% solution i.v. once), dextrose (500 mL of 50% solution i.v. once), and oral aspirin (5 boluses/d for 3 d). Outcome variables included fever, presence of fetid vaginal discharge, and uterine score at d 6 and 14 after diagnosis, survival at 30 and 100 d in milk, reproductive performance, and incidence of other health disorders after PM. A group of 200 control healthy cows (CH) was matched with PM cows at d 0, and calcium and fatty acid serum concentrations were determined at calving and at the day of diagnosis of PM (d 0). Calcium status was also assessed in PM cows at d 1, 2, 3, and 6 after diagnosis. Treatment effects were tested by logistic regression, repeated measures analysis, and ANOVA. Average calcium serum concentrations at d 0 were lower in PM cows (1.57 mmol/L) compared with CH cows (2.10 mmol/L). In PM cows, calcium concentrations at d 1, 2, 3, and 6 after diagnosis were significantly higher in the CA group. Fatty acid serum concentrations at calving and at d 0 were higher in PM cows compared with CH cows (0.48 vs. 0.37 mmol/L and 0.49 vs. 0.35 mmol/L, for calving and d 0). No effect was observed for calcium administration on health and survival outcomes. However, the proportion of cows inseminated by 150 d in milk was greater for CA compared with control cows (66 vs. 55%). In conclusion, supplementing oral calcium at the time of diagnosing PM had no effect on health. High fatty acid concentrations at calving were significant risk factors for occurrence of PM. Furthermore, cows affected with PM had lower calcium and higher fatty acid concentrations than CH cows at d 0.
Key words: puerperal metritis, calcium, fatty acid

INTRODUCTION

The peripartum period is a critical time for cow health and survival. Calving is accompanied by significant endocrine changes (Grummer et al., 2004), and high-producing dairy cows require drastic metabolic adjustments to support milk synthesis. The abrupt increase in nutrient requirements at a time when feed intake is depressed results in a shift from a positive to a negative energy balance, where fat mobilization increases fatty acid concentrations. Simultaneously, peripartal synthesis and secretion of colostrum result in major losses of

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[1]Current address: Department of Animal Sciences, Colorado State University, Fort Collins, CO 80523-1171.
[2]Corresponding author: pablo.pinedo@colostate.edu

Ca (Horst et al., 2005; Kimura et al., 2006; Martinez et al., 2012). As a response to low serum Ca concentrations, homeostatic mechanisms that include intestinal absorption and bone resorption are activated, but in many cases subclinical or clinical hypocalcemia conditions are unavoidable (Reinhardt et al., 2011). These events and concurrent immune suppression related to calving result in suboptimal health and performance in the affected cows (Goff, 2004; Burton et al., 2005; Hammon et al., 2006).

Uterine diseases, such as metritis and endometritis, are highly prevalent in high-producing dairy cows and are associated with decreased pregnancy per AI, extended interval to pregnancy, increased culling, and economic losses (Sheldon and Dobson, 2004; Gilbert et al., 2005; LeBlanc, 2008). In addition, animal welfare is compromised by metritis, as affected cows suffer from loss of appetite, often become dehydrated, and may also show signs of pain (Sheldon et al., 2006; Stojkov et al., 2015).

The incidence of metritis in dairy cows ranges from 10 to 36% (Santos et al., 2010; Chapinal et al., 2011) and the disorder is more frequently diagnosed during the first week postpartum (Sheldon et al., 2006). A more severe condition, puerperal metritis (**PM**), defined as an acute systemic illness due to infection of the uterus with bacteria, usually within 21 d after parturition (Sheldon et al., 2006), is a life-threatening condition affecting a significant number of cows.

According to a survey conducted in 2002 (NAHMS, 2002), the incidence of milk fever in US dairy herds averaged 5.2%, and as reviewed by DeGaris and Lean (2008), in 10 European studies the incidence was 6.17%, and for 10 Australasian studies it was 3.5%. Nevertheless, the prevalence of subclinical hypocalcemia (**SCH**) remains at 25 and 47% in primiparous and multiparous cows, respectively (Reinhardt et al., 2011; Martinez et al., 2014). Hypocalcemic cows have reduced feed intake and rumination, increased plasma concentrations of cortisol (Horst and Jorgensen, 1982; Hansen et al., 2003), limited numbers of neutrophils with phagocytic activity (Ducusin et al., 2003; Martinez et al., 2012, 2014), and reduced concentrations of cytosolic Ca^{2+} in mononuclear cells (Kimura et al., 2006), which results in a higher susceptibility to peripartal disease. This association has been extensively reported (Curtis et al., 1983; Risco et al., 1984; Chapinal et al., 2011) and may be related to the lack of adequate ionized Ca concentrations required for smooth muscle contractions (Hansen et al., 2003), together with limited supply of glucose and ionized Ca for adequate immune function. Oral calcium supplementation has been proposed as a complement to dietary means of managing hypocalcemia in dairy herds (Oetzel, 2013) and could be targeted to cows at the highest risk to develop disease.

We hypothesized that the concentration of serum calcium at peripartum and at PM diagnosis will be lower in cows affected by PM compared with matched control cows. Consequently, the addition of oral calcium to the PM treatment would improve cow recovery and subsequent health and fertility. Therefore, the objective of the study was to evaluate the effect of oral calcium administration on the cure, survival, subsequent presentation of peripartal health disorders [clinical and subclinical mastitis, pneumonia, and purulent vaginal discharge (**PVD**)], and reproductive performance of Holstein cows diagnosed with PM under certified organic management. A second objective was to evaluate the metabolic status (calcium and fatty acid serum concentrations) at calving and at the time of diagnosis in PM and matched healthy control cows.

MATERIALS AND METHODS

The West Texas A&M University Institutional Animal Care & Use Committee approved the animal-related procedures in this study.

Study Population

The study population consisted of Holstein cows from a single large certified organic dairy farm (7,150 milking cows) located in the Texas panhandle. All cows were housed in freestall barns with sand-bedded stalls and free access to a contiguous dry lot. Prepartum primiparous and multiparous cows were comingled. Cows were milked thrice daily and milk yield was recorded monthly for individual cows. The rolling herd average milk production was 8,600 kg. Cows were fed a TMR twice a day to meet or exceed the nutritional requirements for a lactating Holstein cow producing 30 kg/d of milk with 3.5% fat and 3.1% true protein (NRC, 2001). During the grazing season (May to September), cows had access to pasture and grazing provided a significant portion of the total ration. Through the study period prepartum diet was based on corn silage (10.5 to 16.0%, DM basis), wheat silage (10.5 to 16.6%), alfalfa hay (32 to 41%), grass hay (14.2 to 20%), grain mix (12.6 to 19.2%), and mineral and vitamin mix (3.8%). Anionic salts were included into the ration (dietary cation anion difference = −100 mEq/kg). During the nongrazing season, the postpartum diet consisted of corn silage (14 to 17.5%); wheat silage (13 to 20%); a premix containing soybean, soy hulls, corn, wheat, and minerals and vitamins (47.5 to 50.5%); sorghum silage (3.0 to 4.5%); alfalfa hay (12 to 16%); and grass hay (0 to 3%).