

Effect of High-Dose Vitamin D₃ Injection Prepartum as Prophylaxis of Milk Fever on Bone Metabolism in Dairy Cattle

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Introduction

Milk fever (MF) is one of the most important metabolic diseases of dairy cattle, therefore, its control is very important. It is well known that parenteral application of high-dose vitamin D₃ before calving can prevent MF in dairy cattle. This practice is in use in Slovenia since 1962. The mechanism of action is by activation in liver and kidneys into hormonal form calcitriol. The main role of calcitriol is activation of active Ca absorption in the intestines. Calcitriol also has an effect on bone tissue. The purpose of this study was to test the effect of a parenteral high dose of vitamin D₃ on bone metabolism in dairy cattle.

Materials and Methods

The study was carried out on 33 healthy, high-yielding Holstein Friesian cows before at least the fourth lactation, during winter time, when they were housed in tie-stalls. The animals were fed, according to NRC (2001) recommendations, a calculated winter ration served as a complete mix (based on home produced forages—grass and corn silage) adapted to high productivity, for close-up and early-lactation cows. No anionic salts were administered to the cows in the study. The cows were divided into two groups: the test group consisted of 13 cows (average parity 5.54 ± 1.76) that were treated with IM injection of 10 million IU of vitamin D₃ (Duphafral® Vit. D₃ 1000, Fort Dodge Veterinaria, Spain), two to 10 days before calving, and the control group of 20 cows (average parity 5.15 ± 1.35). Blood samples for measurement of tCa, iP, bone alkaline phosphatase (bALP) and C-terminal telopeptide crosslinks of collagen I (CTX) were collected 12 to 48 hours after calving (sampling 1) and 10-20 days-in-milk (sampling 2) from the *v. caudalis mediana* in evacuated tubes without any additives.

Serum was harvested and analyses performed with commercial kits according to manufacturer's instructions. The obtained data from sampling 1 and 2 were compared between the test and control groups using t-test or Mann Whitney U test if data were not normally distributed. Statistical significance was set at $P < 0.05$.

Results

In both samplings higher tCa and iP values were measured in the test group than in the control group, but the differences were not statistically significant ($P > 0.05$). In sampling 1, mean bALP and CTx were lower in the test group (25.84 ± 7.53 U/L and 0.471 ± 0.328 ng/mL, respectively), than in the control group (31.02 ± 7.22 U/L and 0.623 ± 0.325 ng/L, respectively, $P = 0.06$ and $P > 0.05$, respectively). In sampling 2, bALP and CTx were higher in the test group (26.38 ± 5.60 U/L and 1.842 ± 1.869 ng/mL, respectively) than in the control group (24.26 ± 5.11 U/L and 1.185 ± 0.786 ng/L, respectively), but the differences were not significant ($P > 0.05$). In the control group six out of 20 cows (30%) developed MF, while in the test group two out of 13 cows (15.4%) developed MF.

Significance

We conclude that IM injection of a high-dose of vitamin D₃ to dairy cows two to 10 days before calving does not statistically significantly affect bone metabolism after calving, but nevertheless it reduces the incidence of MF. It appears that high-dose vitamin D₃ does not enhance bone resorption as anticipated, but rather lowers bone metabolism near the postparturient time. The main effect of high-dose vitamin D₃ is enhancing resorption of Ca from the intestines, and according to our results, reducing Ca use for bone synthesis. Further studies in this field are needed.