

EFFECTS OF 1α -OHD₃ INJECTION ON PLASMA CONCENTRATIONS OF 1,25-(OH)₂D, PTH AND CA IN HYPOCALCEMIC COWS

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Introduction

In the previous study, we carried out the injection of 1α -hydroxyvitamin D₃ (1α -OHD₃) to compare its effects on the plasma $1,25$ -dihydroxyvitamin D ($1,25$ -(OH)₂D) and calcium (Ca) concentrations in lactating cows, and suggested it to be appropriate for the prevention of the parturient hypocalcemia to inject 500 μ g of 1α -OHD₃ intramuscularly within 2 to 5 days before parturition [6]. Bar et al. [1] injected 350 or 700 μ g of 1α -OHD₃ to cows for 72 to 24 h before calving and reported that plasma $1,25$ -(OH)₂D concentration reached the peak at 24 to 48 h after injection and that plasma Ca concentration increased by 700 μ g dose of 1α -OHD₃ injection. They suggested that a single injection of 700 μ g 1α -OHD₃ may be an effective prophylactic treatment against milk fever. However, it is difficult to predict exactly the time of parturition within 72 to 24 h before parturition. The purpose of the present study was, therefore, to investigate the effects of injection of 1α -OHD₃ to cows within 24 h before parturition to make wide use of 1α -OHD₃ injection for prophylactic treatment against milk fever.

Materials and Methods

Thirteen mature Jersey cows (4.2 average calvings) were divided into two groups, an untreated control (control group) consisting of 7 cows and a test group (1α -OHD₃ group) consisting of 6 cows. Each cow in the 1α -OHD₃ group once received intramuscularly the injection of 500 μ g 1α -OHD₃ (provided by Chugai Pharmaceutical, Co., Ltd.) at 28.5 to 11.5 h before parturition. Heparinized blood samples were obtained from the external jugular vein at 0800 h for 7 days before parturition and at 12, 24, 48, 72 h after parturition. Milk samples were taken from the mixture of a whole day milk every day for 4 days after parturition. The plasma concentration of $1,25$ -(OH)₂D was measured by a modified method of Lambert et al. [5]. The plasma PTH concentration was determined with a PTH radioimmunoassay kit (Commissariat L'energie Atomique). Plasma hydroxyproline (Hyp) was measured by the method of Jamall et al.

Results

The plasma $1,25$ -(OH)₂D concentration in the 1α -OHD₃ group showed a tendency to be higher than that in the control group at 12 h after parturition, but did not differ significantly from the latter (Fig.1). On the other hand, the plasma PTH concentration in the 1α -OHD₃ group was significantly lower than that in the control group at 0, 24 and 48 h after parturition (Fig.2). The plasma Ca concentration in the 1α -OHD₃ group was significantly higher than that in the control group at 0, 24 and 48 hrs after calving (Fig.3), while the plasma Pi concentration was significantly higher in the 1α -OHD₃

group only at 48 h after calving (Fig.4). The plasma Hyp concentration (Fig.5) and the amounts of Ca and Pi in the milk did not differ significantly between both groups, respectively .

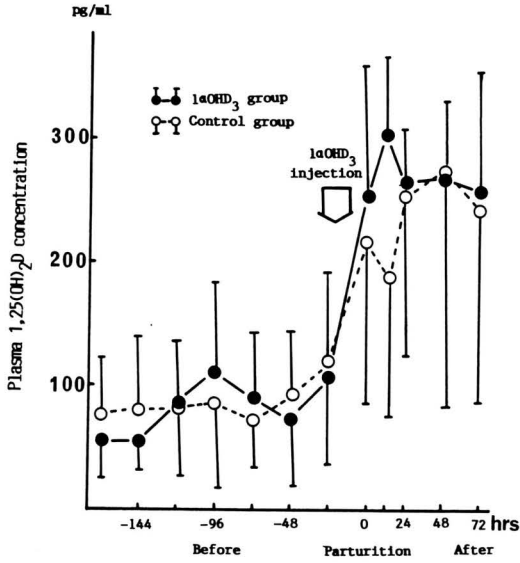


Fig. 1. Changes in plasma concentration of 1,25-(OH)₂D in control and 1 α -OHD₃ groups.

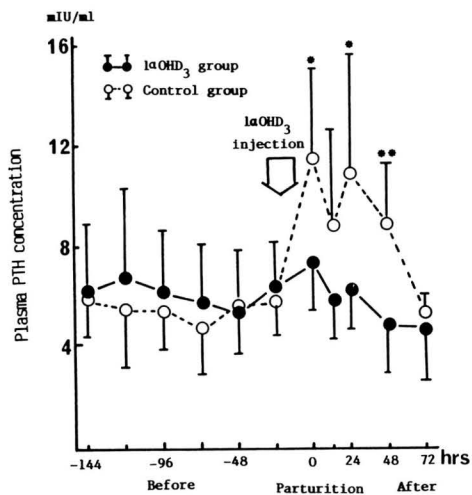


Fig. 2. Changes in plasma concentration of PTH in control and 1 α -OHd₃ groups.

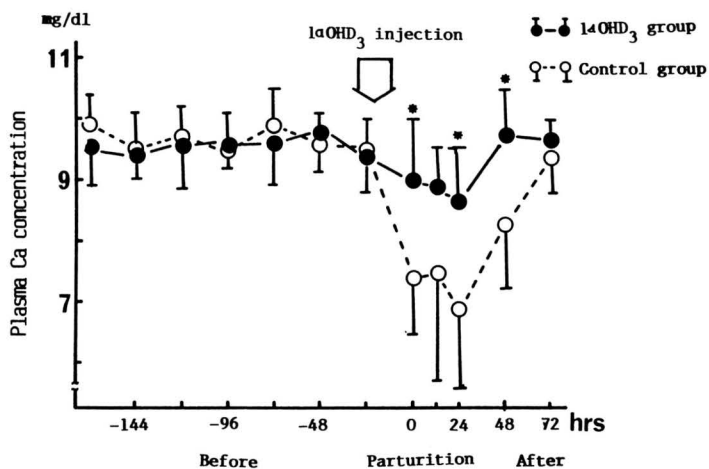


Fig. 3. Changes in plasma concentration of Ca in control and 1 α -OHd₃ groups.

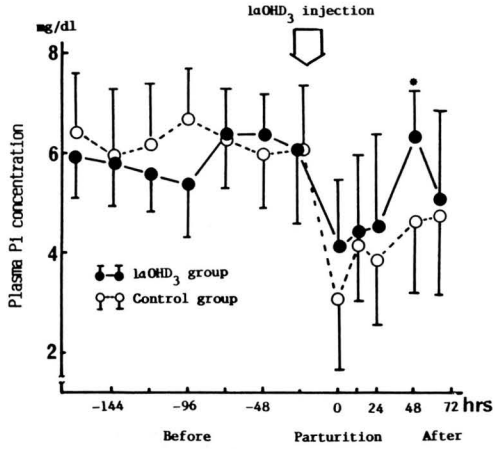


Fig. 4. Changes in plasma concentration of Pi in control and 1 α -OHD₃ groups.

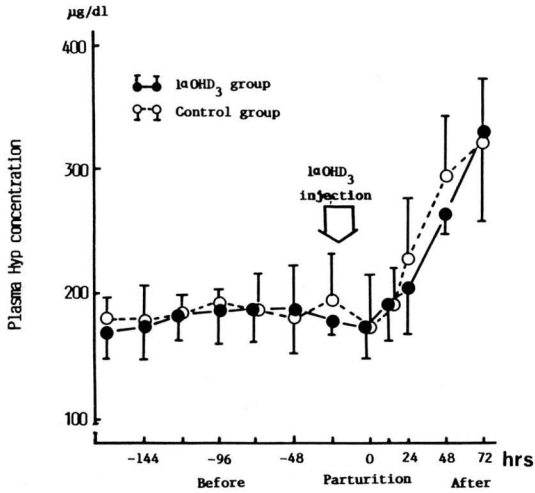


Fig. 5. Changes in plasma concentration of Hyp in control and 1 α -OHD₃ groups.

Discussion

Bar et al. [1] injected 350 or 700 μ g of 1α -OHD₃ intramuscularly to pregnant dry cows that had calved at 36 to 52 h before parturition, and reported that the plasma 1,25-(OH)₂D concentration of cows injected with 1α -OHD₃ increased rapidly, and reached the peak at 24 to 48 h after parturition. In the present study, the plasma 1,25-(OH)₂D concentration in the 1α -OHD₃ group showed the rapid increase at parturition (at 11.5 to 28.5 h after the injection), and reached the peak at 12 h after parturition. The pattern of increase of 1,25-(OH)₂D after 1α -OHD₃ injection was almost similar to that reported by Bar et al., but the time of the peak after parturition was different between our and Bar's experiments [1]. This was thought to be caused by the difference in the injection time between 28.5 to 11.5 h before parturition in our experiment and 52 to 36 h before parturition in their experiment.

The hypocalcemia at parturition probably induced the secretion of PTH [4]. The high plasma PTH after parturition, together with the decrease in the plasma Ca, appear to account for the increased kidney production of 1,25-(OH)₂D and for its accumulation in the plasma. The present results indicate that a injection of 500 μ g 1α -OHD₃ prevented the decrease of plasma Ca and increase of plasma PTH at parturition. The mechanism of the prevention of hypocalcemia associated with the high 1,25-(OH)₂D concentration may have resulted from increased intestinal Ca absorption, reduced Ca excretion by the kidney, and increased bone resorption [3]. Increased plasma Hyp is believed to be associated with bone resorption [2]. Injection of 1α -OHD₃ did not cause significant changes in plasma Hyp and suggested that 1α -OHD₃ increased plasma Ca and Pi through a mechanism other than increased bone resorption.

These findings suggest it to be appropriate for the prevention of the parturient hypocalcemia to inject 500 μ g of 1α -OHD₃ intramuscularly at foreknowable time (for 0.5 to 1 day) of parturition before calving.

Summary

Thirteen mature cows (4.2 average calvings) were divided into two groups, a control group consisting of 7 cows and a 1α -OHD₃ group consisting of 7 cows. Each cow in the 1α -OHD₃ group once received intramuscularly the injection of 500 μ g 1α -OHD₃ (provided by Chugai Pharmaceutical, Co., Ltd.) at 28.5 to 11.5 h before parturition. The plasma 1,25-(OH)₂D concentration in the 1α -OHD₃ group tended to be higher than that in the control group. On the other hand, the plasma PTH concentration in the 1α -OHD₃ group was significantly lower than that in the control group at 0, 24 and 48 h after injection. The plasma Ca concentration in the 1α -OHD₃ group was significantly higher than that in the control group at 0, 24 and 48 h after calving, while the plasma Pi concentration was higher in the 1α -OHD₃ group only at 48 h after calving. These findings suggest it to be appropriate for the prevention of the parturient hypocalcemia to inject 500 μ g of 1α -OHD₃ intramuscularly at foreknowable time (for 0.5 to 1 day) of parturition before calving.

References

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