Physiology of bone resorption during hypocalcemia in dairy cows

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The collagen metabolites hydroxyproline (HYP), deoxypyridinoline (DPD) and the carboxyterminal telopeptide of type I collagen (ICTP) are suitable markers for bone resorption in humans and several animal species. In this study we wanted to investigate if these specific bone markers are also suitable to make evidence of bone resorption during hypocalcemia in dairy cows.

In a field trial involving 18 five to nine-year-old cows with symptoms of periparturient paresis (group A) and 19 five to 13-year old healthy control cows without symptoms (group B), urine and blood samples were collected on day 1, 2, 3, 4, 5, 9 and 14 days after parturition. After the samples were taken on day 1 the cows of group A were treated with a Ca-infusion. HYP concentrations in urine were measured with a colorimetric method. DPD concentrations in urine were quantified with an enzyme immunoassay and ICTP concentrations in the serum with a radioimmunoassay. HYP and DPD concentrations in the urine were corrected for urinary creatinine. Changes with time of the concentrations in urine and serum were examined with the 2-tailed Wilcoxon's sign rank test for paired comparisons and the group effect at the same time was investigated with the Mann-Whitney U-test.

In group A the mean ±SD serum Ca concentration was 1.4 ± 0.2 mmol/l and the mean P concentration 0.5 ± 0.2 mmol/l on day 1 whereas those of group B were 2.0 ± 0.1 mmol/l and 1.5 ± 0.2 mmol/l, respectively. The differences between the groups were significant with a p-value of 0.0001 and 0.0001, respectively. On day 2, there was still a significant difference between the groups referred to P with $p = 0.004$. A significant increase of the corrected urinary HYP concentration was observed from parturition to day 14 (from 2.8 to 8.8 µmol/mmol creatinine) and the concentrations at the different times were higher in group A than in group B. The mean corrected DPD concentration in urine increased after parturition to reach a peak at day 9 while that of ICTP peaked at day 5. For DPD and ICTP the mean concentrations between the groups did not differ significantly.

HYP showed significant differences between the two groups. Because HYP is not specific for bone and only 10% of it is eliminated in the urine, this difference could be explained through a different rate of metabolism in the liver. This hypothesis is supported by the lack of difference for DPD and ICTP between the two groups. DPD and ICTP are useful tools to follow bone resorption in dairy cows, although in our study no difference between the two groups could be found which means that both groups are able to mobilize Ca from bone. The different time patterns of DPD and ICTP are perhaps related to a different rate of metabolism of ICTP to DPD. Further studies are needed to improve knowledge of the physiology of bone markers.

This abstract was received too late to be included at the AABP meeting.