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Plasma Calcitonin in the Bovine Species (40635)[1]

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A variety of agents has been identified as calcitonin (CT) secretagogues during acute studies of their effects *in vivo* (1). However, few studies of the chronic regulation of calcitonin secretion have been reported. To pursue this, we have evaluated the effect of age, sex, and dietary calcium on plasma calcitonin in the bovine species. These studies demonstrate both similarities and differences of plasma calcitonin between the bovine species and other animal species.

Materials and methods. Blood samples were collected at random from the jugular vein from 169 (nonlactating) bovines of varying age, sex, and dietary calcium intake (Table I). Plasma was separated from each sample and stored frozen for subsequent measurements. Calcitonin was measured in each sample by a previously described radioimmunoassay procedure and calcium by atomic absorption spectrophotometry (2, 3). Student's *t* test was used for statistical analysis.

Results and discussion. Table I summarizes the results of the study. Calcium and calcitonin are represented as means (±SE) of at least triplicate determinations. These expanded studies confirm our earlier preliminary findings (2) that plasma CT is generally higher in bulls than in cows (Table I). The importance of gonadal factors in influencing plasma CT is further emphasized by the significantly ($P < 0.01$) lower calcitonin in steers (Table I, Group I) than in bulls and even in virgin females (Table I, Group H) of comparable age and dietary calcium intake who have similar plasma calcium concentrations. Sex-related differences in immunoassayable calcitonin have also been observed in other species. In the salmon and in the rat, plasma CT is higher in females (4–7), whereas in humans, males have higher plasma calcitonin (8, 9). In addition to sex, the current studies demonstrate that age also influences plasma CT: In the bovine species, younger animals tended to have higher plasma CT as well as calcium (Table I). In humans, higher levels of CT have also been reported in infants than adults and a decrease in calcitonin secretion as a function of age has recently been observed in adult females (10, 11). By contrast, in adult rats, plasma CT increases as a function of age (7, 12). These calcitonin differences may play some role in the differences of bone metabolism among animal species (13, 14).

Dietary calcium also seems to influence plasma CT in the bovine species. In general, bulls have higher plasma CT than cows whereas there were no consistent calcium differences between the sexes (Table I). More specifically, bulls of comparable age on a higher calcium diet (Table I, Group D) have significantly ($P < 0.01$) higher plasma CT than those on a lower calcium diet (Table I, Group B) despite no significant differences in calcium between the two groups. The high dietary calcium of the bovine species is generally designed for the increased needs of cows due to pregnancy and lactation. Thus, bulls ingest calcium which exceeds their physiological needs; in fact, it has been estimated that the dietary calcium need for a mature bull is 25 g/day (15). Because of this, it is reasonable to assume that the increased plasma CT in bulls represents a compensatory increase in hormone secretion to counter the excessive calcium ingestion.

The chronic hypercalcitoninemia in bulls may account for the progressive incidence of osteopetrosis which may involve most if not all of these animals past 7 years of age (16). The persistent C-cell stimulation may also

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TABLE I. PLASMA CALCITONIN AND CALCIUM IN THE BOVINE SPECIES

Group	Number	Animals	Age, years (mean ±SE)	Dietary calcium g/day	Calcitonin pg/ml (mean ±SE)	Calcium mg/dl (mean ±SE)
A[a]	20	Bulls	<6 (1.26 ± 0.05)	70	305 ± 12	10.29 ± 0.09
B	19	Bulls	≥6 (10.30 ± 0.49)	90	254 ± 10	9.70 ± 0.11
C	4	Bulls	<6 (3.38 ± 0.37)	110	294 ± 10	9.88 ± 0.09
D[b]	15	Bulls	≥6 (9.30 ± 0.48)	110	303 ± 12	9.59 ± 0.09
E[c]	14	Cows	<6 (3.33 ± 0.32)	200	186 ± 17	10.08 ± 0.06
F	10	Cows	≥6 (7.31 ± 0.65)	200	134 ± 8	9.71 ± 0.14
G	23	Virgins	<2 (1.03 ± 0.07)	78	264 ± 31	9.50 ± 0.06
H	30	Virgins	≥2 (3.4 ± 0.08)	56	240 ± 12	9.27 ± 0.07
I[d]	34	Steers	≥2 (3.3 ± 0.02)	56	190 ± 9	9.29 ± 0.07

[a] Significantly ($P < 0.01$) higher than B.
[b] Significantly ($P < 0.01$) higher than B.
[c] Significantly ($P < 0.05$) higher than F.
[d] Significantly ($P < 0.01$) lower than H and A–C.

account for the occurrence of medullary thyroid carcinoma in the bull (17). These views are supported by the fact that osteopetrosis and medullary thyroid carcinoma occur exclusively in bulls and not in female bovines (16, 17). However, it is likely that other facts play some role in at least the medullary thyroid carcinoma since this tumor can be accompanied by parathyroid hyperplasia and pheochromocytomas, a syndrome remarkably similar to the genetically transmitted multiple endocrine neoplasia, type II of humans (17).

These studies demonstrate that, as in other species, plasma CT in the bovine species is influenced by age and sex, and by diet. When the results are compared to other animal studies, it is clear that species-specific differences modulate the role of these factors in regulating plasma CT (1–10). Other factors must also play a role in the sex differences of plasma calcitonin among different animal species.

Summary. Calcitonin (CT) was measured by radioimmunoassay in plasma samples from 169 bovines of varying age, sex, and calcium diets. Younger animals had higher plasma CT than older animals. Bulls had higher plasma CT than cows or steers. Older bulls on a high calcium diet had higher plasma CT than those on a low calcium diet whereas there was no significant difference in plasma calcium between them. These studies demonstrate that age, sex, and dietary calcium can influence plasma CT in the bovine.

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