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SOME ASPECTS OF CALCIUM AND MAGNESIUM METABOLISM IN CAMEL CALVES

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ABSTRACT

Serum calcium (Ca) and magnesium (Mg) were measured in 30 camel calves at 3, 6, 9 and 12 months of age. The levels were high at 3 month, which decreased with increasing age. The infusion of EDTA into experimental animals resulted in a slight decrease in serum Ca concentration but it had no effect on Mg. Calcium borogluconate administration into two experimental animals led to an increase in serum Ca concentration within 30-60 minutes, then it returned to pre-injection level. This treatment had no effect on serum Mg. Partial parathyroidectomy resulted in a decline in both serum Ca and Mg levels which returned to pre-surgical levels 24 hours post surgery. The results of this study highlighted the possible involvement of the parathyroid gland in the regulation of Ca and Mg metabolism in the young camel.

Key words: Calcium, calf camel, magnesium, metabolism

Calcium (Ca) and magnesium (Mg) have vital functions in the body and must be available in adequate amounts to satisfy body requirements. Ca is stored in the animal body in bone and teeth and acts as a mineral source when dietary supply is inadequate (TCORN, 1991). Normal blood calcium is achieved by adjusting intestinal transport of Ca from ingested food source and release of Ca from bone (Arthur and Martin, 1973). In man and animals Ca metabolism is regulated by parathyroid hormone (PTH), 1,25 dihydroxy vitamin D and calcitonin (Yagil, 1985). The main hormonal control is a feedback mechanism involving the parathyroid gland (Charles, 1981).

Magnesium is required for normal skeletal development as a constituent of bone. In mammals endocrine glands appear to be involved in magnesium metabolism. Many investigations suggest that the parathyroid glands influence magnesium metabolism (Greenberg and Mackey, 1932; Heaton, 1965; Buckle *et al*, 1968; Barri *et al*, 1990). On the other hand, vitamin D seems to play an important role in magnesium metabolism in ruminants. Renal excretion of Mg and Mg absorption from the gastrointestinal tract both are increased by 1,25 dihydroxy vitamin D_3 (Fontenot *et al*, 1989).

This present study was initiated to study calcium and magnesium metabolism in the young camel calves. Reports on this particular aspect are lacking.

Materials and Methods

Sampling : Blood samples were collected from 30 young camels (3-12 months old) by venipuncture into clean plain silicon coated vacutainer tubes. The separated sera were kept into clean vials at 4°C until analysis.

Induction of hypocalcaemia : Hypocalcaemia was induced into two animals (one month old) using ethylene-diamine tetra-acetic acid (EDTA) @ 1 gm/15 kg body weight given as 2% solution intravenously. Blood samples were taken regularly every 30 minutes for 12 hours.

Induction of hypercalcaemia : Each of the two young camels (one month old) was given 400 ml of 40% calcium borogluconate intravenously and 400 ml of 20% calcium borogluconate subcutaneously. Blood samples were collected before and after calcium administration at 0, 30, 60 and 90 minutes of injection.

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Surgical removal of the parathyroid glands (PTX): Two young camels (one month old) were utilised in this experiment and partial parathyroidectomy (PTX) was performed. The anaesthetic was given @ 0.2 mg/kg body weight (1 ml xylazine, seton 2%, I.V.). The parathyroids were identified as seed like structure embedded within the thyroid tissue beneath the thyroid capsule. Blood samples were taken before and after surgery at appropriate intervals.

Biochemical methods : Serum calcium and magnesium were measured by atomic absorption spectroscopy (Pye-Unicam Sp 90, Spectrophotometer, Unicam Instruments Ltd., Cambridge, England). Serum inorganic phosphorus was determined by the method described by Varley (1967).

Statistical analysis : The results of serum Ca, Mg and P concentrations were statistically analysed according to the method of Gomez and Gomez (1984) using analysis of variance (ANOVA) procedure.

Results

The effect of increasing age on serum Ca, Mg and P in the young growing camel is summarised in Table 1. The concentrations of serum Ca and Mg at the age of 3 month are significantly higher ($P<0.05$) than that at the age of 6, 9 and 12 month. Inorganic phosphorus concentration although higher at the age of 3 month, is not significantly different than that at the age of 6, 9 and 12 month. In both animals, serum Ca concentration tended to decrease within 30 - 60 minutes from the commencement of dosing with EDTA, then stabilised at this level till the end of the experiment. Serum Mg concentration was not affected by EDTA infusion.

Table 1. The concentration of serum Ca, Mg and Pi in the camel calves.

Age	Mineral Concentration		
	Ca (mg/100 ml)	Mg (mg/100 ml)	Pi (mg/100 ml)
3 months	$11.2^{a} \pm 0.2$	$4.5^{a} \pm 0.6$	$6.7^{a} \pm 0.23$
6 months	$9.6^{b} \pm 0.4$	$2.6^{b} \pm 0.1$	$6.46^{a} \pm 0.6$
9 months	$9.7^{b} \pm 0.4$	$3.04^{b} \pm 0.3$	$6.26^{a} \pm 0.5$
12 months	$9.8^{b} \pm 0.4$	$2.7^{b} \pm 0.3$	$5.58^{a} \pm 0.4$

Means with the same letter are not significantly different ($P<0.05$).

Within 30-60 minutes after administration of calcium borogluconate serum Ca concentration tended to rise, then declined and remained constant till the end of the experiment. This treatment had no effect on serum Mg.

The partial parathyroidectomy (PTX) resulted in a slight decrease in serum Ca and Mg concentrations. After 24 hours surgery, serum Ca and Mg concentrations were almost normal and comparable to pre-surgical levels.

Discussion

In the current study the concentrations of Ca and Mg in the blood of the growing camel calf were shown to decrease with increasing age. However, the observed high levels of Ca and Mg at the age of 3 month may be due to persistent hypercalcaemia and hypermagnesaemia since foetal life. In sheep and cattle similar hypercalcaemia may persist upto two weeks after birth (Care and Ross, 1984), while in the pig and human adult levels of calcium concentration are rapidly attained after birth. This hypercalcaemia and hypermagnaesemia in the camel calves emphasised the importance of Ca and Mg in the ossification of the skeleton as it progressed to maturity. Thereafter, the concentrations of both Ca and Mg decreased with increasing age. Similar results were reported in cattle by Smith (1961) who found that the efficiency of utilisation of Ca as well as that of Mg decreased as the calves get older. The low plasma Mg level in young animals was due to the fact that the uptake of Mg by young animals was more rapid than adult ones. Furthermore, it has been found that the exchange of Mg was five to ten times greater in young animals than in old animals (Breibart *et al*, 1960). Since young animals have more water content than old animals, more water ions are adsorbed to the surface of bone crystal resulting in low Mg ions in the blood (Fontenot *et al*, 1989).

The results showed that EDTA administration led to a slight decrease in calcium concentration

but no effect on magnesium. This was probably due to the chelating effect of EDTA, however, this insignificant decrease might be due to the small dose of EDTA used in this experiment or the parathyroids of the camel might have responded to this chelating effect producing more parathyroid hormone (PTH) which has resulted in an increased calcium absorption from the small intestine or increased bone resorption releasing Ca in the blood of camel calves, thus a buffering effect was created which has resisted any decline in calcium concentration. Similar results were obtained with experiments in foeti of difference species. Smithe *et al* (1972) and Care *et al* (1975) have demonstrated that the foetal sheep parathyroid glands responded to induced hypocalcaemia by increasing the plasma concentration of PTH. The same results was found in the foetal calf (Wardsworth *et al*, 1982) and foetal monkey (Pitkin *et al*, 1980).

The results showed a small rise in serum calcium concentration 30 to 60 minutes after administrating calcium borogluconate then the levels declined to normal values. This slight increase was insignificant ($p > 0.05$) and it might have been resisted by the secretion of calcitonin by the thyroid gland. The administration of calcium borogluconate had no effect on serum magnesium concentration. The effect of partial parathyroidectomy on serum Ca and Mg in the camel calf revealed a decrease in both Ca and Mg within 30 to 60 minutes post removal, this could be explained either due to the effect of stress imposed by surgery or to reduced PTH levels resulting in reduced intestinal Ca and Mg absorption leading to decreased serum levels. Although this reduction in serum Ca and Mg was insignificant ($p > 0.05$), it highlighted a fact that the parathyroid gland may have a role in Ca and Mg metabolism in the young camel calf through the action of PTH on intestinal absorption of Ca and Mg. Also the insignificant reduction in Ca and Mg could be attributed to the fact that this surgical approach was partial and a functioning pair of parathyroid could still be intact producing PTH. It could be concluded that the parathyroid glands of the young growing camel calf may have a role to play in calcium and magnesium metabolism. Further research should be done to elaborate this work to study all factors which could be involved in Ca and Mg metabolism in the camel calf.

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Diagnosis and surveillance of natural cameline surra with enzyme linked immunosorbent assay and polymerase chain reaction method

The study was conducted to standardise and validate polymerase chain reaction (PCR) and double antibody sandwich enzyme linked immunosorbent assay for antigen detection (Ag-ELISA) for the diagnosis of *Trypanosoma evansi* infection in camel and application of molecular, serological and parasitological diagnostic tools in a field survey and comparison of their efficacy.

In this cross-sectional study realised from July 2002 to May 2003, a total population of 1161 camels of different age, sex and general condition, belonging to different villages and towns of Western Rajasthan state viz. Belasar, Mundsar, Sadasar, Amarpura, Nada, Ratangarh and Bikaner were examined. On clinical examination, 217 (18.69%) camels were found suspected for surra. The results showed a parasitological prevalence of 4.14% by wet blood film examination and 4.60 per cent by thin blood smear examination, serological prevalence of 9.67% and by PCR 17.05%. PCR revealed a specific 227 bp band in positive samples. The intensity of PCR bands was variable in different test samples depending upon the level of infection in the test samples.

Mouse inoculation test carried out for selected 25 camels resulted in 150 per cent increase in the animals found positive as compared to wet blood film and thin blood smear examination. In 11 out of 19 infected mice (57.8%) trypanosomes appeared in first 7 days with an average of 4.36 days. While in remaining eight mice the same appeared on 10, 22, 24, 22, 25, 22, 24 and 38 days post inoculation (DPI). It was found that blood from camels with a high level of parasitaemia caused the most acute infections in rodents. It was also observed that though the infections established in both mice of all the groups but the course of infection in the group of mice inoculated from blood of same camel was variable in some of the groups.

The results obtained using parasitological and PCR methods revealed a significant difference in the prevalence of surra. The positivity of PCR in rural and urban camels was 20.80 and 2.27% respectively, while its per cent positivity in different age groups i.e. upto 5 yeas, 5 to 10 years and > 10 years, was 21.74, 17.26 and 11.53%, respectively. The higher incidence of *Trypanosoma evansi* infection was observed in female camels (24.34%) than males (8.82%).

The history of intermittent fever, emaciation, anaemia, oedema and poor condition significantly correlated with positive serological status in Ag-ELISA as well as trypanosome DNA detection by PCR. Two active foci were identified in Amarpura and Nada, the villages on the edge of Indira Gandhi Canal.

Courtesy : Ph.D.Thesis (2003) submitted to Department of Veterinary Parasitology, College of Veterinary and Animal Science, Rajasthan Agricultural University, Bikaner (India) by Dr. Narender Singh.