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Haematological and Histopathological Alterations in Sodium Thiocyanate-induced Hypothyroid Camels (*Camelus dromedarius*)

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Abstract: A state of hypothyroidism was induced in camels by the repeated daily intramuscular injection of sodium thiocyanate (3 mg kg^{-1} Body weight) for three consecutive months. Blood samples were collected every three days for haematological examination and portions of the thyroid glands were further obtained at slaughter for histological investigation. It was found that administration of thiocyanate resulted in a significant reduction in haemoglobin (Hb) concentration, packed cell volume (PCV), red blood cell count (RBCs) and increased mean cell haemoglobin (MCH), mean cell haemoglobin concentration (MCHC) and mean cell volume (MCV) in camels. The morphological alterations in the thyroid glands were similar to those previously observed in camels living in iodine deficient areas.

Key words: Camel, hypothyroidism, sodium thiocyanate, haematology, histopathology

INTRODUCTION

The natural incidence of colloid goitre in camels has been previously described in iodine deficient areas (Decker *et al.,* 1979; Tageldin *et al.,* 1985; Abu Damir *et al.,* 1990). Iodine deficiency is not the sole cause of goitre in man and animals. Goitrogenic substances in certain foods can cause goitre in man and animals if given in large amounts (Bourdoux *et al.*, 1978). In Darfur state, Western Sudan, a severe juvenile hypothyroidism was described and related to goitrogenic factors (Moreno *et al.,* 1993). Among many goitrogenic substances that have direct effects on the thyroid gland is the thiocyanate (SCN) which functions through inhibition of the iodine trapping mechanism (Capen, 1994). Thiocyanate is capable of inducing iodine deficiency within the thyroid gland, in the presence or absence of adequate iodide intake, sensitizing it to goitrogens and inhibiting iodine organification (Lindsay *et al*., 1992). The aim of this study is to investigate the haematological and histopathological changes in experimentally induced hypothyroidism in camels as a result of thiocyanate administration.

MATERIALS AND METHODS

Experimental design: Four adult female camels (*Camelus dromedarius*) 4-6 years old were brought from Almewelih area, west of Omdurman. The weights of the animals ranged between 350 and 398 kg. They were housed in one large pen at the Radioisotope Department, Soba. They were fed on sorghum hay (Abu Sabeen) and provided with water *ad libitum*. Before the start of the experiment, all animals were clinically examined for their freedom from external and internal parasites.

The camels were then given daily injections of sodium thiocyanate solution (sodium thiocyanate; NaSCN, supplied by Hopkin and Williams, Chadwell Heath, Essex, England), at a dose rate of 3 mg kg^{-1} body weight, intramuscularly for three consecutive months. Samples of whole blood were collected every three days by jugular vein puncture in clean dry vacutainer tubes containing sodium fluoride for the haematological methods as described by Jain (1986). Examination of all blood samples was conducted within one hour after sampling.

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Haematological methods: The haematological parameters and indices including haemoglobin concentration (Hb), packed cell volume (PCV), red blood cell (RBC) count, mean cell volume (MCV), mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) were estimated as described by Jain (1986).

Histopathological methods: Two pieces from each pair of the thyroid gland were obtained from the camels at slaughter by the end of the experiment. These were immediately fixed in 10% formalin, embedded in paraffin wax, sectioned at 5 μm and subsequently stained with Heamatoxylin and Eosin.

Statistical methods: The results were statistically analyzed according to Gomez and Gomez (1984) using ANOVA, where P values higher than 0.05 were considered insignificant.

RESULTS

Haematological findings: The result of Hb concentration, PCV, RBC counts, MCV, MCH and MCHC of the four camels injected with sodium thiocyanate (NaSCN) were presented in Table 1.

Administration of NaSCN significantly ($P<0.01$) lowered the haemoglobin concentration, PCV and RBC count. However, it was noticed that the treatment significantly ($P<0.01$) increased the MCV, MCH and MCHC. The mean values of Hb, PCV and MCHC of the three months showed non-significant differences at $P<0.05$. However, the mean value of RBC count in the third month was significantly ($P<0.05$) lower than that of the first month while the mean values of the third month for the MCV and the MCH were significantly ($P<0.05$) higher than their respective mean values in the first month.

Clinical and histopathological findings: The tentative examination of the camels before slaughtering showed no visible change at the neck region at examination. However, on palpation, a slight variation between the left and right lobes was observed.

On postmortem, the thyroids were generally found to be ovoid in shape but some were elongated. The surface was smooth, rough and cystic. The cysts were varying in sizes, bulging from the surface and involving both lobes and sometimes even the isthmus. The texture of most of the glands was firm. The cut surface exuded a sticky jelly like fluid. Examination of the thyroid sections under the microscope showed evidence of hyperplastic goitre (Fig. 1). The follicles were lined with cuboidal or tall columnar epithelial cells. These lining cells were often proliferating resulting in partial reduction or complete occlusion of follicular lumina. The follicles were of different sizes and irregular shapes. In most of the follicles the colloid was reduced in amount or completely absent. Areas of thick interfollicular spaces as a result of fibrous tissue proliferation and diffuse fibrosis were also seen. Other sections, however, showed evidence of colloid goitre in which the majority of the follicles were enlarged and the colloid is abundant (Fig. 2). The follicular walls were enormously stretched and lined by flattened epithelium. Some follicular epithelium was detached from the basement membrane. Occasionally the lining epithelium was broken resulting in the escape of the

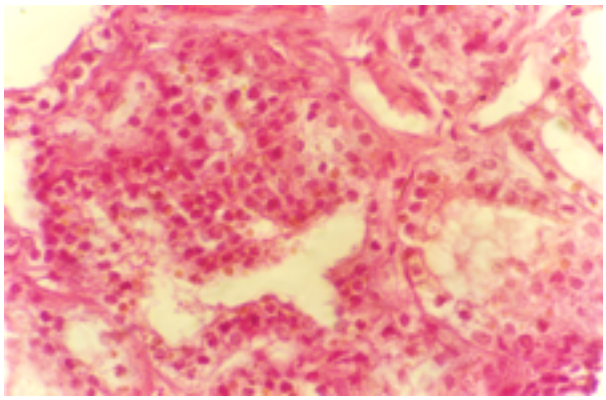

Fig. 1: Hyperplastic goitre. The proliferation of the epithelium resulted in reduction or complete occlusion of the follicular Lumina. H and EX40

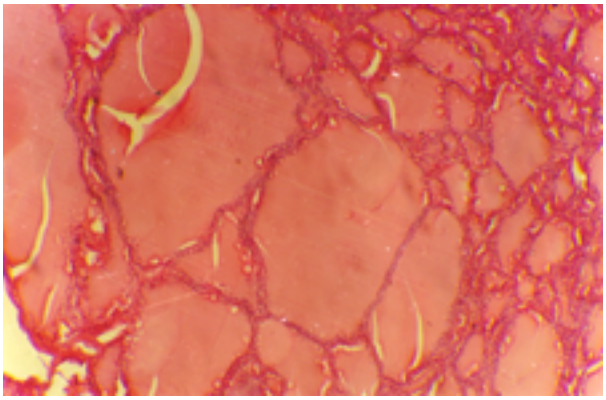

Fig. 2: Enlarged follicles filled with colloid. The follicular walls are stretched and the lining epithelium is flattened. H and EX10

Table 1: Changes in haematological values and RBC indices of sodium-thiocyanate-induced hypothyroid camels (means ± SE range in parenthesis)

Month	1st month	2nd month	3rd month
Hb (g dl^{-1})	9.09^{a}±0.31 (8.7-9.6)	8.30^{a}±0.39 (7.8-8.9)	7.82^{a}±0.29 (7.4-8.4)
PCV (%)	19.89^{a}±0.72 (19-20.8)	18.25^{a}±1.57 (16.5-21.8)	17.07^{a}±1.01 (15.5-18.8)
RBC (10^{6} mm^{-3})	6.45^{a}±0.29 (6-6.9)	5.39^{b}±0.57 (4.6-6.4)	5.04^{b}±0.57 (4.4-5.5)
MCV (ft)	31.07^{b}±1.32 (29-32.9)	33.83^{a}±2.83 (29-38.9)	34.37^{a}±2.65 (29.1-38)
MCH (pg)	14.21^{b}±0.88 (12.8-15.5)	15.58^{a}±1.31 (13.7-17.4)	15.77^{a}±1.07 (14.4-17.4)
MCHC (g dl^{-1})	45.75^{a}±1.58 (42.2-47.7)	46.17^{a}±1.53 (43.7-47.9)	46.07^{a}±1.96 (42.9-49.3)

Means in the same row with similar letters are not significantly different at $P<0.05$

colloid into the space between the lining epithelium and the basement membrane. Many follicles had ruptured and coalesced to form large cysts with colloid seeping into the interfollicular spaces.

DISCUSSION

The results of this study indicated a pattern of relative decrease in Hb, RBC and PCV values with time. This could be attributed to the gradual build up of thiocyanate concentration in the blood of treated camels. The present data on total Hb concentration, RBC count and PCV is significantly lower than the normal camel values reported by Lakhotia *et al.* (1964), Tartour (1971) and Hussein *et al.* (1983), however, it is comparable with the findings of Abu Damir *et al.* (1990) in goitrous camels. The decrease in Hb concentration, RBC count and PCV indicated that a state of mild anaemia had occurred as a result of thiocyanate treatment. Kelley (1984) reported that, reduction in the amount of Hb below the normal level gives rise to a state of anaemia, which may or may not be due to a reduction in the RBC population and/or in the PCV value. A moderate normocytic monochromic anaemia was associated with clinical hypothyroidism in the dog and the haemogram was characteristic of the depression type of anaemia (Kaneko, 1980). The reduction in PCV could be attributed to the decreased circulating RBCs. The mean values of MCH, MCHC and MCV were significantly increased with thiocyanate-induced hypothyroidism. The values reported for MCH in this study were found to be only slightly higher than the reports of Hussein *et al.* (1983) but they were lower than the values reported by Lakhotia *et al.* (1964). The mean values of MCHC were found to be higher than the findings of Lakhotia *et al.* (1964); Tartour (1971); Hussein *et al.* (1983) and Abu Damir *et al.* (1990), but lower than the values reported by Yagil (1985). The increased MCHC value observed in this study may suggest an increased oxygen carrying capacity for the decreased circulating RBCs. The mean values of MCV were in accordance with the findings of Abu Damir *et al.* (1990), but lower than the values of normal camels reported by Lakhotia *et al.* (1964), Tartour (1971) and Hussein *et al.* (1982) and higher than the values reported by Yagil (1985).

The clinical and histopathological pictures of the present study were similar to those previously observed in cases of colloid goitre (Jubb *et al.*, 1985; Tageldin *et al.*, 1985 and Abu Damir *et al.*, 1990). However, histological evidence of hyperplastic changes was also observed in sodium thiocyanate treated camels.

It is concluded that the repeated administration of thiocyanate in camels induced alterations in the thyroid glands (colloid goitre) similar to those produced in camels living in iodine deficient areas. These were accompanied by significant reduction in haemoglobin concentration, packed cell volume, red blood cell count and increased mean cell haemoglobin, mean cell haemoglobin concentration and mean cell volume. Changes in blood constituents and haematological indices were clearly observed, but the mechanisms by which these changes were brought are not fully understood and need more investigation.

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