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EFFECT OF THYROXINE ADMINISTRATION ON THE LEVELS OF CALCIUM, PHOSPHORUS AND MAGNESIUM IN SERUM AND BONE IN RATS

(With One Table)

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تأثير تعاطي هرمون الثيروكسين علي مستوي الكالسيوم ، الفوسفور غير العضوي ، الماغنسيوم في المصل والعظام في الفئران

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أجريت هذه الدراسة لإيضاح تأثير إعطاء هرمون الثيروكسين علي كل من الكالسيوم والفوسفور غير العضوي والماغنسيوم في الدم والعظام . وأجريت الدراسة علي ٢٠ فأر أبيض ناضج ، قسمت إلي مجموعتين : الأولي أعطيت الهرمون لمدة شهر كامل ، والثانية أستخدمت كمجموعة ضابطة . وقد أوضحت النتائج إرتفاع مستوي الكالسيوم في دم المجموعة الأولي . وأظهرت النتائج أيضا إرتفاع محتوي رماد العظام من العناصر الثلاثة في المجموعة الأولي وأستنتج أن إعطاء هرمون الثيروكسين له دور في عملية تنظيم مستوي الكالسيوم في الدم وترسيب عناصر الكالسيوم والفوسفور غير عضوي والماغنسيوم في العظام .

SUMMARY

The current work was planed out to clarify tne effect of thyroxine adminstration on regulation of calcium, inorganic phosphorus and magnesium levels in blood and bone. A total of 20 mature rats were utilized and divided into two groups; treated and control groups. Thyroxine was given to rats of treated group for one month. The results showed a higher calcium level in blood of treated group. Moreover, the levels of the three tested elements were significantly higher in bone ash of treated group. It can be concluded that thyroxine has a role in the regulation of calcium level in blood and deposition of calcium, phosphorus and magnesium in bone.

INTRODUCTION

It was too early since the important role of thyroid gland has been recognized. The gland secretes thyroxine (T_4) and triiodothyronine (T_3), which have profound effect on the body metabolic rate, as well as calcitonin which is considered one of the main hormones influencing calcium metabolism (McDONALD, 1980 and GUYTON, 1986). It is known that T_4 and T_3 play the fundamental role in carbohydrate, protein

and fat metabolism (PETKOV & GEORGIEV, 1983 and SERIES et al., 1987). Moreover, it is recently found that these two hormones may affectcalcium level (TAYLOR et al., 1987). It is also recorded that T_3 and T_4 requlate O_2 consumption and energy production (BARKER, 1964; ISMAIL-BEIGI & EDELMAN, 1971 and ABOUL-ELA et al., 1988).

Calcium, phosphorus and magnesium are the most important mineral elements, required for bone formarion (ARTHUR, 1964; DUKES, 1967; SYMONDS & TREACHER, 1967; BLOOD & HANDERSON, 1974 and COLES, 1977). The majority of these elements; calcium (99%), phosphorus (80%) and magnesium (70%) are found in the complex salts of bones (HARPER et al., 1977).

It has long been known that thyroid hormone is essential for normal skeletal growh and bone formation. In case of hypothyroidism the skeletal growth is greatly retarded, whereas, in case of hyperthyroidism excessive skeletal growth often occurs (GUYTON, 1986). There is no available literature about the exact role of thyroxine in the metabolism and regulation of calcium, phosphorus and magnesium levels. Therefore, the present study was planned out to clarify the effect of thyroxine administration on the levels of these minerals in serum and bone.

MATERIAL and METHODS

Twenty mature albino rats were utlized in this study. Rats were divided into two comparable groups. Animals of the first group were kept as control. Whereas, rats of the second group were given thyroxine sodium (El-Troxin, Glaxo, England) in drinking water in a daily dose of 2 ug/rat for one month. At the end of the experimental period blood samples were collected separatly from all rats for serum separation. Then after, rats were sacrified and long bones of each rat were separated, cleaned and kept for ash preparation as outlined by A.O.A.C. (1984). The levels of calcium, inorganic phosphorus and magnesium were determined in serum and bone ash according to RagSARKER and CHAWKAN (1967); GOMORRI (1942) and GINDLER & HEATH (1971) respectively. Data were statistically analysed according to SNEDECOR (1971).

RESULTS

Table 1: Calcium, inorganic phosphorus and magnesium levels (mg%) in serum and bone ash in control rats and those administred thyroxine. (Mean ± S.E).

	Calcium mg%		phosphorus mg%		Magnesium mg%	
	control	treated	control	treated	control	treated
Serum	5.711±0.57	8.94±0.71**	3.604±0.30	3.27±0.25	4.48±0.40	3.80±0.35
Bone ash mg/100 mg ash	21.69±1.18	47.5±2.29**	10.78±1.17	20.06±1.54**	4.24±0.35	8.5±0.59**

** : Significant at (P/0.01).

The levels of calcium inorganic phosphorus and magnesium (mg%) in serum and bone ash of rats of control group and those adminstered (T_4) and presented in Table (1). Itis obvious that calcium level in the serum of treated group was significantly ($P/ 0.01$) higher than its level in control group. Meanwhile, the levels of the three tested elements in bone ash were significantly ($P/ 0.01$) higher than the corresponding values of control group.

DISCUSSION

The present results showed clearly that adminstration of T_4 for one month resulted in marked hypercalcaemia. It is known that one of the main functions of T_4 is increasing the activity of gasterointestinal tract and the ability of absorption of different elements (EDWARD, 1977 and GUYTON, 1986). Therefore, the estimated higher calcium level in serum following T_4 adminstration can be attributed partially to increased calcium absorption from the gastero intestinal tract. It is reported that hormones, other than parathormone and calcitonin, including thyroxine may regulate calcium haemostasis (CAPEN & MARTIN, 1982 and CAPEN, 1983). Moreover, it is recorded that thyroxine plays a role in the regulation of calcium level in blood (TAYLOR et al., 1987). These previous studies indicate tht T_4 can be incorporated between hormones regulating calcium level. Recently, it is mentioned that hyperthyroidism is considered one of the causes of hypercalcaemia (KANEKO, 1989). Bearing in mind that calcitonin is hypocalcaemia factor, hypercalcaemia recorded in cases of hyperthyriodism might be due to an increase in thyroxine secretion. Therefore the hypercalcaemia resulted from thyroxine administration in the present study, seems to be logic. However, further studies are required to clarify the exact role of T_4 causing hypercalcaemia.

The results of the present study showed also that the levels of calcium, inorganic phosphorus and magnesium in bone ash of rats receiving thyroxine were significantly higher compared to control group. Thyroxine is necessary for growth and it is thought that its action is permissive as it permits somatotropin and other factors to manifest their action (McDONALD, 1982). Thyroxine stimulates protein anabolism in oesteoblasts and thus increasing their activities (HARPER et al., 1977). Therefore, it was anticepated that the rate of deposition of calcium, phosphorus and magnesium, the main minerals necessary for bone formation, might be increased following thyroxine administration for a relatively long period. Consquently, the apparently higher levels of these elements in bone ash of treated group is acceptable.

It could be concluded that thyroxine can be considered one of the hormones regulating calcium levelin blood, besides, thyroxine promotes deposition of calcium, phosphorus and magnesium in bone.

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