HISTOLOGICAL OBSERVATIONS ON THE CHANGES IN THYROID ACTIVITY IN THE SCINCID LIZARD, *MABUYA STRIATA*, DURING DIFFERENT PHASES OF TAIL REGENERATION

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ABSTRACT

Measurements of the follicle cells of the thyroid during different phases of regeneration of the tail in the scincid lizard, *Mabuya striata*, indicate a decrease in thyroid activity during the wound-healing phase and an increase at the end of the blastema phase.

INTRODUCTION

The significance of endocrine secretion of the thyroid has drawn the attention of a number of developmental biologists as the hormone thyroxine brings about various physiological changes during anuran metamorphosis. The regenerative power of these amphibians gradually diminishes as metamorphosis advances. It may be absent in the fully metamorphosed animals (Rose 1964), or sometimes restricted to wound healing or to the formation of a hypermorphic cartilaginous spike (Richards *et al.* 1975). Further, Pawlowsky (1933), Peadorr (1953) and Schotte & Washburn (1954) showed that thyroidectomy, treatment with thiourea, or increased doses of thyroxine hinder amphibian regeneration. Nevertheless, Tassava (1969) and Bromley & Thornton (1974) presented data indicating that prolactin when present with thyroxine promotes limb regeneration. Thus these reports suggest some possible relationship of thyroxine to metamorphic changes and capacity for regeneration in the amphibians. However, the role of thyroxine and other thyroid secretions in regeneration of reptiles is still unknown. The following communication describes an attempt to examine histological differences in the thyroid activity in the normal scincid lizard, *Mabuya striata*, and those showing different stages of tail regeneration, with a view to assessing the role of thyroid secretion in the regenerative processes of this reptile.

MATERIAL AND METHOD

The thyroid gland was removed and fixed in 10% formol saline at room temperature for 12 hours. The tissue was then embedded in paraffin wax, sectioned at 5 μm and stained in haematoxylin-eosin for histological observations. The measurements of height of epithelial cells of follicle and the ratio between the inner follicle diameter and number of cells in a follicle (d/n ratio) were calculated according to Lever (1948). Five follicles from each gland were selected at random for measurements. The observations were made on animals during their non-breeding season and the whole set of observations was confined to the first 50 days during tail regeneration.

The stages of tail regeneration used are arbitrarily defined for the purpose of discussion. The process of regeneration is in fact a continuous one.

OBSERVATIONS

The data on the thyroid activity during the different stages of tail regeneration are summarized in Table 1.

The observations revealed that the thyroid of an adult lizard with a normal tail is more active than that of a lizard with a regenerating tail. After tail autotomy, thyroid activity decreased during the wound-healing phase (Table 1). In the experimental animals a consistent change in the thyroid activity was noticed during the blastema phase. Since the increase in height of the follicle cells indicates an active state of thyroid secretion (Shah & Chakko 1968), it could tentatively be said that a higher thyroxine production might be taking place by the end of the blastema phase. Increased secretion of thyroxine at the end of the blastema could also be confirmed from the fact that there was noticeable reduction in the colloid from

TABLE 1

Thyroid activity in regenerating tail of *Mabuya striata*

Stages of regeneration. Values expressed as μm ± standard deviation.

Thyroid parameters	*Normal*	*Wound healing*	*Blastema*	*Differentiation*	*Growth*	*Fully-regenerated*
Diameter of follicle	39,5±3,84	60,4±3,60	52,4±0,42	53,8±1,16	56,3±1,14	42,3±0,89
Height of follicle cells	2,9 ± 0,85	2,4±0,42	3,4±1,74	2,5±0,36	2,8±0,20	2,5±0,33
Number of cells in a follicle	30±1,67	32±1,99	60±2,52	36±1,44	38±2,54	32±0,68
d/n Ratio	131±0,19	1,89±0,24	0,87±0,25	1,49±0,12	1,48±0,15	1,32±0,19

the lumen of the follicle. The d/n ratio, during the blastema, also showed a considerable decrease, pointing out an increased thyroid activity (Shah & Chakko 1968). Thereafter, the thyroid activity remained constant during the differentiation and growth phases by which time the tail was fully regenerated. In the fully regenerated tail, the height of follicle cells and d/n ratio almost equalled that of the normal tail. This perhaps marks the completion of the process of tail regeneration where active morphological and metabolic activities have more or less settled at a normal pace.

DISCUSSION

Hyperthyroidism in amphibians is known to inhibit regeneration, whereas hypothyroidism favours the process (Schmidt 1968). This author also suggested that the healing processes such as migration, proliferation and accumulation of epithelial cells covering the amputation wound in newts take less time in the hypothyroid newt, *Triturus viridescens*, than in euthyroid ones. Extrapolating these results to the wound-healing process in the regenerating tail of *M. striata*, it could be speculated that a decreased thyroid activity favours the initiation of the wound-healing process (Table 1). However, it must be borne in mind that the wound-healing is not the end of this phenomenon initiated as a result of autotomy, but it is just the beginning of the dynamic process of regeneration.

From the data on the thyroid activity in the lizard during different phases of tail regeneration, it could be assumed that an optimal concentration of thyroxine in the circulating blood is necessary during the blastema phase of regenerating tail in *M. striata*. So, to bring an optimum level of thyroxine into the blood during the blastema phase, the thyroid is activated; this is shown by increase in height of follicle cells and decreased d/n ratio (Table 1). Perhaps this sudden burst of thyroid secretion during the blastema may be for initiation of differentiation and once this is achieved the presence of thyroid hormone might not be required.

In conclusion it could be said that the changes that occur in thyroid activity in *M. striata* are adaptive in nature, *i.e.* they bring the thyroxine level in the blood to a required level during certain stages of regeneration, *viz.* the blastema. Thus, if the thyroid is more active than required, its activity or secretion is reduced, and if less active than required, it is activated to a required state in order to facilitate the unhindered process of regeneration.

In the present work, however, attention was focussed only on the histological changes that take place in the thyroid gland during the normal regeneration of the tail. Experimental studies employing thyroidectomy, administration of prolactin and thyroxine, and analysis of serum tyrosine level in the blood could provide further information on the role of thyroid secretion during regeneration. These experiments are being conducted in our laboratory.

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REFERENCES

BROMLEY, S C & THORNTON, C S 1974. Effect of a highly purified growth hormone on the limb regeneration in the hypophysectomized newt, *Notophthalmus viridescens*. *J. exp. Zool.* 190: 143-154.

LEVER, J 1948. A mathematical method for the determination of the thyroid gland. *Proc. Sect. Sci. K. ned. Acad. Wet. C.* 51: 1302.

PAWLOWSKY, E N 1933. Regeneration of the intestine in *Rana clamitans* larvae. *J. exp. Zool.* 141: 449-475.

PEADON, A M 1953. The effects of thiourea on limb regeneration in the tadpole. *Growth,* 17: 21-44.

RICHARDS, C M, CARLSON, B M & ROGERS, S L 1975. Regeneration of digits and forelimbs in the Kenyan frog, *Hyperolius viridiflavus ferniquei*. *J. Morph.* 146: 431-446.

ROSE, S M 1964. *Physiology of Amphibia.* Ed. John A Moore. New York: Academic Press.

SCHMIDT, A J 1968. *Cellular biology of vertebrate regeneration and repair.* Chicago & London: University Press of Chicago.

SCHOTTE, O E & WASHBURN, W W 1954. Effects of thyroidectomy on the regeneration of the forelimbs in *Triturus viridescens*. *Anat. Rec.* 120: 156.

SHAH, R V & CHAKKO, T V 1968. Preliminary observations on the changes in the thyroid activity in the house lizard, *Hemidactylus flaviviridis*. *J. biol. Sci.* 11: 41-44.

TASSAVA, R A 1969. Hormonal and nutritional requirements for limb regeneration and survival of the adult newts. *J. exp. Zool.* 170: 33-54.