It may be that it is along these lines that efforts must be made to discover the role of indoleamine. Perhaps they participate in an afferent function, but it is evidently not by accident that the whole population of these cells is located far out at the periphery of the chemoreceptor system.

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SUBMICROSCOPIC CHANGES IN THE THYROID GLAND IN BURNS

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The submicroscopic changes in the thyrocytes and perifollicular blood capillaries were studied on the 1st, 2nd, 7th, 14th, 21st, and 28th days after experimental burns on sexually mature male guinea pigs. During the period of burn shock the picture in the thyroid gland was dominated by macrofollicles formed by thickened thyrocytes. The lumen of the capillaries was dilated and the ultrastructure of their wall disturbed. On the 7th-14th day an increase in the height of the cells, with hypertrophy and hyperplasia of the intracellular organelles, were observed. Together with hyperplastic changes in the thyrocytes and endothelial cells, destruction of the membranous components of the cells increased; in the later stages of burns (21st and 28th days) this led to the development of severe necrobiotic lesions of the cells and to a sharp disturbance of vaso-parenchymatous relationships in the gland.

KEY WORDS: *thyroid gland; ultrastructure; burns.*

Considerable material has been collected in recent years on disturbance of the functions of the anterior pituitary and adrenal cortex in burns [3, 4]. The morphology of the endocrine glands and, in particular, of the thyroid gland, has received much less study [2, 6]. There are only a few brief and contradictory reports in the literature on the character of the histological changes in the thyroid gland in burn shock [7-11] and one paper on a study of the thyroid gland in the later stages of burns [2]. There is absolutely no information in the accessible literature on changes in the thyroid gland in burns detected by investigation at the ultrastructural level.

With these facts in mind, and also considering the important role of thyroid hormones in the pathogenesis of burns, the investigation described below was undertaken.

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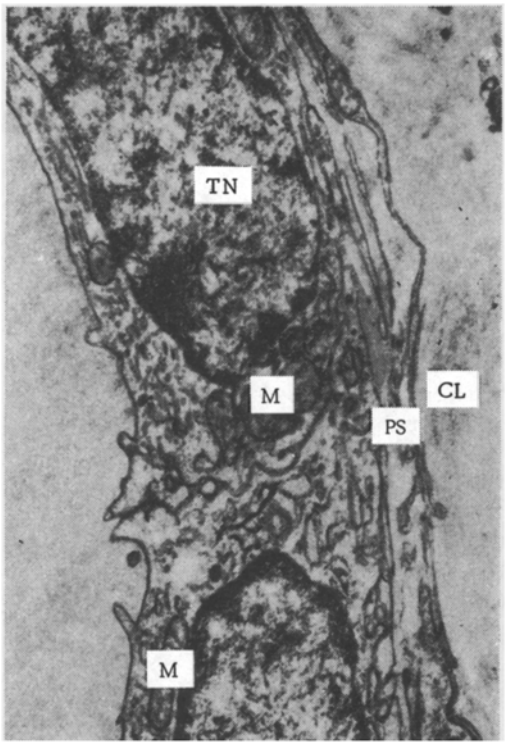

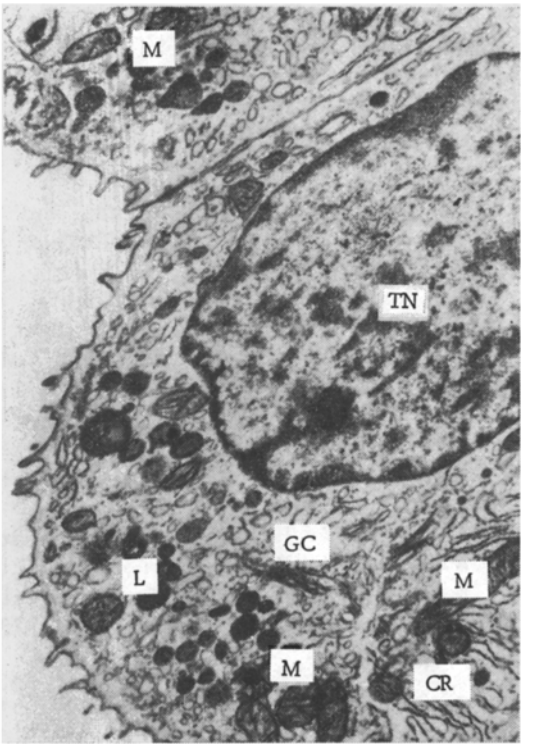

Fig. 1

Fig. 2

Fig. 1. Submicroscopic changes in thyrocytes and wall of blood capillary in burn shock. Reduction in size of microvilli and height of thyrocytes, fragmentation of cristae and focal homogenization of matrix of mitochondria. Changes in endothelium and periendothelial space of capillary. TN) Thyrocyte nucleus; M) mitochondria; PS) periendothelial space; CL) capillary lumen; 16,000×.

Fig. 2. Ultrastructure of follicular thyrocytes on seventh day after burns. Tubules of cytoplasmic reticulum moderately dilated. Well-defined Golgi complex, most mitochondria have osmiophilic matrix, many microvesicles and granules present in cytoplasm. Number of microvilli on apical surface increased. L) Lysosomes; CR) cytoplasmic reticulum; GC) Golgi complex. Remainder of legend as in Fig. 1; 17,000×.

EXPERIMENTAL METHOD

Experiments were carried out on 40 sexually mature male guinea pigs. Burns were inflicted for 60 sec by water vapor at a temperature 96-97°C on the epilated surface of the back. The size of the lesion on average was 20% of the body surface. Histological investigations of the skin confirmed the development of burns of degrees IIIA and IIIB. The animals were decapitated after 1-2, 7, 14, 21, and 28 days.

Material for electron microscopy (the UEMV-100 microscope) was processed in the usual way.

Considering data in the literature on differences in the structure of the follicular cells resulting from differences in their functional state [1, 5], a parallel study was made of the ultrastructure of the thyroid gland cells of intact animals.

EXPERIMENTAL RESULTS

The structure of the thyroid parenchyma 1-2 days after burning was mainly macrofollicular. An increase in the quantity of colloid was accompanied by a decrease in the height of many thyrocytes. The number and size of the submicrovilli on the apical surface of these cells were appreciably reduced (Fig. 1). The cytoplasmic reticulum and Golgi complex were poorly defined. Few granules, pale vesicles, and vacuoles could be seen in the cytoplasm of the flattened cells. Darkening of the matrix, destruction of the cristae, and some disturbance of the membrane were observed in many mitochondria. Most of the capillaries of the

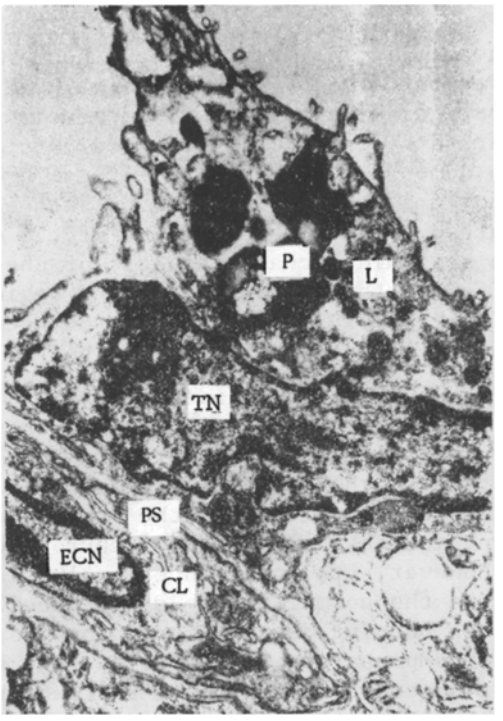

Fig. 3. Gross changes in ultrastructure of thyrocyte on 28th day of burns. Marked changes in shape of thyrocyte. Many primary and secondary lysosomes present in vacuolated cytoplasm. Lumen of perifollicular capillary has collapsed. ECN) Endothelial cell nucleus; P) autophagosomes. Remainder of legend as in Figs. 1 and 2; 15,000×.

glands were dilated, and the number of pinocytotic vesicles and microvilli in their endothelium was reduced. Connections between the endothelial cells were frequently disturbed and sometimes swelling and desquamation of the endothelial cells were present.

A rather different picture could be observed in the thyroid gland on the seventh day after burns. Many cells of the thyroid epithelium were now cubical, and some even cylindrical in shape (Fig. 2). The nuclei in these last cells, although preserving comparatively smooth outlines, were located in the central part of the cell. In cytoplasm of the thyrocytes and, in particular, in their apical part, many microvesicles, granules, and lysosomes of different shapes and sizes could be seen. Meanwhile the number and size of the microvilli on the apical surface of the cells increased. The tubules of the cytoplasmic reticulum in this period after burns were always moderately dilated. The Golgi complex was constantly visible. The number of mitochondria with an osmiophilic matrix was increased, but in many of them the orientation of the cristae was changed and local disturbance of the integrity of the membrane could be observed.

Besides the cells described above, follicular thyrocytes with strongly hyperchromic nuclei and a small quantity of cytoplasm, in which the few organoids were difficult to identify, also were found.

Toward the end of the second week of burns there was a tendency toward the accumulation of primary lysosomes with clearly outlined membranes, free ribosomes, microvesicles, and granules in the cytoplasm of many of the thyrocytes. In the region of the moderately dilated cytoplasmic reticulum autophagosomes were frequently seen. Another characteristic feature of this period after burns was a sharp increase in size of the nuclei of many of the endothelial cells, as a result of which the lumen of the blood capillaries was considerably reduced. Many pinocytotic vesicles, granules, and microvilli were observed in the endothelium of the functionally excited sinusoids.

On the 21st-28th day after burns considerable vacuolation of the cytoplasm was observed in many of the hormone-forming follicular cells and the number of secondary lysosomes was increased. The latter were distributed mainly in the apical part of the high-prismatic thyrocytes. The sharp dilatation, vacuolation, and fragmentation of the tubules of the cytoplasmic reticulum, and the marked destruction of the ordinary and, in particular, of the enlarged mitochondria also were demonstrative. Besides these profound changes in the organelles, the clarity of the cytolemma was reduced and, on the basal surface, the integrity of the plasma membrane was disturbed. The ultrastructure of the endothelial cells and of the periendothelial spaces of the sinusoids, characteristic of the capillaries, was disturbed. Even more profound changes affected the thyrocytes in the region of collapsed capillaries, leading to the development of irreversible degenerative changes and necrobiotic lesions and subsequent desquamation of the cells into the lumen of the follicles (Fig. 3).

The results of these investigations thus indicate that in response to burn trauma a series of structural changes develops in the thyroid gland which are manifested differently at different stages after burning. In the period of burn shock, ultrastructural changes indicating the low functional state of the organ take place in the cells of the thyroid epithelium and perifollicular blood capillaries. On the 7th day after burning considerable hyperplastic changes reflecting increased activity of thyrocytes were observed in the overwhelming majority of cells. However, prolonged functional strain on the cells associated with burns evidently complicates the normal course of intracellular regeneration: Toward the end of the second week after burning destructive changes appear in the organoids of the cytoplasm, and as a result the compensatory and adaptive powers of the hormone-forming cells are reduced. Even more marked destruction of the ultrastructure of the organelles is found in the functionally exhausted cells on the 21st-28th days after burning; these changes ultimately lead to the development of profound necrobiotic lesions of the thyrocytes and are evidence of lasting depression of thyroid function in the later stages of burns.

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