PharmacologyOnLine

Archives • 2021 • vol.3 • 968-974

THE MICROSCOPIC AND ULTRAMICROSCOPIC CHANGES OF THE WHITE RATS' THYROID GLAND 7 DAYS AFTER EXPERIMANTAL THERMAL BURN INJURY UNDER NaCl SYSTEMIC ADMINASTRATION

[1]Tiron, O. I.; [2]Nebesna, Z. M.; [3]Yatsyna O. I.; [4]Badiuk, N. S.*
[1]Odessa National Medical University, Odessa, Ukraine
[2]I. Horbachevsky Ternopil National Medical University, Ternopil, Ukraine
[3]National Cancer Institute, Kyiv, Ukraine
[4]Odessa International Medical University, Odessa, Ukraine

*corresponding author *badiuk_ns@ukr.net

Abstract

The conducted microscopic and ultramicroscopic examinations revealed that 7 days after experimental burn injury the thyroid gland exhibits alterations of the follicular structure, thyroid epithelium, blood vessels and stroma. Most of such alterations are the signs of thyroid destruction. In the central regions of the lobules there are small follicles containing small amount of colloid; the latter is rarefied, fine, slightly oxyphilic and contains large resorption vacuoles.

The cells of the thyroid epithelium are columnar or cuboidal; their characteristic features are intracellular edema, hypochromic nuclei and irregular cell borders. The stromal interfollicular connective tissue is swollen, containing leukocyte infiltrates, mainly in its perivascular regions. Both thyroid arteries and veins are blood-filled, and their walls are swollen.

he tunica media of the arteries is enlarged; its smooth muscle cells exhibit intracellular edema and contain intensely basophilic nuclei. Impaired thyroid hemodynamics is also manifested by the changes in the vessels of the microvascular bed: most venules are blood-filled, the walls of arterioles are thickened and swollen, containing perivascular leukocyte infiltrates.

All human studies were conducted in compliance with the rules of the Helsinki Declaration of the World Medical Association "Ethical principles of medical research with human participation as an object of study". Informed consent was obtained from all participants.

Keywords: *burn injury, thyroid gland, light microscopy, electron microscopy*

Introduction

It is a common knowledge that burn injuries, particularly severe ones, cause systemic response and may lead to alterations in other organs [1]. The described effects include pulmonary damage, brain atrophy, acute renal failure, liver failure, hepatic fatty infiltration, gut atrophy, cardiac and thymus dysfunction. The metabolic alterations following burn injuries may form the complex picture of burn-associated hypermetabolism and include lipolysis and fat catabolism, loss of bone mineral density, hormone dysfunction and depletion and thyroid dysfunction [2, 3]. Despite some conducted research the existing scientific data is insufficient to answer the question whether alterations in the thyroid function contribute to the hypermetabolism after burns [4].

The fact that functional alterations are often accompanied by morphological changes led us to scrutinize the thyroid gland after severe thermal burns.

The aim of the present study is to determine the microscopic and ultramicroscopic changes in the thyroid structure of the experimental animals 7 days after modeled skin burn.

Materials and methods

The collection of biological material for microscopic examination was performed according to the generally accepted method [5]. The thyroid gland samples were fixed with 10% neutral formalin solution, then dehydrated by passing through increasing concentrations of alcohol and embedded into paraffin blocks. The obtained sections, 5-6 μm thick, were stained with Hematoxylin-Eosin [5].

The histological sections were examined under the MIKROmed SEO SCAN light microscope, the photomicrographs were taken with the Vision CCD Camera with an image output system for histological specimens. The thyroid gland samples collected for electron microscopic examination were fixed with 2,5% glutaraldehyde solution, then post-fixed with 1% osmium tetroxide prepared with phosphate buffer. Further processing was performed according to the generally accepted method [5].

Ultrathin sections made with ultramicrotome УМПТ-7 were contrasted with uranyl acetate, lead citrate according to the Reynolds method [6] and examined under the electron microscope ПЕМ-125К.

Results

The conducted microscopic examinations revealed that 7 days after experimental burn injury the thyroid gland exhibits alterations of the follicular structure, thyroid epithelium, blood vessels and stroma. Most of such alterations are the signs of thyroid destruction. The thyroid lobules contain follicles of different size, and some of them are deformed. In the central regions of the lobules there are small follicles containing small amount of colloid; the latter is rarefied, fine, slightly oxyphilic and contains large resorption vacuoles. The cells of the thyroid epithelium are columnar or cuboidal; their characteristic features are intracellular edema, hypochromic nuclei and irregular cell borders (Fig. 1). Mainly in the central parts of the lobules there are observed interfollicular islets. The stromal interfollicular connective tissue is swollen, containing leukocyte infiltrates, mainly in its perivascular regions. In the peripheral regions of the lobules there are observed large altered follicles with dense or rarefied colloid; the resorption vacuoles are almost not detected. The thyrocytes of such follicles are squamous; some desquamated cells are observed within follicular lumen (Fig. 2).

Both thyroid arteries and veins are blood-filled, and their walls are swollen. The tunica media of the arteries is enlarged; its smooth muscle cells exhibit intracellular edema and contain intensely basophilic nuclei. The endothelium of the tunica intima is also altered, the cell nuclei bulge into the arterial lumen; the margination of leukocytes is observed. The adventitia is swollen and infiltrated with leukocytes. The veins are also blood-filled, their walls are swollen and exhibit local thinning (Fig. 3). The vessels with narrowed, collapsed lumens, deformed, locally thinned or thickened walls are also observed.

Impaired thyroid hemodynamics is also manifested by the changes in the vessels of the microvascular bed: most venules are blood-filled, the walls of arterioles are thickened and swollen, containing perivascular leukocyte infiltrates.

The electron microscopic examination revealed the ultrastructural alterations of the thyroid

capillary wall and follicular thyrocytes 7 days after experimental burn injury under NaCl systemic administration. Thyrocytes of the large follicles are flattened, containing elongated nuclei with blurred, occasionally homogenic nuclear envelope with numerous invaginations. Some regions of the nuclear envelope exhibit dilatations of the perinuclear space. The karyoplasm contains small regions occupied by euchromatin and marginally located lumps of heterochromatin. The nuclei are small and shrinked. The cytoplasm is swollen, electron lucent and contains destructively changed organelles. The canaliculi of the rER are thickened or thinned. The mitochondria are not numerous; their shape is altered, vacuolized. The mitochondrial matrix is rare, the cristae are reduced. The cytoplasm contains few free ribosomes and polysomes. The thyrocytes' apical domain contains vesicles and osmiophilic lysosomes. The thyrocytes' plasma membrane forms occasional short microvilli (Fig. 4).

The electron microscopic examination revealed heterogeneous changes in the thyroid blood capillaries 7 days after modeled burn injury under NaCl systemic administration. The walls of most capillaries are swollen; their lumens are enlarged, markedly blood-filled with formation of erythrocyte stasis and sludge. The nuclei of endothelial cells are deformed, elongated or ellipse-shaped; the karyoplasm contains predominantly euchromatin and lumps of osmophilic heterochromatin at the periphery. There are reveled the local invaginations nuclear envelope; its outer and inner membranes are blurred. The perinuclear space is locally expanded. The endothelial cells cytoplasm contains poorly developed organelles exhibiting the signs of destruction. The tubules of the rough Endoplasmic reticulum are significantly dilated and thickened; the large vacuoles and cavities are formed. The shape of the mitochondria is altered, but their outer and inner membranes are well distinguished; the gaps between partially fragmented cristae are filled with rarefied mitochondrial matrix. The cell-to-cell junctions remained intact. The peripheral cytoplasm is moderately swollen, electron light, containing small amount of micropinocytotic vesicles, caveolae and fenestrations. The luminal surface is blurred and contains occasional short microvilli. The basal lamina is slightly thickened or thinned, indistinctly contoured (Fig. 5). The pericytes are characterized by an altered shape of the nuclei, enlightened areas of the cytoplasm, and impaired membrane organelles.

Conclusions

The conducted micro- and ultramicroscopic examination of the experimental animals' thyroid gland 7 days after modeled burn injury under NaCl systemic administration revealed structural remodeling of the thyrocytes, capillary wall, stromal connective tissue with the signs of their destruction and alteration. The latter indicates on the functional alterations of the gland.

Acknowledgments

The authors declsre that there are no conflicts of interest.

References

1. Jeschke MG, Gauglitz GG, Kulp GA, Finnerty CC, Williams FN, Kraft R, Suman OE, Mlcak RP, Herndon DN. Long-term persistance of the pathophysiologic response to severe burn injury. PLoS One. 2011;6(7):e21245. doi: 10.1371/journal.pone.0021245. Epub 2011 Jul 18. PMID: 21789167; PMCID: PMC3138751.
2. Krishnan P, Frew Q, Green A, Martin R, Dziewulski P. Cause of death and correlation with autopsy findings in burns patients. Burns. 2013 Jun;39(4):583-8. doi: 10.1016/j.burns.2012.09.017. Epub 2012 Nov 6. PMID: 23137628.
3. Porter C, Tompkins RG, Finnerty CC, Sidossis LS, Suman OE, Herndon DN. The metabolic stress response to burn trauma: current understanding and therapies. Lancet. 2016 Oct 1;388(10052):1417-1426. doi: 10.1016/S0140-6736(16)31469-6. PMID: 27707498; PMCID: PMC5753602.
4. Smeds S, Kågedal B, Liedén G, Liljedahl SO. Thyroid function after thermal trauma. Scand J Plast Reconstr Surg. 1981;15(2):141-8. doi: 10.3109/02844318109103426. PMID: 6803354.
5. Goralskiy LP, Homich VT, Kononskiy OI. Fundamentals of histological technique and morphofunctional methods of research in norm and in pathology. Zhitomir: Polissya; 2011.
6. Reynolds ES. The use of lead citrate at high pH as an electron-opaque stain in electron

microscopy. *J Cell Biol.* 1963;17(1):208-212. | doi:10.1083/jcb.17.1.208

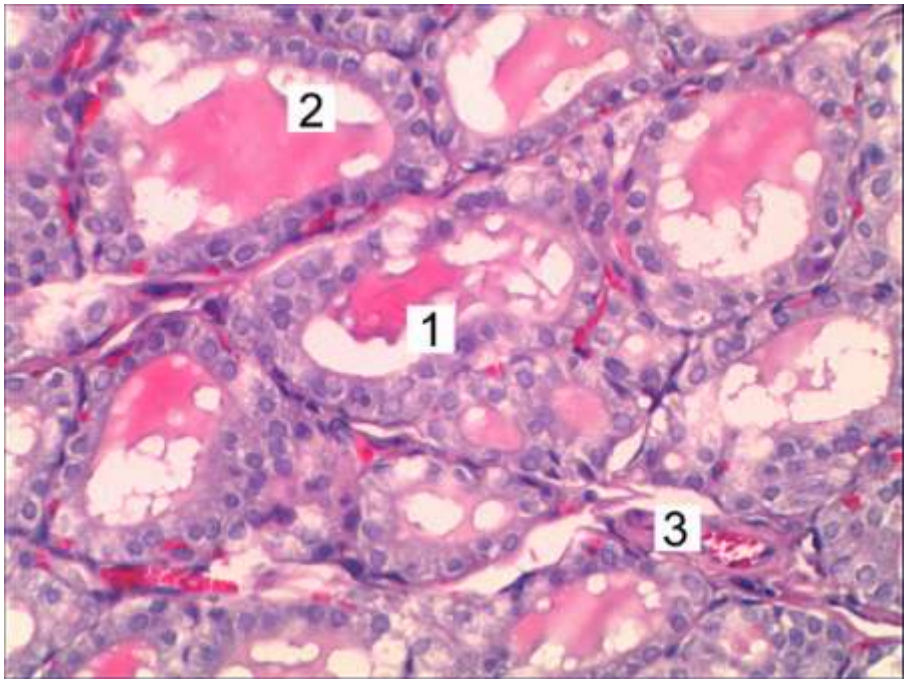

Figure 1. Histological changes of the thyroid gland 7 days after modeled burn injury under NaCl systemic administration. The shape of the thyroid follicles is altered (1), colloid containing resorption vacuoles (2), arteriole (3). Hematoxylin-Eosin staining. x 200.

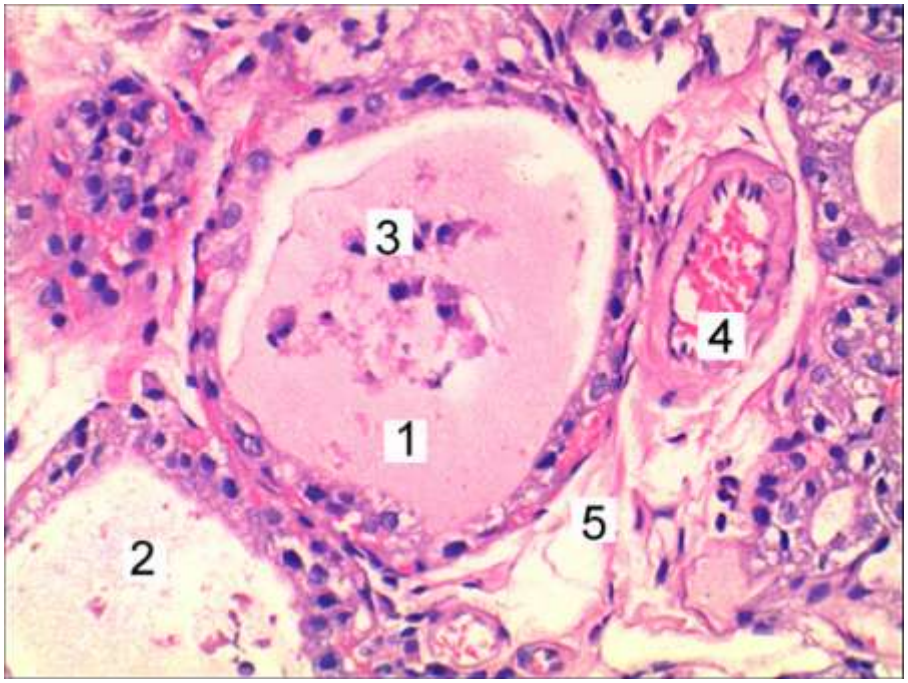

Figure 2. Histological changes of the thyroid gland 7 days after modeled burn injury under NaCl systemic administration. Enlarged follicles (1), rarefied colloid (2), desquamated thyrocytes within follicular lumen (3), artery (4), swollen interstitial connective tissue (5). Hematoxylin-Eosin staining. x 200.

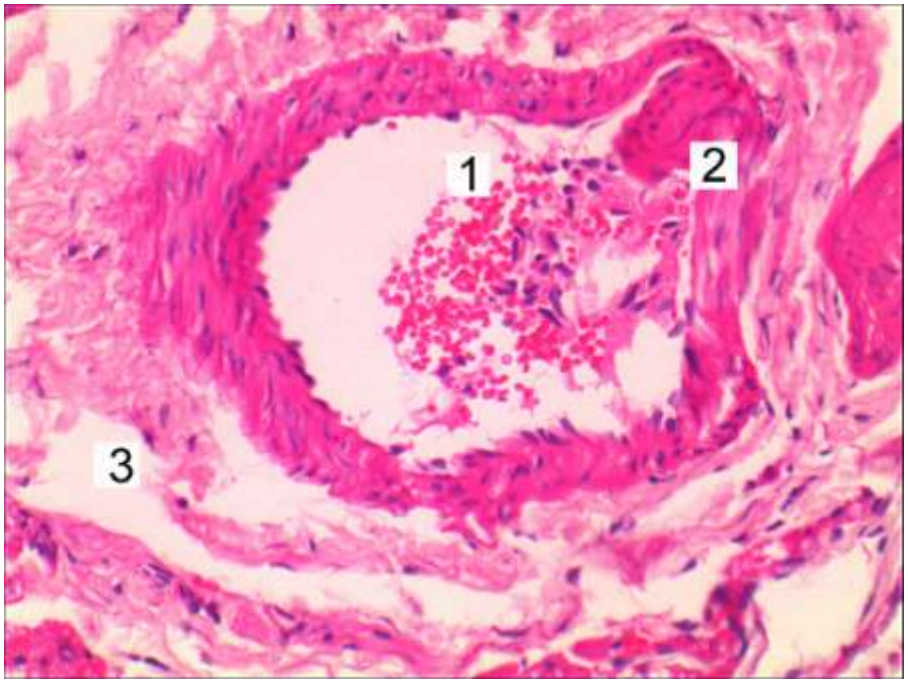

Figure 3. Microscopic changes of the thyroid gland 7 days after modeled burn injury under NaCl systemic administration. Arterial lumen (1), deformation of the arterial wall (2), swollen adventitia (3). Hematoxylin-Eosin staining. x 200.

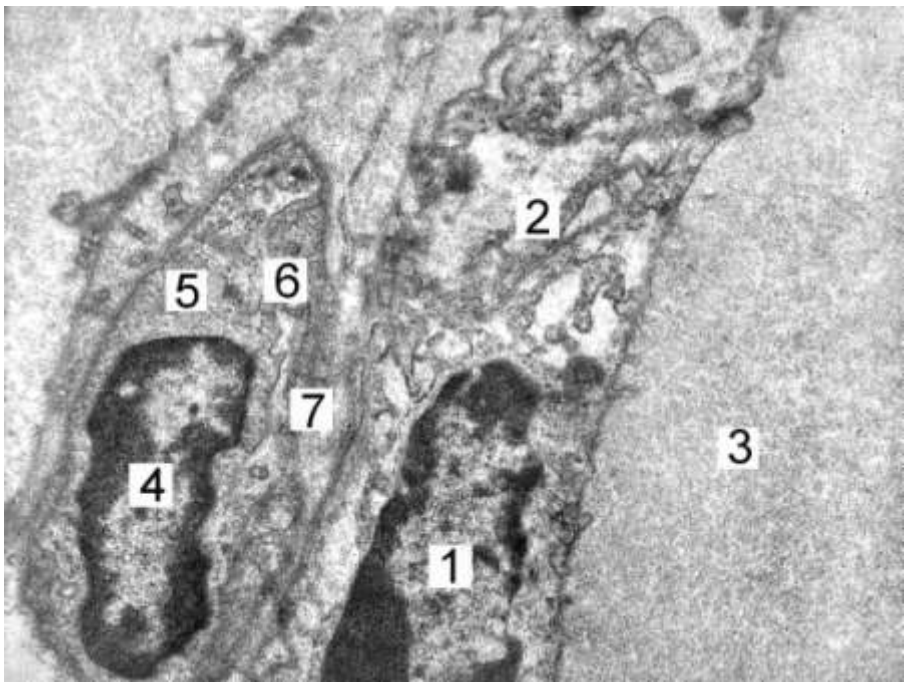

Figure 4. Ultramicroscopic changes of the thyroid gland 7 days after modeled burn injury under NaCl systemic administration. Nucleus (1), and cytoplasm of the thyrocyte (2), colloid (3), nucleus (4), and cytoplasm of the endothelial cell (5), narrow capillary lumen (6), basal lamina (7). x 10 000.

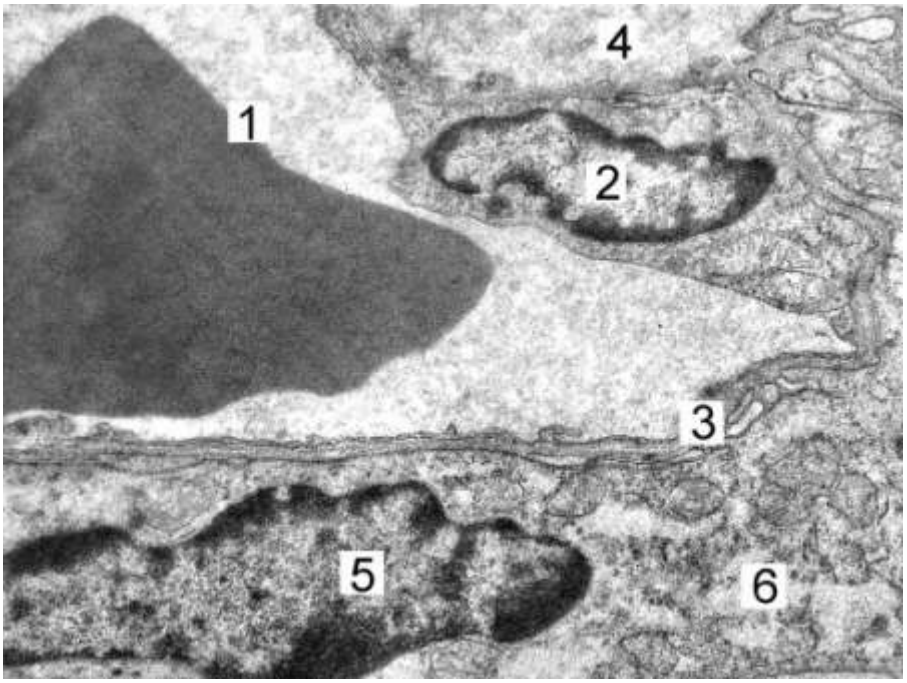

Figure 5. Ultramicroscopic changes of the thyroid gland 7 days after modeled burn injury under NaCl systemic administration. Erythrocyte within capillary lumen (1), nucleus of the endothelial cell (2), basal lamina (3), interstitial connective tissue (4), nucleus (5) and cytoplasm of the thyrocyte (6) x 10 000.