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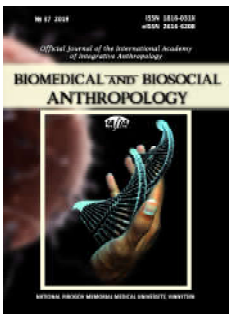

Features of morphological changes in the thyroid gland of white male rats 1 day after thermal trauma of the skin on the background of the introduction of 0.9 % NaCl solution

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Despite the fact that the main pathogenetic factor in the development of burn disease is the alteration of the skin, the severity of the condition of patients in the acute period of the disease is due to systemic changes in the body caused by thermal factor. Being a powerful stress factor, severe burns are accompanied by activation of the hypothalamic-pituitary system. Although thyroid hormones are not considered typical "stress hormones", they also play a role in maintaining vasomotor function under stress. The question of thyroid dysfunction on the background of burn injury remains debatable, and scientific data on its morphological and ultramicroscopic changes are quite limited. The aim of the work is to establish microscopic and submicroscopic changes of the thyroid gland of experimental animals in the stage of shock after thermal trauma of the skin. Experimental studies were performed on 12 white adult male rats, which received a thermal burn of the skin of 2-3 degrees with a lesion area of 21-23 % of the skin. An infusion of 0.9 % NaCl solution at a dose of 10 ml/kg was performed into the inferior vena cava. Collection of material for histological and electron microscopic examinations was performed according to generally accepted methods. Histological specimens were examined using a MIKROmed SEO SCAN light microscope and photo-documented using a Vision CCD Camera with an image output system from histological specimens. Ultrathin sections made on an ultramicrotome UMPT-7 were contrasted with uranyl acetate, lead citrate according to the Reynolds method and studied under an electron microscope PEM-125K. Conducted micro- and submicroscopic studies of the structural components of the thyroid gland a day after the reproduction of thermal trauma to the skin on the background of the introduction of 0.9 % NaCl solution revealed reactive adjunctive-compensatory changes and initial manifestations of destruction. Vascular, stromal and parenchymal components of the organ in the stage of shock after burns correspond to the state of "stress" as a reaction to pathological exogenous exposure, and the intensification of metabolic processes in the affected organism of experimental animals.

Keywords: *thyroid gland, thermal skin burn, light microscopy, electron microscopy, rats.*

Introduction

Despite the fact that the main pathogenetic factor in the development of burns is the alteration of the skin, the severity of patients in the acute period of the disease is due to systemic changes in the body caused by thermal factor [14, 15, 16]. Systemic changes in the body due to severe burn injuries develop due to the massive release of inflammatory mediators, which cause a widespread increase in the permeability of blood vessels. In addition, the activation of complement components and intravascular stimulation of neutrophils leads to the formation of a large number of cytotoxic free radicals [6, 12, 19].

The increase in blood vessel permeability occurs not only in the burn area, but also in distant organs and tissues due to the release of blood cytokines and inflammatory mediators such as thrombin, bradykinin, histamine, reactive oxygen species, vascular endothelial growth factor (VEGF), necrosis factor tumors - α (TNF-α), lipopolysaccharide (LP), etc. [12, 16].

Being a powerful stress factor, severe burns are accompanied by activation of the hypothalamic-pituitary

system. Although thyroid hormones are not considered typical "stress hormones", they also play a role in maintaining vasomotor function under stress. Decreased levels of thyroxine in the blood are associated with decreased contractile activity of the myocardium, hemodynamic instability, and electrolyte imbalance [4, 5, 17, 20, 23].

It is known that the level of thyroid-stimulating hormone adenohypophysis may increase on the background of burn injury, but the question of thyroid dysfunction remains debatable, and scientific data on its morphological and ultramicroscopic changes are quite limited [1, 7, 8].

The aim of the work is to establish microscopic and submicroscopic changes of the thyroid gland of experimental animals in the stage of shock after thermal trauma of the skin.

Materials and methods

Experimental studies were performed on 12 white adult male rats. The keeping and manipulation of animals was carried out in accordance with the "General Ethical Principles of Animal Experiments", adopted by the First National Congress on Bioethics (Kyiv, 2001), also guided by the recommendations of the "European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes" (Strasbourg, 1985), guidelines of the State Pharmacological Center of the Ministry of Health of Ukraine on "Preclinical studies of medicinal products" (2001).

Thermal burn of the skin of 2-3 degrees was carried out by applying to the pre-depilated side surfaces of the body of rats four copper plates for 10 seconds, which were pre-heated for 6 minutes in water with a temperature of 100°C [11]. The area of skin lesions was 21-23 %.

Infusion of 0.9 % NaCl solution at a dose of 10 ml/kg was performed in the inferior vena cava after catheterization under aseptic conditions through the femoral vein.

Catheterization of the main vessels, staging of skin burns and decapitation of animals was performed under propofol anesthesia (60 mg/kg i/v).

Collection of material for microscopic examinations was performed according to conventional methods [10]. Pieces of the thyroid gland were fixed in 10 % neutral formalin solution, dehydrated in alcohols of increasing concentration, poured into paraffin blocks. The sections made, 5-6 μm thick, were stained with hematoxylin-eosin [10]. Histological specimens were examined using a MIKROmed SEO SCAN light microscope and photo-documented using a Vision CCD Camera with an image output system from histological specimens.

For electron microscopic examinations, pieces of the thyroid gland were removed, fixed in 2.5 % glutaraldehyde solution, and postfixed with 1 % osmium tetroxide solution on phosphate buffer. Further processing was performed according to the generally accepted method [10]. Ultrathin sections made on an ultramicrotome UMPT-7 were contrasted with uranyl acetate, lead citrate according to the Reynolds method and studied under an electron microscope PEM-125K.

Results

Histological examinations of the thyroid gland of experimental animals showed that a day after the burn injury revealed reorganization of blood vessels, stroma and parenchyma of the organ. There is a violation of hemodynamics of the body, for most vessels, especially veins and venules are characterized by plethora, wall edema, especially adventitia. There is an increase in the permeability of the walls of the vessels of the hemomicrocirculatory tract, especially capillaries, which tightly surround the follicles, which contributes to edema of vascular walls, components of stromal loose connective tissue, intercellular edema (Fig. 1). Histo- and leukocyte cells are found in the perivascular space.

The parenchyma of the organ is formed by follicles of mostly medium size, in which the thyrocytes lining the wall of low prismatic shape, the colloid is moderately oxyphilic, there are vacuoles of resorption (Fig. 2). Also, in this period of observation, single large follicles with dense, intensely oxyphilic colloid, squamous thyroid epithelium are observed mainly subcapsularly. In the central parts of the lobe there are small follicles in which thyrocytes are highly prismatic, there is little or no colloid enlightened and there are vacuoles of resorption due to the intensification of metabolic processes after burn injury (see Fig. 1, Fig. 2).

At the submicroscopic level, thyrocytes of most follicles had a cubic, low-prismatic shape, round-oval, hypertrophied with moderately electron-dense nucleus, slight intussusception of the nucleolus, karyoplasm of such cells contained euchromatin, however, marginally placed lumps of heterochromatin were detected. Large nucleoli

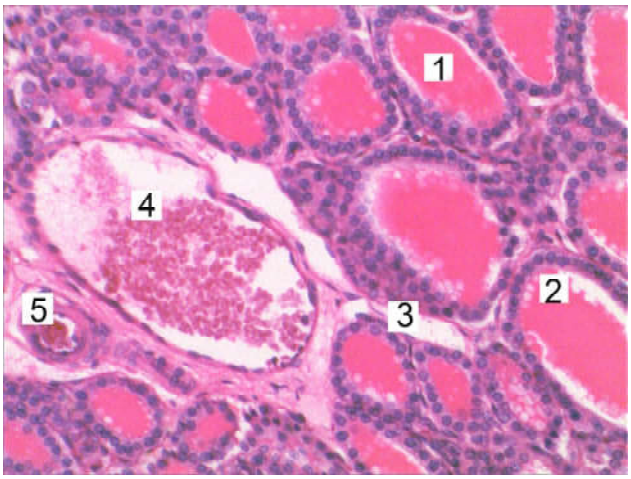

Fig. 1. Microscopic changes of the thyroid gland 1 day after the experimental burn injury on the background of the introduction of 0.9 % NaCl solution. Staining with hematoxylin and eosin. x200. Symbols: 1 - follicles, 2 - colloid resorption vacuoles, 3 - perifollicular swollen connective tissue, 4 - blood-filled vein, 5 - artery.

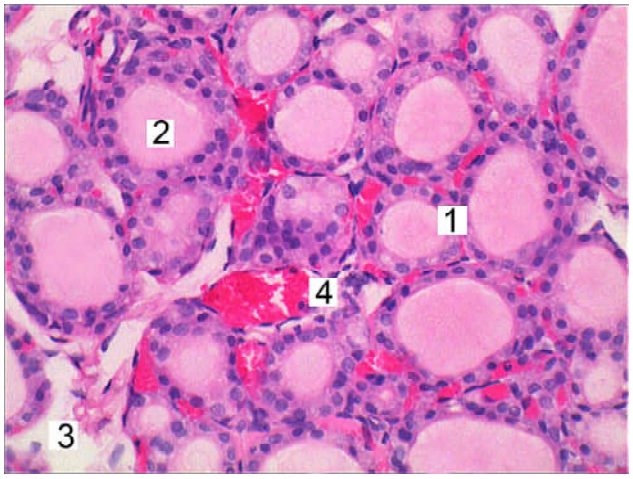

Fig. 2. Histological changes of the thyroid gland 1 day after the experimental burn injury on the background of the introduction of 0.9 % NaCl solution. Staining with hematoxylin and eosin. x200. Symbols: 1 - small follicles, 2 - enlightened colloid, 3 - swollen interstitium, 4 - blood-filled vessels of the hemomicrocirculatory tract.

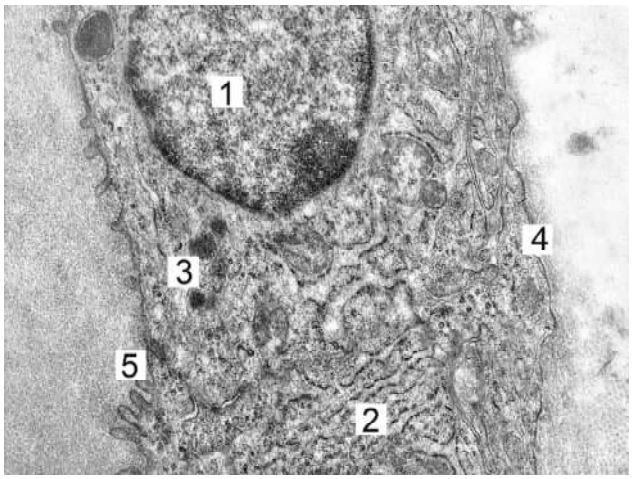

Fig. 3. Submicroscopic changes of thyroid thyrocyte 1 day after experimental burn injury on the background of the introduction of 0.9 % NaCl solution. x13 000. Designation: 1 - nucleus, 2 - tubules of granular endoplasmic reticulum in the cytoplasm, 3 - lysosomes, 4 - basement membrane, 5 - microvilli on the apical surface of cells.

were determined. In the moderately electron-transparent cytoplasm, there are dilated tubules of the endoplasmic reticulum and the Golgi complex, numerous vacuoles and microbubbles are located mainly below the apical part of the cells (Fig. 3). Mitochondria are hypertrophied, swollen with a moderate electron-transparent matrix, there is a discomplexation of the cristae, they are few. In the cytoplasm of the apical part of the cells are identified vacuoles filled with colloid and lysosomes and phagosomes involved in the breakdown of colloid and the release of hormones into the hemomicrocirculatory tract of the gland. Also, apical surface of the cells contains a significant number of microvilli, some of which are deformed (Fig. 4, Fig. 5).

At this time of the experiment also detected hemocapillaries without signs of excessive blood supply, they had single shaped elements of blood. The nuclei of endothelial cells are oval, the karyoplasm was dominated by euchromatin, the karyolemma formed shallow intussusception. Cytoplasmic areas without signs of edema, there are numerous micropinocytic vesicles, caveolae, fenestrae are detected. Organelles of cells without pronounced signs of destruction. The basement membrane is swollen in some areas. This condition of hemocapillaries indicates the presence of relatively structurally unchanged hemocapillaries in the body in the shock stage after thermal injury.

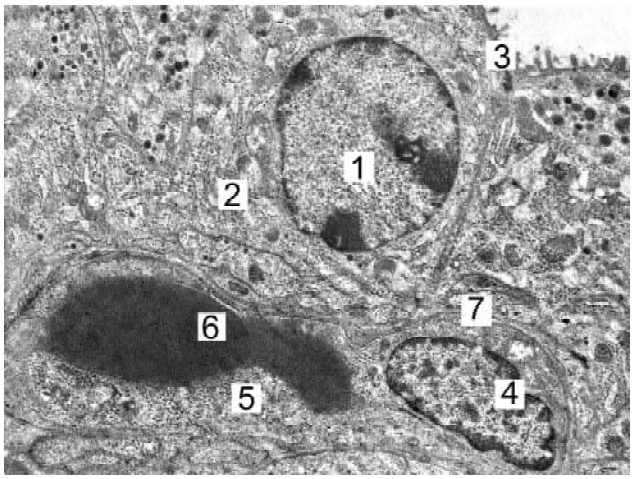

Fig. 4. Submicroscopic changes of the thyroid gland 1 day after the experimental burn injury on the background of the introduction of 0.9 % NaCl solution. x10 000. Designation: 1 - thyrocyte nucleus, 2 - thyrocyte cytoplasm, 3 - microvilli on the apical surface of cells, 4 - endothelial cell nucleus, 5 - endothelial cell cytoplasm, 6 - erythrocytes in the lumen, 7 - basement membrane.

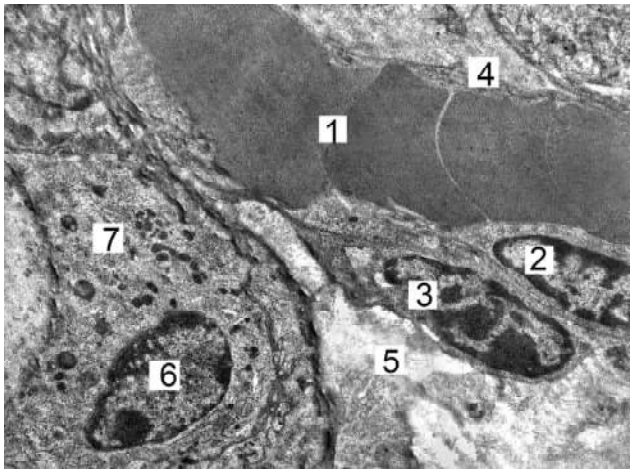

Fig. 5. Submicroscopic changes of the thyroid gland 1 day after the experimental burn injury on the background of the introduction of 0.9 % NaCl solution. x10 000. Designation: 1 - blood-filled capillary lumen with erythrocyte stasis, 2 - endothelial cell nucleus, 3 - pericyte, 4 - basement membrane, 5 - interstitial connective tissue, 6 - thyrocyte nucleus, 7 - thyrocyte cytoplasm.

Discussion

Our results on microscopic and submicroscopic changes in the thyroid gland of experimental animals 24 h after thermal trauma to the skin generally do not contradict those obtained in other studies [2, 3, 9, 13, 18, 21]. Thus, according to other authors at 2, 12, 24 hours after the burn there was a widespread expansion of follicles. The lumen of the follicles was filled with a large amount of eosinophilic colloid. The cells of the follicular epithelium were markedly flattened, had a cubic or flat shape. In the apical part of the follicular cells there was a meager amount of cytoplasm with a significantly reduced number of PAS-positive granules, drops of colloid were almost completely absent. The main ultrastructural changes of the thyroid gland on the 2nd, 12th, 24th hour after the burn were presented as marked expansion and degranulation of the granular endoplasmic reticulum, reduction of the Golgi complex, while the Golgi complex tanks were expanded, the number of vacuoles was reduced. In the apical part of the follicle there was a scanty number of microvilli and vacuoles. Drops of colloid and pseudopodia were also not observed. Lysosomes were rare. Mitochondria were also solitary and small in size with signs of focal vacuolation and pyknosis. There was an increased electron density of the cytoplasm. The nucleus had an irregular shape, the perinuclear space was expanded, the amount of heterochromatin was increased. 24 hours after the burn, pseudo-inclusions were often observed in the nucleus, and a significant part of the cytoplasm was rarefied.

The results of these studies do not contradict the fact that within 2-24 hours after the burn, the main pathological changes in the thyroid gland correspond to the first phase of the lesion - the phase of post-traumatic depression. This phase is characterized by widespread enlargement of the gland follicles. The cells of the follicular epithelium flatten, become cubic or flat. The amount of colloid increases significantly in the lumen of the follicle and decreases significantly in the cytoplasm of follicular cells. Ultrastructural changes in follicular cells are presented as damage to structures involved in the synthesis of thyroglobulin (granular endoplasmic reticulum, Golgi complex, cytoplasmic vesicles of the apical part of the follicles) and poor development of organelles involved in the secretion of hormones (pseudopodia and lysosomes).

Conclusions

Conducted micro- and submicroscopic studies of the structural components of the thyroid gland a day after the reproduction of thermal trauma to the skin on the background of the introduction of 0.9 % NaCl solution revealed reactive adjunctive-compensatory changes and initial manifestations of destruction. Vascular, stromal and parenchymal components of the organ in the stage of shock after burns correspond to the state of "stress" as a reaction to pathological exogenous exposure, and the intensification of metabolic processes in the affected organism of experimental animals.

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ОСОБЛИВОСТІ МОРФОЛОГІЧНИХ ЗМІН ЩИТОПОДІБНОЇ ЗАЛОЗИ БІЛИХ ЩУРІВ-САМЦІВ ЧЕРЕЗ 1 ДОБУ ПІСЛЯ ТЕРМІЧНОЇ ТРАВМИ ШКІРИ НА ФОНІ ВВЕДЕННЯ 0,9 % РОЗЧИНУ NACL

Тірон О. І.

Незважаючи на те, що основним патогенетичним чинником розвитку опікової хвороби є альтерація шкірного покрову, тяжкість стану пацієнтів у гострий період хвороби обумовлюється системними змінами в організмі, які викликає термічний фактор. Являючи собою потужний фактор стресу, великий опік супроводжується активацією гіпоталамо-гіпофізарної системи. Хоча гормони щитоподібної залози не вважаються типовими "гормонами стресу", вони також відіграють певну роль у підтримці вазомоторної функції у стані стресу. Питання стосовно порушень функціональної активності щитоподібної залози на тлі опікової травми залишається дискутабельним, а наукові дані стосовно її морфологічних та ультрамікроскопічних змін є доволі обмеженими. Мета роботи - встановлення мікроскопічних і субмікроскопічних змін щитоподібної залози експериментальних тварин в стадії шоку після термічної травми шкіри. Експериментальні дослідження проведені на 12 білих статевозрілих щурах-самцях, яким було нанесено термічний опік шкіри 2-3 ступеня площею ураження 21-23 % шкіри. Інфузію 0,9 % розчину NaCl у дозі 10 мл/кг проводили у нижню порожнисту вену. Забір матеріалу для гістологічних та електронномікроскопічних досліджень проводили згідно загальноприйнятих методик. Гістологічні препарати вивчали за допомогою світлового мікроскопа MIKROmed SEO SCAN та фотодокументували за допомогою відеокамери Vision CCD Camera з системою виводу зображення з гістологічних препаратів. Ультратонкі зрізи, виготовлені на ультрамікротомі УМПТ-7, контрастували уранілацетатом, цитратом свинцю згідно методу Рейнольдса та вивчали в електронному мікроскопі ПЕМ-125К. Проведені мікро- та субмікроскопічні дослідження структурних компонентів щитоподібної залози через добу після відтворення термічної травми шкіри на тлі введення 0,9 % розчину NaCl встановили реактивні пристовувально-компенсаторні зміни та початкові прояви деструкції. Судинні, стромальні і паренхіматозні компоненти органа в стадії шоку після опіку відповідають стану "напруження", як реакції на патологічний екзогенний вплив, та інтенсифікації обмінних процесів ураженого організму експериментальних тварин.

Ключові слова: *щитоподібна залоза, термічний опік шкіри, світлова мікроскопія, електронна мікроскопія, щури.*

ОСОБЕННОСТИ МОРФОЛОГИЧЕСКИХ ИЗМЕНЕНИЙ ЩИТОВИДНОЙ ЖЕЛЕЗЫ БЕЛЫХ КРЫС-САМЦОВ ЧЕРЕЗ 1 СУТКИ ПОСЛЕ ТЕРМИЧЕСКОЙ ТРАВМЫ КОЖИ НА ФОНЕ ВВЕДЕНИЯ 0,9 % РАСТВОРА NACL

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Несмотря на то, что основным патогенетическим фактором развития ожоговой болезни является альтерация кожного покрова, тяжесть состояния пациентов в острый период болезни обусловлена системными изменениями в организме, вызванными термическим фактором. Являясь мощным фактором стресса, обширный ожог сопровождается активацией гипоталамо-гипофизарной системы. Гормоны щитовидной железы, хоть и не являются типичными "гормонами стресса", играют определенную роль в поддержании вазомоторной функции. Вопрос касательно нарушений функциональной активности щитовидной железы на фоне ожоговой болезни остается дискутабельным, а научные данные о ее морфологических и ультрамикроскопических изменениях достаточно ограничены. Цель работы - установить микроскопические и ультрамикроскопические изменения щитовидной железы экспериментальных животных в стадии шока после термической травмы кожи. Экспериментальные исследования проведены на 12 белых половозрелых крысах-самцах, которым был нанесен термический ожог кожи 2-3 степени площадью поражения 21-23 % кожи. Инфузию 0,9 % раствора NaCl в дозе 10 мл/кг проводили в нижнюю полую вену. Забор материала для гистологических и электронномикроскопических исследований проводили согласно общепринятых методик. Гистологические препараты изучали с помощью светового микроскопа MIKROmed SEO SCAN и фотодокументировали с помощью видеокамеры Vision CCD Camera с системой вывода изображения с гистологических препаратов. Ультратонкие срезы, изготовленные на ультрамикротоме УМПТ-7, контрастировали уранилацетатом, цитратом свинца по методу Рейнольдса и изучали в электронном микроскопе ПЭМ-125К. Проведенные микро- и субмикроскопические исследования структурных компонентов щитовидной железы через сутки после воспроизведения термической травмы кожи на фоне введения 0,9 % раствора NaCl установили реактивные приспособительно-компенсаторные изменения и начальные проявления деструкции. Сосудистые, стромальные и паренхиматозные компоненты органа в стадии шока соответствуют состоянию "напряжения", как реакции на патологическое экзогенное влияние, и интенсификации обменных процессов пораженного организма экспериментальных животных.

Ключевые слова: *щитовидная железа, термический ожог кожи, световая микроскопия, электронная микроскопия, крысы.*