

Thyroid Cells Development under Thyreostatic Burdon

Rasulov Khamidulla Abdullaevich

Tashkent Pediatric Medical Institute, Ph.D., associate professor, Tashkent, Uzbekistan

Abstract Today thyroid gland pathologies take one of the leading places among endocrine disorders. Factors such as unfavorable ecology, change of environmental micro element composition, hereditary predisposition play a certain role in the development of thyroid pathology. Morphology of thyroid tissue, which is well known reliably reflects the degree of thyroid functional activity in various physiological and pathological conditions of an organism, in fact is not studied in various stages of experimental hypothyroids early postnatal ontogenesis. Merkazolil is one of the thyreostatics that block pyroxide oxidase, participating in the synthesis of thyroid hormones of thyroid gland, which prevents the iodization process. The active part of the drug enters the thyroid gland tissue which formed a stable compound with hydrogen peroxide, as a result of which the enzymatic function catalyzes the iodine compound. The synthesis of thyroid hormones in the beginning decreases, and follicular contents increase in the future. A-cells-thyrocytesthat are lined on the wall of the follicle of the gland, B-cells are found in the parenchyma of the gland were first described in 1898 year were found in nodular goiter, adenomas and some thyroid diseases. C-cells are calcitoninocytes that produce the parathyroid hormone antagonist of calcitonin. It is necessary to find out the effect of merkazolil on the functional morphology of the thyroid gland in laboratory rats undergoing hypothyroidism, and also to establish the significance of the changes undergoing in the growing organism in the formation of structural damage to the organ.

Keywords Thyroid gland, Ashkenazi cells, Oxyphilic epithelium, Merkazolil

1. Introduction

Thyroid gland- a butterfly-shaped organ located in the base of the neck.

Ashkenazi cells- B-cells are found in the parenchyma of the gland.

Oxyphilic epithelium-they are found throughout the body as the thyroid gland.

Merkazolil- one of the thyreostatics that block pyroxide oxidase, participating in the synthesis of thyroid hormones of thyroid gland.

Today thyroid gland pathologies take one of the leading places among endocrine disorders. Factors such as unfavorable ecology, change of environmental micro element composition, hereditary predisposition play a certain role in the development of thyroid pathology. Morphology of thyroid tissue, which is well known reliably reflects the degree of thyroid functional activity in various physiological and pathological conditions of an organism [4], in fact is not studied in various stages of experimental hypothyroids early postnatal ontogenesis.

At the same time certain morphological functional shifts in thyroid gland are observed in the process of physiological aging, which are testified in multiple publications of modern scientists [1,3-5].

The aforesaid is relevant to the basic cell population of thyroid gland, represented by A-cells (thyrocytes) forming follicular compartment of the gland and secreting iodine-containing thyroid hormones. Besides that, thyroid gland is a multicomponent organ including two more populations of cells such as B-cell (Ashkenazi cells, Hurthle cells, oncocytes, oxyphilic cells) and C-cells (parafollicular cells, calcitoninocytes) [6,7,9].

A-cells-thyrocytesthat are lined on the wall of the follicle of the gland,

B-cells are found in the parenchyma of the gland were first described in 1898 year were found in nodular goiter, adenomas and some thyroid diseases.

C-cells are calcitoninocytes that produce the parathyroid hormone antagonist of calcitonin.

Products of B and C-cells' secretion play a significant part both in the activity of an organism and functioning of Thyroid Gland producing thyroid hormones [2,10].

It is difficult to imagine, that in the decrease of thyroid functional activity and various unfavorable impacts on body, including iodine deficiency, populations of these cells stay non-sensitive and intact. Taking into account all the aforesaid, it is interesting to clarify the effect of merkazolil on the functional morphology of TG in laboratory rats with

* Corresponding author:

jakhongir2025@gmail.com (Rasulov Khamidulla Abdullaevich)

Published online at <http://journal.sapub.org/ajmms>

Copyright © 2019 The Author(s). Published by Scientific & Academic Publishing

This work is licensed under the Creative Commons Attribution International

License (CC BY). <http://creativecommons.org/licenses/by/4.0/>

hypothyroids, and to determine the importance of each of these factors in the formation of structural lesions in the organ.

No special researches were performed in this field.

2. The Objective

To study morphological functional condition of Thyroid Gland in the aspect of early ontogenesis with its hypofunction.

3. Materials and Methods

We used 33 not thoroughbred infant rats being 150-180g. In the first set (I and III groups — 9 rats at the 30th day and 7 rats at the 60th day, respectively) we studied morphological structure of thyroid gland in control animals. In the second set (II and IV groups — 8 rats at the 30th day and 9 rats at the 60th day respectively) we studied morphological alterations in anatomical structures of thyroid gland with hypothyroids. In the blood serum of the experimental group, the content of total thyroxine was 58.6 ± 1.17 nmol/L, significantly lower than the control (<0.05). The study included 2 control groups (9 and 7 individuals) to compare the obtained results of morphological studies of the experimental groups. Hypothyroid was caused by administration of one of thyreostatics – Merkasolil in the dosage 3 mg/kg of animals' body mass.

All rats were held in similar conditions of a vivarium and received usual food. Animals were excluded from the experiment by means of ether overdose. An experimental model of hypothyroidism was carried out according to the method of V.Y. Khryshchanovich 2012 year. During the experiment, cases of overdose and side effects were not detected.

Samples of thyroid tissue from both lobules of TG of control and experimental rats with hypothyroid were fixed in 12% solution of neutral formalin, dehydrated in alcohol with growing concentration, and coated by paraffin. Serial histological slices were stained by hematoxylin and eosine,

and using Van-Gizon's method.

Morphometric analysis of thyroid epithelial cells was performed in compliance with V.P. Volkov's recommendations (2015). Density of each kind of cells of thyroid parenchyma (V) was determined by calculation in the microscope field of vision 300W Pixel CCD Electronic Eyepiece Dual Mechanical Mobile platform, attached 150x140 mm flat platform, range of mobile devices: 75x55 mm, KOHLER reflective backlight, 6 V / 20 W halogen lamp with adjustable brightness.

That parameter characterizes expression of hyper and/or hypoplasia of certain cells pool as a whole.

Average diameter of the nuclei of the studied cells (AND), indicating the degree of hyper or hypotrophy of each cell, was determined by means of measurement of the greatest (a) and the smallest (b) sizes of nuclear and consequent calculation using the following formulae [4,11]:

$$AND = \sqrt{ab}$$

According to the results of morphometric measurements, we calculated integral parameter such as functional activity index (FAI) for each cell population using the formulae:

$$FAI = V * AND / 20$$

Statistical processing of the obtained data was performed by means of non-parametric statistic methods differing by sufficient capacity, simplicity, reliability, and self-descriptiveness [8].

FAI- functional activity index makes it possible to mathematically assess the state of the glandular parenchyma.

V- the volume cells glandular parenchyma the field of view determines the number of cellular elements

AND- the average diameter of the nuclei.

4. Results and Discussion

That research demonstrates that morphological functional condition of TG is significantly affected by both age and mercasolil administration (Table 1). Dynamics of structural alterations in various cell populations was remarkably different in its expression and direction.

Table 1. Morphometric analysis of the parameters of thyroid epithelial cells in healthy and hypothyroid infant rats

Parameters		Control groups		Hypothyroid groups	
		I(30 day, n=9)	II(60 day, n=7)	III(30 day, n=8)	IV(60 day, n=9)
Follicular epithelium	V	84.62	74.52	22.45*	19.06*
	AND	3.84	3.71	3.82	3.71
	FAI	16.24	13.82	4.28*	3.54*
Oxyphilicepithelium	V	5.72	4.81	10.26*	5.24*
	AND	6.28	6.01	6.34	6.38
	FAI	1.79	1.45*	3.25	1.67*
Parafollicular epithelium	V	9.51	8.73	21.23	12.29
	AND	4.73	4.40	4.58	4.70*
	FAI	2.25	1.92	4.86*	2.89*

Note: * – differences and reliable compared to the data of the control group with $p \leq 0.05$.

As it is seen from the table comparative analysis of the values in the I and II groups characterizing duration of thyreostatic effect on morphological peculiarities and degree of TG functional activity, thyreocytes significantly diminish secretory activity at various stages of the experiment. However, Ashkenazi cells and calcitoninocytes demonstrate intensification of functioning associated with age.

Observed changes clearly reflect dynamics of FAI values of the mentioned cells. Shifts in the degree of their functional activity to any side are linked with statistically significant fluctuations of V, i.e. processes of hypo and/or hyperplasia, determining the quantity of cell populations. There were no remarkable alterations in cells, and that was testified by stable AND in the groups of observation, a comparison of the results of the study in control animals and in hypothyroid rats (groups I and III with mercazolil intake) shows a statistically significant associated decrease in all studied parameters of B and C cells. This serves as evidence of the inhibition of the functional activity of these cells, due to both a reduction in the number of both cell populations (decrease in V) and hypotrophy phenomena of their constituent cell elements (decrease in SDA).

Almost similar consequences of age factor effect were observed in the process of thyreostatic administration, and that was demonstrated by the comparison of the values in the III and IV groups. Exclusions were only AND B- and C-cells, demonstrating that increase of their secretory activity occurred not only due to hyperplasia of cell pools as a whole, but also because of individual hypertrophy of cell elements in its composition.

However, that phenomenon does not compensate quantitative decrease of the expression of mentioned morphological functional shifts of B- and C-cells at the later stages of the experiment. So, if in the I and II age groups growth of FAI values was +56.2% for the first, and +94.2% for the second, in the III and IV groups these values were equal to +9.3% and +60.3% respectively. Differences in the percents were statistically significant. That kind of regularity was not determined in relation to A-cells; in the process of ontogenesis FAI decreased by 60.7%, while in combination with merkasolil administration by 61.1% (insignificant difference). According to the literature, cretinism disease occurs from 3 months in a state of hypothyroidism. In our experiment, we studied the 2-month duration of hypothyroidism.

Aging dynamics of structural-functional parameters of B and C-cells, including those in the conditions of merkasolil administration, can be considered to be compensatory-adjustment process, taking a special place among adaptive reactions of a growing organism, linked with the basic function of TG to produce iodine-containing hormones. Besides that, described alterations in parafollicular cells reflect demands of an organism in the production of calcitonin for the maintenance of calcium homeostasis for the whole life, and conditions promoting its disorder, and particularly hypothyroids.

Though, in the later case compensatory reaction of both cell populations was significantly suppressed as a result of thyreostatic effect of merkasolil, which notably affects functional morphology of B and C-cells and suppressing its activity, what is seen in the further description.

In fact, comparison of the research results of the control animals, who did not receive merkasolil, and with hypothyroids (I and III groups) demonstrated statistically significant decrease of all examined parameters of B and C-cells associated with merkasolil administration. That served to be a proof of suppression of these cells' functional activity conditioned by both the decrease of the number of both cell populations (decrease of V), and phenomena of hypertrophy of component cellular elements (decrease of AND).

A-cells demonstrate the same tendency, but their comparative hypofunction occurs consequently only in the drop of V and stable AND. Totally FAI of A, B and C cells' pools diminished quite steadily, by 13.0%, 17.1% and 9.9% respectively. That kind of FAI dynamics reflects similarity of revealed morphological functional alterations in all three cell populations in TG in cases hypothyroids in young age.

Among the animals elder than 60 days (II and IV groups) we noticed absolutely equal structural functional shifts. We noted decrease of FAI of thyroid epithelium by 15.6%, oncocytes by 44.7%, and calcitoninocytes by 25.6%. In other words, in adult age B-cells suffer thyreostatic effect of merkasolil most of all, while C and A cells suffer it the least.

Comparison of the obtained percent values, characterizing alterations of the studied quantitative parameters of various cell pools of TG in hypothyroids dependently on the age of animals, showed almost similar speed of A-cells secretory activity decrease (differences were not statistically significant) caused only by merkasolil effect. However, when we consider two other TG cell types these differences are very noticeable and reliable. Thus, mature animals, which received merkasolil for a long term, had more severe morphological and functional disorders in B and C-cells than in the young age. Thus, under the influence of mercazolil, a significant decrease in the production of thyroid hormones occurs, as a result of which the volume of follicles increases. This condition leads to an increase in the gland itself.

Apparently, long-term hypothyroids leads to a sudden shortening of the mentioned compensatory capabilities of the cell elements, maladjustment, and expressed dysfunction based on profound structural lesions. Age factor so plays an important part. This experiment was conducted with growing organism.

Thus, as a whole, vectors of pathological shifts of A-cells both of age character and those conditioned by thyreostatic effect of merkasolil have the same direction. Opposite to that, alterations of B and C-cells associated with age and hypothyroids are differently directed.

5. Conclusions

As a result of experimental research we revealed different directions of alterations in functional and morphological status of various TG cells' populations associated with age and conditioned by thyreostatic effect of merkasolil.

Morphological shifts in TG tissues cause more severe structural cellular disorders. Impact of the thyreostatic (merkasolil) is dominating pathogenic agent determining both degree and severity, and the terms of development of morphological functional alterations in TG, which serve to be material basis of its hypofunction.

REFERENCES

- [1] Basal Autophagy Deficiency Causes Thyroid Follicular Epithelial Cell Death in Mice. Botashev V.S., Jikayev G.D., Sevrukova O.I.. Complex histological and immunological study of B-cells in auto immune thyroiditis and neoplastic processes in thyroid gland // fund. Stud. 2014. № 4, p. 1. p. 48—50. (in Russian)
- [2] Development of the thyroid gland. Mikael Nilsson, Henrik Fagman Development 2017 144: 2123-2140; doi: 10.1242/dev.145615. *Endocrinology*, Volume 160, Issue 9, September 2019, Pages 2085–2092.
- [3] Ibrokhimova L.I., Rasulov H.A. // Morphological changes in paraarticular tissues in children with congenital dislocation of the hip against the background of hypothyroidism / Theory Medical Clinicjournals No. 2, 2018, 124-125pp.
- [4] Isaeva N.Z., Ibrokhimova L.I., Eshonqulova B.D. // Structural features of paraarticular components on the background of hypothyroidism with congenital hip dislocation / XXIV International Scientific and Practical Conference “Scientific Research: Key Problems of the III Millennium” Moscow, April 1-2, 2018 87-90pp.
- [5] Khidirova G.O., Rasulov H.A. // Morphological features of metaepiphyseal bone tissue in rats with hypoparathyroidism / Pediatrics journal No. 1, 2018, pp. 56-58.
- [6] Rasulov H.A. // Morphofunctional features of rats pelvic limb tendons normal and in experimental hypothyroidism / Pediatrics journal No. 1, 2018, pp. 117-121.
- [7] Morphological and Functional Changes in the Thyroid Follicles of the Aged Murine and Humans. Junguee Lee, Shinae Yi, Yea Eun Kang, Hyeon-Woo Kim, Kyong Hye Joung, Hae Joung Sul, Koon Soon Kim, and Minho ShongJ Patho Transl Med. 2016 Nov; 50(6): 426-435. Epub 2016 Oct 14.
- [8] Morphological and Functional Changes in the Thyroid Follicles of the Aged Murine and Humans. 2016 The Korean Society of Pathologists / The Korean Society for Cytopathology.
- [9] The effect of maternal hypothyroidism on the postnatal development of the pituitary–thyroid axis in albino rats: a histological, morphometric, and immunohistochemical study. Mohamed R Shehata, Dorreia A Mohamed, Manal M. Samy El-Meligy, Ashraf E Bastwrous May-August 2019| Vol 4| Issue 2.
- [10] The History and Future of Treatment of Hypothyroidism. Author manuscript; available in PMC 2016 Aug 11.
- [11] Volkov V.P.. Functional morphology of thyroid gland in antipsychotic therapy dependent on age // Universum: Med. And pharmacy.; elect.scien.jour. 2015. № 1 (14). (in Russian)