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Morphofunctional Changes in Basophilic Cells of the Adenohypophysis during Post-resuscitation Disease

Aminjon Gadaeyevich Karabayev[1*] and Rajabboy Isroilovich Isroilov[2]

[1]Department of Pathological Physiology, Samarkand Medical Institute, Republic of Uzbekistan.
[2]Center of Pathological Anatomy, Ministry of Health, Republic of Uzbekistan.

Authors' contributions:

This work was carried out in collaboration between both authors. Author AGK developed the study, conducted statistical analysis, compiled a protocol and wrote the first draft of the manuscript. Author RII is a scientific consultant in this work. Both authors read and approved the final manuscript

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ABSTRACT

In the post-resuscitation period through the I-II-III-IV-V - stages and long - term periods (1 and 3 months) of post – resuscitation disease, the morpho functional activity of β-and d-basophil cells of the adenohypophysis was studied in white male rats with a weight of 180-220 g, who suffered a 10-minute stop of systemic circulation (compression of the vascular bundle of the heart by the method of V. G. Korpachev). False-operated animals served as a control. Morphological, morphometric, histochemical, and cytophotometric studies of the state of both β - and d - basophil cells of the adenohypophysis were performed. We used image analysis using a leys microscope with an electronic micro-nozzle attached to an Intel computer, and the content of the glycoprotein was studied using a cytophotometer. In the postoperative period during the phase I identified in the background of gipergidratace cytoplasmic β - and d - basophilic cells of the anterior pituitary, in the period of II-III stage disease gipergidratace nuclei β - and d - basophilic cells of the anterior pituitary revealed an increase in the excretion of glycoprotein in blood, i.e., the observed compensatory-adaptive reactions. Starting from stage IV and in remote periods of post-resuscitation disease, compensatory and restorative processes were observed against the background of hyperhydration of the nuclei.

**Corresponding author: E-mail: aminjon@bk.ru;*

Keywords: Clinical death; post-resuscitation period; basophilic cells; adenohypophysis; glycoprotein.

1. INTRODUCTION

The study of mechanisms and patterns of disorders developing at the level of the hypothalamic-pituitary system is essential for identifying the mechanism of reactivity disorders in the post-resuscitation period. Hypoxic and reoxygenation processes undoubtedly affect the morphofunctional state of the cells of the Central nervous system (CNS) [1], respectively, and the neurosecretory structures of the hypothalamic-pituitary system of the body [2,3,4]. Currently, one of the most urgent tasks of resuscitation is to find effective methods of protecting brain nerve cells and subcortical structures [5,6].

In the post-resuscitation period, the prevalence of activity of sympathoadrenal system and connection ergotropic functions of the body contributes to the prevalence catabloic processes ATP cell structure [7,8,9]. At the same time, the productive state of the body's cells remains at a disadvantage, that is, there is an imbalance between the sympathetic nervous system and the parasympathetic nervous system, between the catabolic and anabolic hormonal systems and processes [10,11,12, 13].

The main link responsible for the production of various States of the body is the preoptic and arcuate nucleus of the hypothalamus, as well as alpha and beta basophilic cells of the adenohypophysis, which lead to an increase in gonadal hormones and the subsequent development of physiological responses of the body [14,2].

To analyze the regularities and mechanisms of post-resuscitation changes in basophilic cells of the adenohypophysis, it is essential to study the morphofunctional activity of basophilic cells of the adenohypophysis in the post-resuscitation period when modelling a 10-minute clinical death.

1.1 Purpose of Research

To identify morphofunctional changes in the basophilic cells of the adenohypophysis in the I-II-III-IV-V stages and remote periods (1 and 3 months) of post-resuscitation disease when modelling 10-minute clinical death.

2. MATERIALS AND METHODS

In connection with this task, the study was conducted on 70 mongrel male rats with a bodyweight of 170-220 g. in which the state of clinical death and post-resuscitation illness was modeled according [15]. All the studied animals were divided into 2 groups.

Group I included 35 intact rats (false-operated animals).

In group II, 35 rats, post-resuscitation disease was simulated after 10 minutes of clinical death. At the same time, the studied rats were in the same conditions and on the same diet.

The slaughter of animals was carried out by instantaneous decapitation. For each term, 10 or more animals were slaughtered.

Pieces of the brain, including the hypothalamus and pituitary, were fixed in Buena's fluid. After posting on alcohols of ascending concentration, the pieces were filled with paraffin, then they were prepared into sections 5-7 microns thick, oriented in the frontal or sagittal planes .

Sections were coloured using the following methods:

1. The Color of the paraldehyde fuchsinfor Gomori to gab with the color of the azan for Heidengain.
2. Chromo - alum hematoxylin And phloxin staining by Homori.
3. Hematoxylin-eosin for a General overview of cross-sections and judgment of morphological shifts in cells of the hypothalamic-pituitary system.

The study of the adenohypophysis was carried out at the level of b - and d - basophil cells of the anterior pituitary lobe. The functional activity of basophil cells of the adenohypophysis were determined according to the criteria of the functional activity of cells (high, moderate and low activity) content of glycoprotein a measurement of the volume of nuclei of citoplasma basophilic cells of the pituitary gland, which includes the calculation of the percentage of individual types of basophilic cells [16,17].

The content of glycoprotein in basophilic cells of the adenohypophysis was determined by two-wave cytophotometric method [18].

The volume of cytoplasm, nuclei and nucleoli of cells was measured using a micrometer MOV-1-15.

The functional character of the nuclei was evaluated using the nuclear-cytoplasmic index. Index = the nucleus /volume of the cytoplasm. An increase in the index indicates an increase in the genetic activity and hydration of cell nuclei. A decrease in the index indicates the hydration of the cytoplasm and a decrease in the genetic activity of cell nuclei [19].

To determine the reliability of differences between the indicators of individual groups of experimental animals, statistical processing was performed using the standard Microsoft Office – Excel 2000 software package. The differences between the two compared indicators were considered reliable at P=0,05 and P < 0,05.

3. RESULTS AND DISCUSSION

In the study, the morphofunctional reactivity of basophilic cells of the adenohypophysisin intact animals, β - and d - basophilic cells are scattered throughout the adenohypophysis (Fig. 1A). They are mainly defined around the vessels. When determining the functional activity of β - and d – basophilic adenocytes, cells are at a stage of different functional activity. At the same time, in β - and d-basophilic cells, the number of highly active cells is 10,6 ± 0,4% and 10,8 ± 0,4%. The glycoprotein is located mainly in the pericaryon region. The drug is mainly dominated by cells of moderate functional activity, their number varies between 70,6 ± 0,4% and 70,4 ± 0,6%, the glycoprotein in them is scattered throughout the cytoplasm, diffusely and loosely, and the number of cells of low functional activity, that is, with a densely located glycoprotein in the cytoplasm is determined within 18,8 ± 0,4% and 18,8 ± 0,4%. On average, the content of glycoprotein in β - and d-basophilic cells is determined in the range of 155,8 ± 3,3 u. u. and 156,0 ± 3,1 u.u.

The value of the nuclear-cytoplasmic ratio in β - basophilic adenocytes is equal to 0,215 ± 0,0009, and in d-basophilic adenocytes the value of the nuclear-cytoplasmic ratio is less in comparison with β - basophilic adenocytes and is equal to 0,156 ± 0,001.

If the obtained data is interpreted with the data of A. L. Polenov (1971), we can say that the basophilic cells of the adenohypophysis are at the stage of moderate functional activity.

In the post-resuscitation period of stage I of the disease in the adenohypophysis (Fig. 1B) there is an increase in the functional activity of β - and d-basophilic cells, that is, there is a transition of basophilic cells to a higher functional activity, where the high functional activity in β-basophilic cells is increased to 16,0±0,9%, and in d - basophilic cells to 16,8±1,1 (P < 0,01). Accordingly, there is a decrease in the number of basophilic cells of moderate and low functional activity, in β - basophilic cells to 68,8±1,0 % (Px > 0,05) and 15,2±0,4% (P < 0,01), and in d - basophilic cells to 68,2±1,6% (P > 0,05) and 15,0±0,7% (P < 0,01) with a decrease in the glycoprotein in β - basophilic cells to 148,2±1,8 (P > 0,05), and in d - basophilic cells up to 147,4±1,7 units (p > 0,05). The index of the nuclear-cytoplasmic in β-and d - basophilic adenocytes decreases to significant values. In this case, in β-basophilic adenocytes, it is equal to 0,211±0,004 (P < 0,01), and in d - basophilic adenocytes it is 0,153±0,0004 (P > 0,05).

Stage II of the disease (Fig. 1C) in basophilic cells of the adenohypophysis, a further increase in the number of basophilic cells of high functional activity in β - basophilic cells to 27,8±1.2% (P < 0,001), and in d - basophilic cells to 26,6±1,3% (P < 0,001) with a decrease in the number of basophilic cells of moderate and low functional activity decreases in β - basophilic cells to 59,2±0,9% (P < 0,001) and 13,0±1,0% (P < 0,001), as well as the amount of glycoprotein to 144,6±1,9 units (p < 0,05). In d-basophilic cells, the number of cells of moderate and low functional activity decreases to 59,8±1,4% (P < 0,01) and 13,6 ±0,9% (P < 0,01), including the amount of glycoprotein to 132,1±1,8 u. u. (P < 0,01).

The index of the nuclear-cytoplasmic ratio, while in β - basophilic adenocytes decreases to 0,210±0,0004 (P < 0,01), and in d - basophilic adenocytes to 0,153±0,0004 (P > 0,05).

At stage III of the disease (Fig. 1D) basophilic cells of the adenohypophysis are in maximum functional activity. At the same time, the number of cells of high functional activity increases in β - and d - basophilic cells to 62,4±1,2% (P < 0,001) and 61,2±1,4% (P < 0,001). In β-basophilic cells, cells of moderate and low functional activity are reduced to minimum values of 30,8±1,1% (P < 0,001) and 6,6±0,5% (P < 0,001), d - basophilic cells to 31,6±1,3% (P < 0,001) and 7,2±0,4% (P < 0,001). At the same time, against the background of high functional activity, there is a decrease in the amount of glycoprotein in β-

basophilic cells to 127,1±2,4 u. u. (P < 0,01), and in d - basophilic cells to 128,2±2.5 u. u. (P < 0,01).

Where the index is nuclear-cytoplasmic ratio of β - basophilic denieth to 0,214±0,0004 (P > 0,05), and d - basophilic denieth to 0,156±0,0004 (P>0,05), so that at this period occurred perpetrate nuclei of the basophilic cells of the anterior pituitary that corresponds to a substantial increase in the synthetic activity in the cell c data scientists [12].

Consequently, it can be said that in the early post-resuscitation period, β - and d-basophil cells during the I-II stage, there is a predominance of secretory activity of these cells, starting from the III stage of the disease, due to the activation of the genetic apparatus aimed at the synthesis of glycoprtides. That is, in this period of post-resuscitation disease, there is a compensatory-adaptive reaction in the form of increased synthesis and secretion in the β - and d - basophil cells of the adenohypophysis.

Starting from the disease, the functional activity of basophilic cells of the adenohypophysis is still at the stage of enhanced synthesis and secretion (Fig. 1E). There is a decrease in the number of cells of high functional activity in β-basophilic cells to 59,6±0,8% (P<0,001) and d - basophilic cells of high functional activity to 57,6±0,8%, with an increase in the number of cells of moderate and low functional activity in β - basophilic cells to 32.0±0,8% (P<0,001) and 8,4±0,2% (P < 0,001), the glycoprotein to 138,4±1,3 u. (P < 0,01) and d - basophilic cells to 33,4±0,9% (P < 0,001) and 9,0±0,3% (P < 0,001) amount of glycoprotein to 139,4±1,2 (P < 0,001), where the index of nuclear - cytoplasmic ratio of β - basophilic denieth increases to 0,214±0,0003, and d - basophilic denieth to 0,156±0,0004, where the performance slightly compared with previous series of observations (P > 0,05).

At stage V of the disease, the basophilic cells of the adenohypophysis still remain in the stage of high functional activity (Fig. 1G). There is a further decrease in the number of cells of high functional activity in β-basophilic cells to 50,6±0,5% (P < 0,001), and in d - basophilic cells the number of highly active cells to 49,0±0,9% (P < 0,001).

Cells of moderate and low functional activity in β-basophilic cells increased to 39,0±0,6% (P < 0,001) and 10,4±0,5% (P < 0,001), the amount of glycoprotein to 146,6±1,4 (P < 0,05). In d-basophilic cells, the number of cells of moderate and low functional activity increases to 39,8±1,1% (P < 0,001) and 11,2±0,6% (P < 0,001), and the amount of glycoprotein to 147,3±19 (P < 0,05) compared to 24 - hour post – resuscitation disease, the index of the nuclear-cytoplasmic ratio remains increased compared to intact and previous series of observations. In this case, the index in β-basophilic adenocytes is 0,215±0,0004 (P > 0,05) and in d - basophilic adenocytes0,156±0,004 (P > 0,05).

In the remote period of stage V of the disease (after 1 month) in the basophilic cells of the adenohypophysis, there is also a further increase in the content of glycoprotein, a decrease in the volume of cytoplasm, the volume of nuclei and nucleoli more in d-basophilic adenocytes (Fig. 1Z). The number of basophilic cells of moderate and low functional activity in β - basophilic cells increases to 49.6±1.4% (P < 0,001) and 15,8±0,9% (P<0,001). The glycoprotein content is up to 148,0±1,3 (P < 0,05). In d - basophilic cells, cells of moderate and low functional activity were increased, as well as β-basophilic cells to 50,8±1,2% (P < 0,001) and 16,2±0,6% (P < 0,05), the glycoprotein content to 149,4±2,5 u.u. (P<0,01- > 0,05) compared to 24 - hour post-resuscitation disease. The number of cells with high functional activity in β - basophilic cells decreases to 34,6±0,8% (P < 0,001). Such changes are more pronounced in d-basophilic cells. The number of cells with high functional activity decreases to 33,0±0,7% (P < 0,001). The index of the nuclear-cytoplasmic ratio remains at a higher level. In basophilic adenocytes, it is within the range of 0,215±0,0004 (P > 0,05). In d - basophilic adenocytes, it is reduced to 0,156±0,0004(P > 0,05), compared to animals that had post-resuscitation disease after 24 hours.

At the 3rd month of post-resuscitation illness (Fig. 1I) in the adenohypophysis, basophilic cells are still in the stage of high functional activity, As in this case, basophilic cells of high functional activity are at a high level compared to intact ones, the number of them in β - basophilic cells decreases in comparison with 24 - hour post - resuscitation disease to 35,6±0,7% (P<0,001 in d - basophilic cells, as well as β-basophilic cells, cells of high functional activity decrease to 35,4±0,9% (P < 0,001). There is an increase in the number of basophilic cells of moderate and low functional activity, that is, there is a continuation of the recovery process in this period of post-resuscitation disease. Where in β-basophilic cells, the number of cells of

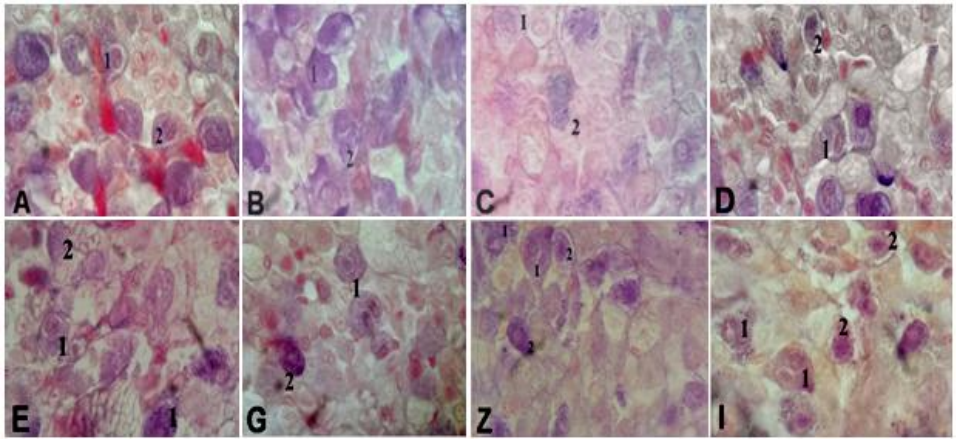

Fig. 1. Morphofunctional reaction of basophilic cells of the adenohypophysis in the post-resuscitation period in the simulation of 10-minute clinical death. Color of the paraldehyde fuchsinfor gomori to gab with the color of the azan for heidengain

Magnification: about.100x, approx. 15x. Numbers are indicated: 1. β-basophilic cells, 2.d-basophilic cells. Note: A-intact animals; during post-resuscitation illness: B-stage I; C-stage II; D-stage III; E-stage IV; G-stage V; Z-after 1 month; I-after 3 months

moderate and low functional activity increases to 48,0±1,3% (P < 0,001) and 16,4±0,9% (P < 0,001), and the amount of glycoprotein to 150,2±1.1 (P < 0,01), as in d - basophilic cells, the number of cells of moderate and low functional activity increases to 47,4±1,3% (P < 0,001) and 17,2±0,9% (P < 0,01). The amount of glycoprotein increases to 151,0±1,4 (P < 0,01) compared to 24 - hour post - resuscitation disease, but the number of cells of moderate and low functional activity, as well as the amount of glycoprotein in β - and d-basophil cells of the adenohypophysis are still at a slightly low level compared to intact cells (P > 0,05).

The index of the nuclear-cytoplasmic ratio in β - and d-basophilic adenocytes is still slightly high compared to intact ones in this period of post-resuscitation disease. Where the nuclear-cytoplasmic ratio in β - basophilic adenocytes decreases to 0,214±0,0004 (P > 0,05), and in d - basophilic adenocytes to 0,157±0,0004 (P > 0,05).

If the obtained data are interpreted with the data of scientists [19,20], then, starting from 3 days of the post-resuscitation period, these animals have a compensatory-restorative process against the background of hyperhydration of the basophilic cell nuclei of the adenohypophysis. The same as in this case, depending on the duration of post-resuscitation disease in the basophilic cells of the adenohypophysis, the hyperhydration of the nuclei decreases and the content of the glycoprotein increases. Thus, based on the data obtained, the following conclusions can be drawn:

4. CONCLUSION

In the early post - resuscitation period-I-II-III stages of the disease, a compensatory-adaptive reaction occurs with an increase in the functional activity of β - and d-basophil cells of the adenohypophysis with the release of a glycoprotein into the blood. Starting from stage IV and in remote periods of post-resuscitation disease, compensatory and restorative processes were observed against the background of hyperhydration of the nuclei.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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