Structural and Functional Characteristics of the Dorsomedial Nucleus of the Cerebral Amygdaloid Complex in Male Rats

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We developed a classification of neuroendocrine neurons of the dorsomedial nucleus of the cerebral amigdaloid complex of male rats; characteristics of these cells are presented.

Key Words: *neuroendocrine neurons; dorsomedial nucleus; cerebral amigdaloid complex; sex steroids*

Neuroendocrine neurons detected in the dorsomedial nucleus of the cerebral amigdaloid complex (AC) were described previously [1,2] and the data on hormone-dependent reversion in these cells in the course of estrous cycle in female rats were reported [3]. Now we characterized the classification of the AC neuroendocrine neurons in male rats.

MATERIALS AND METHODS

The study was carried out on adult male albino Wistar rats (250-300 g). The material for studies was collected under an MBS-9 magnifying glass with a special device (patent No. 1679246 of the Russian Federation), processed routinely, and fixed by plunging in cold 2.5% glutaraldehyde in PBS (pH 7.4). The sections were sliced on an LKB III ultratome, contrasted with lead citrate, and analyzed under a JEM 200 EX electron microscope (75 kV).

RESULTS

Analysis of the neuron ultrastructure with consideration for transcription activity of the nucleus, structural organization of the nucleolus, characteristics of nuclear membranes, protein-producing system of the cytoplasm, mitochondrion, and the vacuolar system detected differences in the structure and functions of the neurons and enabled us to develop classification of these cells.

Few neurons (3% of total number of neurons constituting the nucleus) were in a state of rest. They were characterized by clear euchromatin-rich cell nucleus with compact nucleolus in its central zones. Narrow tubules of the granular cytoplasmic reticulum (CR), small accumulation of polysomes, and a moderate number of mitochondria evenly filled the perikaryon. Solitary vesicles with a dense center, varying in diameters from 60 to 275 nm, primary lysosomes, and individual lipofuchsin granules were seen near the Golgi complex (GC) or plasma membrane.

The status of moderate activity, detected in 16% neurons, was characterized by appearance of signs of transcription activity in the nuclei, enlargement and loosening of the nucleolus, which was shifted towards the nuclear membrane. The number of the nucleolar fibrillar centers containing dense fibrillar component and the number of nuclear pores were increased. The surface of the cell nucleus was uneven due to of invaginations. Small focal accumulations of interchromatin granules and bundles of perichro-

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matin fibrils were seen in the karyoplasm. The number of tubules in the granular CR was increased, dark mitochondria were hypertrophic and hyperplastic. Moderate hypertrophy of GC manifested in dilatation of the cisterns and increased number of transport vesicles, as well as by the appearance of small and large osmiophilic secretion granules. The number of lysosomes, lipofuchsin granules, and vesicles with compact centers in the cytoplasm was increased.

The presence of numerous ribonucleoprotein (RNP) granules (interchromatin and perichromatin) was characteristic of 35% neurons in a state of high activity. Fibrillar centers with dense fibrillar component were detected in the nucleoli located eccentrically. Nuclear membrane was plicated. The nucleus was surrounded by numerous hypertrophic mitochondria. Focal dilatation of the CR tubules, transformed into cisterns, was seen. The cytoplasm contained many free ribosomes and polysomes. The GC was hypertrophic. Multivesicular and multilamellar bodies appeared. The number of vesicles with dense centers was increased in comparison with the moderate activity status.

Strained status of 22% neurons was characterized by high electron density of enlarged nucleus, containing not only much granular material, but also finely granular osmiophilic substance. The nucleolus was enlarged, with well discernible granular component. Large (by the area they occupied) accumulations of interchromatin granules, heterochromatin areas of different size and density, with adjacent perichromatin granules, were detected. The perinuclear space was evenly dilated, nuclear pores were enlarged, nuclear surfaces were plicated, CR tubules were dilated and polysome accumulations lay between them. The GC reached a high level of development, with secretory vesicles forming near it. Blabbing of the nuclear membrane was seen. Many mitochondria were hypertrophic, some with clear matrix; multivesicular and multilamellar bodies were often seen. Structural organization of these neurons indicates high intensity of transcription processes. Osmiophilia of the karyoplasm presumably indicated increased content of proteins involved in the transport of produced RNA into the cytoplasm and in chromatin condensation processes [7,8]. Intracellular regeneration processes are presumably enhanced in these cells, which is seen from the appearance of multilamellar bodies [6].

Structural and functional characteristics of 20% neurons indicated their reduced activity, manifesting by increased content of heterochromatin, reduction or complete disappearance of RNP granules, with still osmiophilic karyoplasm. A compact shrunk nucleolus in these neurons was eccentrically located, contacting with well discernible marginal chromatin. These neurons resembled dark cells, in which the transcription processes were over. The decrease in activity by this variant presumably followed the strain stage. In another group of neurons appearance of signs of reduced activity (enlargement of fibrillar centers, reduction of the granular component in the nucleolus, disappearance of interchromatin granules, *etc.*) was not paralleled by increase in the content of heterochromatin and osmiophilic powder substance; the karyoplasm was moderately osmiophilic and contained many perichromatin granules. Functional activity of these neurons presumably decreased as a result of transition from the state of moderate or high activity, missing the strain stage. Presumably, these neurons can be denoted as reducing their functional activity by accelerated reversion [6].

Reversion to the initial status noted in 3% neurons was characterized by completion of the functional activity: the neurons again acquired the characteristics of clear cells. They were characterized by segregation of the nucleolus components, indicating blockade of protein synthesis. The nuclear surface remained plicated, but the density of the polysome accumulation decreased in the cytoplasm protrusions penetrating into the nucleus.

In addition, solitary pyknomorphic neurons in a state of degeneration and presumably dying by apoptosis were found in the amigdaloid complex of male rats [5].

Hence, amigdaloid complex neurons in male rats are in different structural and functional states: at rest, moderate activity, hyperactivity, strain, reduced activity, returned initial status, and apoptosis. Neuronal death detected only in male rats but not observed in females can be explained by the neuroprotective effect of estrogens [4].

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