

hydrolytic enzymes from the lysosomes could be seen in the cytoplasm. In some cells autophagosomes could be seen, inside which some of the organelles, especially mitochondria, and the outlines of the endoplasmic reticulum were undergoing lysis.

In nerve cells of the superior cervical ganglion changes in acute emotional stress were expressed as some increase in the lumen of the cisternae of the Golgi apparatus, displacement of the nucleolus toward the periphery of the nucleus, and enlargement of the vacuoles in the nucleolus (Fig. 1b). Changes in the nerve cells in the ganglia of the sympathetic chain could be reduced to swelling of the mitochondria, accompanied by translucency of their matrix, and by some widening of the cisternae of rough reticulum and also of the Golgi apparatus. The nuclei played virtually no part in the activation of the neurons.

It can be concluded from the results of this investigation that the predominant changes in acute emotional stress arise and develop in the Golgi apparatus of nerve cells of the ganglion nodosum of the vagus nerve. These changes lead to the formation de novo of a large number of lysosomes — endogenous sources of proteolytic enzymes. There is reason to suppose that in acute emotional stress nerve cells function at the expense of energy formed by lysis of proteins. The results thus suggest that changes in protein metabolism of the nerve cell of the ganglion nodosum in acute emotional stress are linked with the increased production of enzymes, localized in the lysosomes, by the cell.

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EFFECT OF LONG-TERM INTERNAL IRRADIATION ON NEURONS OF THE HYPOTHALAMIC ARCUATE AND SUPRACHIASMATIC NUCLEI AND MEDIAN EMINENCE IN RATS

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The decisive factor in radiation-induced disturbance of activity of the neuroendocrine system is injury to its central stage — the hypothalamus and pituitary [1]. Through the releasing hormones the hypothalamus maintains the optimal level of hormones of the peripheral endocrine glands. It has been shown that of the hypothalamic formations it is the arcuate and suprachiasmatic nuclei (AN and SCN respectively) which are the source of formation of most releasing hormones [2, 4, 5], which are carried along the axons of secretory neurons into the median eminence and are discharged into the capillary blood stream in the primary portal plexus. It is therefore interesting to study the fine structure of neurons of AN and SCN, and also of the median eminence, in rats during long-term internal irradiation, and the investigation described below was carried out for this purpose.

EXPERIMENTAL METHOD

Experiments were carried out on 72 noninbred male rats aged 3 months, which were given a single intravenous injection of the radionuclide preparation ^{75}Se -selenomethionine in a dose of 1.22×10^4 Bq/g body weight. The animals were killed 2 weeks and 1, 3, 6, 9, 12, and 18 months after injection of the radionuclide. AN and SCN of the hypothalamus and the median eminence were taken for electron-microscopic study. The number of granules of secretion and the number of empty vesicles in nerve terminals of the median eminence ending on portal capillaries and also the number of granules of secretion in nerve fibers located not more than 2–3 μm away from the capillary were counted on electron micrographs.

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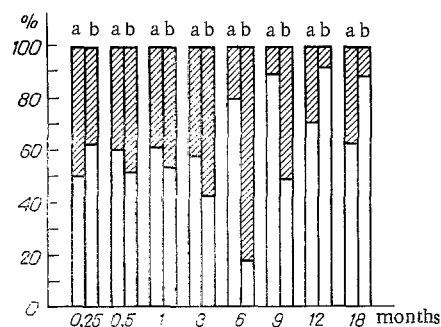


Fig. 1. Relative percentages of granules of secretion (shaded part of column) and empty vesicles (unshaded part) in nerve terminals of median eminence, making contact with portal capillaries (mean number per terminal, obtained by counting 150 nerve terminals at each time). a) Control; b) experiment.

EXPERIMENTAL RESULTS

Two neuron populations differing from each other in their fine organization could be distinguished in AN and SCN of intact animals. One of them ("dark" cells) consisted of neurons with developed organoids. However, the Golgi apparatus of these cells did not contain discretely shaped granules of secretion. The second neuron population had less well-developed organoids ("pale" cells), but nevertheless the cytoplasm of these cells contained granules of secretion which, in the region of the Golgi apparatus, were discretely shaped. Cholinergic and adrenergic synapses were constantly found on the bodies and processes of both neuron populations.

During the first 3 months after injection of the radionuclide the number of granules of secretion, whether located in the region of the Golgi apparatus or in the cytoplasm and along the course of the axons, increased considerably in the cytoplasm of AN neurons of both populations. Under normal conditions granules of secretion were virtually absent in the "dark" cells. No significant changes were found in the structure of the cell organoids. After 6-9 months the network of tubules of the rough endoplasmic reticulum in the cytoplasm of the "pale" AN cells contracted. Most mitochondria in neurons of both populations began to swell and their matrix became pale. Evidence of fragmentation and lysis of the cristae was distinctly seen. The number of primary lysosomes of the "dense body" type increased.

By the 12th and, in particular, the 18th months after injection of the radionuclide the extent of the tubules of the endoplasmic reticulum was somewhat restored. The structure of the mitochondria was back to normal. As before many lysosomes were seen in the cytoplasm of the neurons. Granules of secretion appeared in the cytoplasm of the "pale" neurons. A characteristic feature of the general reaction of AN to injection of ^{75}Se -selenomethionine in the late stages (6-18 months) was a progressive increase in the number of "dark" cells, which were predominant by the end of the experiment.

Marked changes were found in the synaptic system 9-12 months, and particularly by 18 months after injection of the radioactive compound. Some axosomatic synapses were deformed. Precise organization of functionally active points of the synapse was lacking. The number of synaptic vesicles in the presynapse was reduced. Distinct concentration of synaptic vesicles near the presynaptic membrane and thickening of the postsynaptic membrane were frequently absent.

The character and dynamics of changes in the structure of the neurons of SCN were identical to those for neurons of AN but less marked.

The ratio between the numbers of empty vesicles and granules of secretion in the nerve terminals of the median eminence is usually taken to reflect the state of liberation of hypothalamic releasing hormones into the portal blood stream of the pituitary. Calculations showed that during the first 3 months the ratio of granules of secretion to vesicles remained virtually unchanged compared with the control (Fig. 1). However, during this period the number of granules of secretion (the mean per terminal or fiber) increased significantly compared with the control: 17.8 ± 1.3 after 2 weeks ($P < 0.01$), 20.2 ± 1.6 after 1 month ($P < 0.01$), 16 ± 1.1

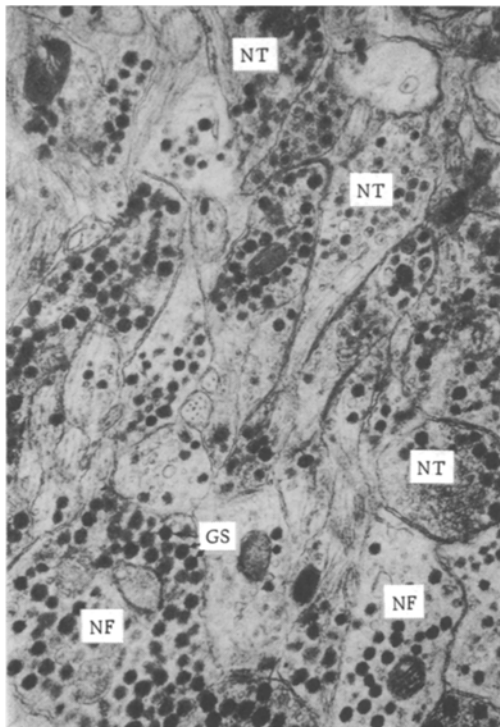


Fig. 2

Fig. 2. Nerve fibers (NF) of median eminence filled with granules of secretion (2 weeks after injection of ^{75}Se -selenomethionine). GS) Granules of secretion, NT) nerve terminals. $17,000\times$.

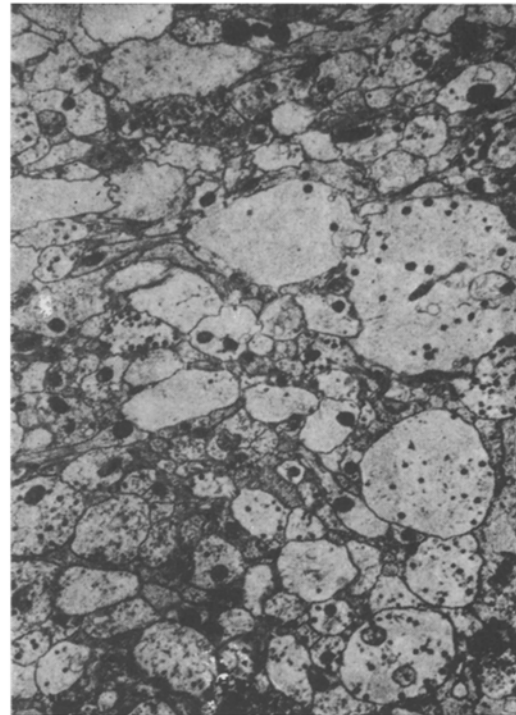


Fig. 3

Fig. 3. Nerve fibers of median eminence 9 months after injection of ^{75}Se -selenomethionine: they contain a few granules of secretion. $6000\times$.

($P < 0.02$) after 3 months; 10.5 ± 1.2 in the control (Fig. 2). Marked inhibition of liberation of the contents of the secretory granules was observed 6-9 months after injection of the preparation and it was accompanied by a decrease in the number of granules in the nerve fibers: 4.3 ± 1.2 after 6 months ($P < 0.01$), 6 ± 1.2 after 9 months ($P < 0.05$); 11.5 ± 1.1 in the control (Fig. 3). By the 18th month the number of granules of secretion in the nerve fibers was relatively restored (9.8 ± 1.4 after 12 months compared with 13 ± 1.2 in the control; 9.6 ± 1.0 after 18 months compared with 12.8 ± 1.8 in the control) and the process of liberation of the contents of the granules of secretion was considerably activated (Fig. 1). Among nerve terminals ending on portal capillaries of the median eminence the number of those which contained only synapse-like vesicles was increased by the end of the experiment. The nerve terminals and fibers also showed trophic disturbances.

Close correlation was thus found between the dynamics of changes in the fine structure of neurons of AN, SCN, and the median eminence during prolonged internal irradiation. Activation of the function of the secretory neurons during the first 3 months after injection of ^{75}Se -selenomethionine was accompanied by an increase in the number of granules of secretion in the nerve fibers and terminals of the median eminence and by forced liberation of their contents into the portal capillaries. Inhibition of functions of AN and SCN neurons (6-12 months) led to a marked decrease in the number of granules of secretion in the nerve fibers of the median eminence, and inhibition of liberation of the contents of the secretory granules into the blood stream of the portal capillaries also was observed.

The presence of deformed synapses on the bodies and processes of the neurons may indicate a disturbance of functional connections between AN and SCN and the other centers of the CNS. Meanwhile, judging from the structure of the organelles, neurons of AN and SCN retain the power to synthesize biologically active substances, the basis for possible recovery of functions of the secretory neurons in the late stages after irradiation. Restoration of the functions of the secretory neurons (by 18 months after injection of the preparation) was accompanied by activation of liberation of the electron-dense contents of the secretory granules into the portal capillaries of the median eminence. Consequently, activation of the hormonopoietic function of the adenohypophysis may be expected.

As already stated, by the end of the experiment the number of nerve terminals containing only synapse-like vesicles in the median eminence was increased. If these vesicles are carriers of acetylcholine, this suggests that cholinergic control over pituitary functions by the hypothalamus is intensified in this period. Acetylcholine, which does not act directly on hormonopoiesis in the pituitary cells, is known to facilitate the forced liberation of hypothalamic hormones into capillaries of the median eminence [3]. This fact explains to some degree activation of the liberation of the contents of the secretory granules from the nerve terminals of the median eminence observed 12 and 18 months after injection of ^{75}Se -selenomethionine.

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ULTRACYTOCHEMICAL STUDY OF OXIDOREDUCTASES IN PARIETAL CELLS OF THE GASTRIC MUCOSA IN GASTRIC CARCINOMA

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The parietal cells of the stomach produce hydrochloric acid. The acid-forming function is often disturbed in some pathological processes in the stomach (chronic gastritis, carcinoma). However, the mechanism of this phenomenon is not yet fully explained.

Biochemical investigations [1, 2, 4-7] have shown that a large quantity of energy is required in order to secrete hydrochloric acid. The main source of this energy is the numerous mitochondria present in the parietal cells. Pokrovskii et al. [4] state that the most powerful substrate for the mitochondrial respiratory chain in the parietal cells is succinate, whereas Gapparov [1] also found a sharp increase in cytochrome oxidase activity in the mitochondria of these cells.

To discover the possible causes of the disturbance of hydrochloric acid secretion in gastric carcinoma an ultracytochemical study was undertaken of succinate hydrogenase (SDH), cytochrome oxidase (CCO), and NADH-dehydrogenase (NADH-DH) activity in the parietal cells of the mucosa of the normal stomach and of the stomach of patients with gastric carcinoma, whose gastric juice was found to have persistently reduced secretion of hydrochloric acid or even achlorhydria.

EXPERIMENTAL METHOD

Biopsy material taken for diagnostic purposes from the gastric mucosa of two groups of subjects was investigated. Group 1 consisted of seven persons with normal acidity of their gastric juice, and with no evident tumor in their stomach; group 2 consisted of five patients with gastric carcinoma accompanied by re-

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