STATE OF THE HYPOTHALAMO-HYPOPHYSEAL SYSTEM IN EXPERIMENTAL BURNS

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Burns covering 21-38% of the body surface were inflicted on rabbits. Activation of neurosecretory processes in the supraoptic and paraventricular nuclei of the hypothalamus and the appearance of large quantities of neurosecretion in the posterior part of the neurohypophysis were observed 2 days after burning. In the late stages neurosecretory processes are restored or degenerative changes develop in the neurosecretory cells.

The hypothalamic neurosecretion is a frequent topic for research at the present time. Morphological and histochemical changes in the hypothalamo-hypophyseal system after burns have been inadequately studied [1-5]. The workers cited, who studied both experimental and clinical material, investigated changes in the hypothalamo-hypophyseal system mainly during the first few hours after severe burning.

The object of the present investigation was to study the state of the hypothalamo-hypophyseal system at various intervals after infliction of a standard experimental burn.

EXPERIMENTAL METHOD

Experiments were carried out on 26 adult rabbits of both sexes weighing from 1950 to 3800 g. The control group consisted of 4 rabbits. Flame burns were inflicted on the animals. The rabbit was tied to a frame, the hair on the back and sides of the trunk was shaved, strips of gauze soaked in benzine were applied to the shaved areas of skin; the exposure to the burn averaged 1 min. From 21 to 38% of the body surface was burned. The rabbits were sacrificed by air embolism 2, 3, 5, 20, and 30-45 days after the thermal injury. Organs for testing (pieces of brain corresponding to the location of the neurosecretory nuclei of the hypothalamus, together with the pituitary) were placed in Bouin's fluid. After 24 h the fixing solution was replaced by a fresh batch of the same solution in which the material was kept in darkness for 1 week, after which it was passed by the rapid method through alcohols of increasing strength and through benzene into paraffin wax. Sections 6-7 μ in thickness were stained with paraldehyde-fuchsin by the Gomori-Gabe method and counterstained in various ways (with azan or methylene blue, or with Janus green). The sections were examined under the light microscope. The 24-h diuresis of the experimental animals was determined throughout the period of observation.

EXPERIMENTAL RESULTS

Microscopic examination of the hypothalamus of the 7 rabbits killed 2 days after burning revealed some increase in the quantity of neurosecretion in the cytoplasm of the neurosecretory cells of the supraoptic nucleus (Fig. 1). In some cases the cytoplasm of these cells was almost universally filled with neurosecretion staining with paraldehyde-fuchsin. Neurosecretion was also found in the processes of the cells.

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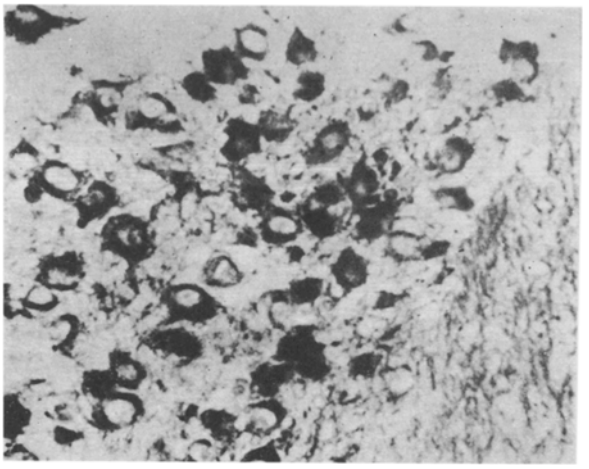

Fig. 1. Supraoptic nucleus of rabbits 2 days after burning. Content of neurosecretion increased in cytoplasm of neurosecretory cells. Gomori–Gabe, 400×.

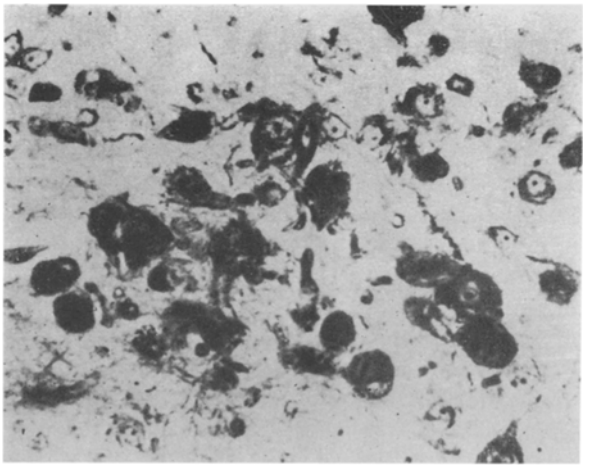

Fig. 2. Paraventricular nucleus of rabbit 2 days after burning. Neurosecretory cells whose cytoplasm is filled with neurosecretion can be seen. Gomori–Gabe, 400×.

A large number of neurosecretory cells whose cytoplasm was filled with neurosecretion (Fig. 2) could be seen in the paraventricular nucleus. Considerable accumulation of neurosecretion was found in the inner part of the wall of the infundibulum, whereas its outer part contained no neurosecretion. The principal posterior part of the neurohypophysis (posterior lobe of the pituitary) contained a fair amount of neurosecretion. Small and medium-sized Herring's bodies were seen mainly in the region of the hilus. Similar changes, incidentally, were found by Muzykant [2] in a study of the hypothalamus and neurohypophysis in persons dying in the torpid stage of burn shock.

The cell picture in the adenohypophysis was close to normal.

Three days after burning, a sharp decrease in the number of neurosecretory cells containing material staining positively with paraldehyde-fuchsin was observed in the supraoptic nucleus, and this material was perinuclear in its distribution. There were very few cells containing neurosecretion in the form of small, discrete granules in the paraventricular nucleus. In the inner part of the median eminence, the minimal quantity of stained neurosecretory material was found, while the outer part was completely empty. The quantity of neurosecretion in the principal posterior lobe of the pituitary was reduced compared with the control. Neurosecretion was concentrated mainly in zones of condensation. The number of Herring's bodies also was reduced.

In the adenohypophysis many β-basophils were found 3 days after burning. They were scattered throughout the section and did not occupy their usual place.

Five days after burning large numbers of cells containing stained neurosecretion could be seen in the supraoptic and paraventricular nuclei. Both nuclei resembled the controls. The cell islands filled with stained neurosecretion could be seen in the inner part of the wall of the median eminence, while its outer part contained no neurosecretory material whatsoever or only small quantities. In the principal posterior part a moderate amount of neurosecretion was seen, mainly in the zones of condensation. Small Herring's bodies were scattered among the tissues.

The number of basophils (mainly β-basophils) in the adenohypophysis was increased. Most were degenerated: the cell body was shrunken and the cell nuclei homogenized.

Twenty days after burning the distinguishing feature of the neurosecretory cells was vacuolation at the borders of the cell body. Their content of stained neurosecretion was almost the same as in the control. The number of degenerating cells was increased.

In the inner part of the median eminence, a very few neurosecretory granules could be seen, while in the outer part there was no neurosecretion at all. The state of the principal posterior part of the neurohypophysis was the same as in the control.

Twenty days after burning the number of basophils in the adenohypophysis was the same as in the control, but the gland remained hyperemic.

In the animals sacrificed 30-45 days after burning, i.e., when the rabbits were in the convalescent stage, the microscopic picture of the neurosecretory cells of the supraoptic and paraventricular nuclei was different: in some cases no neurosecretory material was present, while in others a varied number of cells contained neurosecretion. The neurosecretory cells (especially in the paraventricular nuclei) were shrunken.

No special changes could be seen in the neurohypophysis. Only a small quantity of material staining with paraldehyde-fuchsin could be seen in the principal posterior part of the neurohypophysis, in which there were no Herring's bodies.

The histological picture of the adenohypophysis in the rabbits of this group was indistinguishable from that in the control animals.

On the basis of the histological picture of the hypothalamus, an opinion can be expressed regarding the function of the neurosecretory nuclei of the hypothalamus after burns. Activation of neurosecretory processes in the supraoptic and paraventricular nuclei of the hypothalamus and the passage of large quantities of neurosecretion along the hypothalamo-neurohypophyseal tract into the principal posterior part of the neurohypophysis takes place 2 days after burning. The dynamics of the diuresis also gives evidence for a sharp increase in function of the hypothalamo-neurohypophyseal system. Before burning, the mean 24-h diuresis of the rabbits was 41.8 ± 3 ml, falling sharply to 24.2 ± 2.4 ml ($P < 0.001$) 2 days after burning, presumably because of the secretion of large quantities of antidiuretic factor into the blood stream.

Three days after burning, the production of neurosecretion and its utilization in the body are reduced. In the late stages, in some cases gradual convalescence develops, while in others degenerative changes take place in the neurosecretory cells, and this leads to functional insufficiency of the neurosecretory system.

Consequently, the hypothalamo-neurohypophyseal neurosecretory system in rabbits with experimental burns develops significant pathological changes which are transient in character. The burns evidently act indirectly, not directly, on the peripheral endocrine glands, exerting their effects through the hypothalamo-adenohypophyseal neurosecretory system which regulates their activity.

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