CHANGES IN THE ACCESSORY GROUP OF HYPOTHALAMIC NEUROSECRETORY CELLS AFTER STIMULATION OF THE SUPRAOPTIC NUCLEUS

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Changes in the accessory group of neurosecretory cells in cats were studied in acute experiments under chloralose anesthesia. Unilateral stimulation of the supraoptic nucleus, leading to vasoconstriction, caused activation of cells of the accessory group on the side of stimulation and an increase in size of the nucleolus. Cells of the paraventricular nucleus were unchanged whereas cells of the supraoptic nucleus were activated. The uniformity of response of the accessory group of neurosecretory cells and of the supraoptic nucleus, together with histochemical data in the literature, suggests that the two groups of cells produce vasopressin, some of which accumulates in the posterior lobe of the pituitary and some acts as a mediator outside the hypothalamus.

KEY WORDS: *hypothalamo-hypophyseal system*; *neurosecretion*; *vasopressin*.

Neurosecretory cells located outside the nuclei in larger or smaller groups have been described in the mammalian hypothalamo-hypophyseal neurosecretory system. Such groups are found in man [1, 2], dogs, rabbits, cats [2], rats [2, 4, 6, 9], and guinea pigs [5]. The substance neurophysin-P has been detected in the accessory group of mammalian neurosecretory cells by Evans et al. and Watkins [5, 9] and other workers by immunohistochemical methods. The reaction product was localized in the perikarya and processes, just as in cells of the supraoptic (SON) and paraventricular (PVN) nuclei. All workers regard cells of the accessory groups as typical neurosecretory cells, but differ in the roles attributed to them. Bandaranayke [4] considers that these cells can compensate for the function of the neurosecretory nuclei after their destruction, whereas Palkovits et al. [6] attached no significant role to them. According to their observations, three groups of accessory cells in rats account for 5.5 or 6% of all neurosecretory cells. However, none of the authors cited investigated the functional morphology of the cells of the accessory groups.

The object of this investigation was to study the functional morphology of a large group of neurosecretory cells (accessory groups) in kittens after unilateral stimulation of SON.

EXPERIMENTAL METHOD

In acute physiological experiments on male cats (10 animals) weighing 3-3.5 kg, anesthetized with chloralose, unilateral unipolar stimulation of SON was carried out causing the arterial pressure to rise. The parameters of stimulation were: 100 Hz, 5-6 V, 1 msec; the duration of stimulation was 30 sec and the intervals between stimulation 10 min; stimulation was applied 10 times in each experiment,* 4 cats subjected to all procedures except stimulation were used as the control. The animals were killed by air embolism. The hypothalamic region of the brain and pituitary were fixed in Bouin's fluid. Serial paraffin sections were stained by the Gomori–Gabe method. Activity of the accessory group of neurosecretory cells was determined from the size of the nucleus and distribution of the cells depending on their content of Gomori-positive material [3]. No changes were found in the number of pycnomorphic cells; small pale cells with a not very large nucleus and with a small nucleolus were classed in type III.

*The physiological part of the experiment was carried out by laboratory assistant G. P. Mikhailova.

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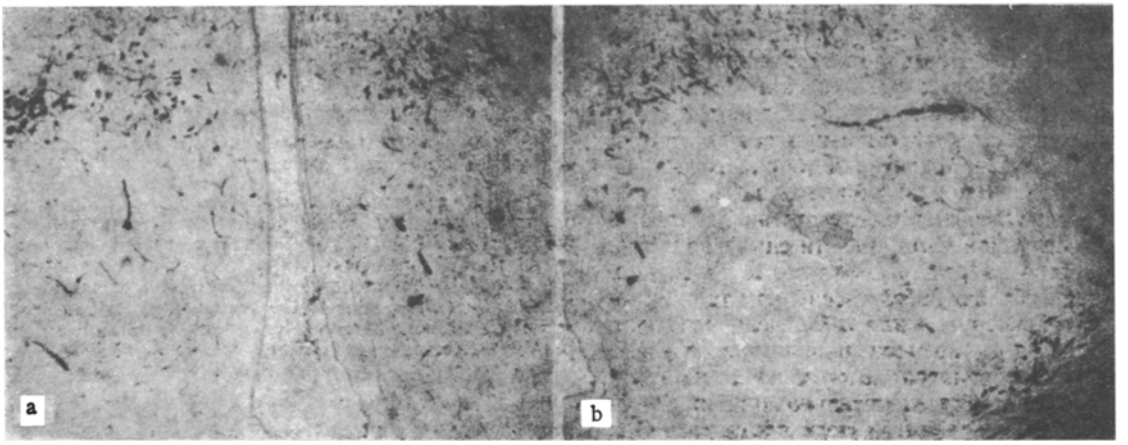

Fig. 1. Frontal section through hypothalamus of cats at level A 13: a) accessory group of neurosecretory cells, a paired formation located symmetrically on both sides of the third ventricle; b) the accessory group lies superior and medially to SON. Neurosecretory cells lie at the side of the arteries and send some of their processes along them. Paraldehyde-fuchsin + azan, 7 × 12.5.

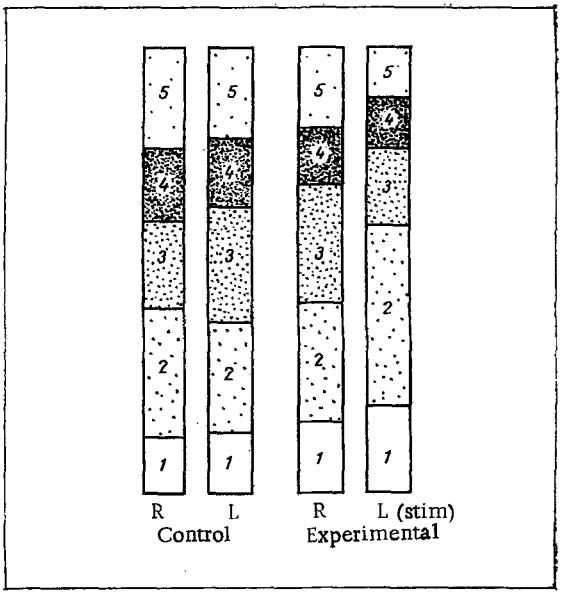

Fig. 2. Distribution of neurosecretory cells of accessory groups of control and experimental animals depending on their content of Gomori-positive material. On the side of stimulation there is an increase in the number of cells actively synthesizing and liberating neurosecretion (Ia and Ib) and a decrease in the number of inactive cells (III). 1) Type Ia, pale cells with large nucleus and nucleolus and with cytoplasm almost free from granules of neurosecretory substance; 2) type Ib, large pale cells with a few granules in perinuclear zone; 3) type Ic, granules of secretion throughout area of perikaryon; 4) type II, "dark" cells; 5) type III, small cells with small nucleoli and few Gomori-positive granules. R) Right; L) left accessory groups.

EXPERIMENTAL RESULTS

A group of neurosecretory cells lies superiorly and medially to SON at the levels A 13-A 12.5 on the stereotaxic atlas [7]. This is a paired formation, containing 30 to 40 cells in

sections on both sides. The cells are a little smaller than in SON and are loosely arranged (Fig. 1a). By their content and distribution of Gomori-positive material, like the cells of PVN and SON, they can be divided conventionally into three types [3]. Unlike the accessory groups in rats, in which the cells are arranged like a sleeve around branches of the carotid artery [6], in cats the neurosecretory cells lie medially to the artery, as it runs tangentially from SON toward the third ventricle (Fig. 1b). The cell processes from the lateral part of the group form a bundle which runs along the vessel and loses itself in SON. Some fibers perhaps form neurovascular contacts. The processes of some cells, lying in the medial part of the group can be traced toward the ependyma of the third ventricle, whereas other axons run toward SON without any form of system. Like Bandaranayke [4], we were unable to discover whether these processes run in the supraoptico-hypophyseal tract or whether they terminate in the nucleus. However, judging from the direction of the cell responses, the former can be assumed to be correct. Many fibers spread out in different directions and it is very likely that they terminate outside the hypothalamus. Traczyk [8], in homogenates and perfusion fluids from a region 5-10 mm from SON and in the brain stem, found high antidiuretic activity, which he attributed to the presence of either neurosecretory cells or their processes in these regions. He considers that the neurosecretion acts in this area as a mediator in the same way as it does in the anterior lobe of the pituitary. Vasopressin formed outside the hypothalamus perhaps owes part of its origin to the cells of the accessory groups.

Unilateral stimulation of SON caused a redistribution of the cell composition of the accessory group on the side of stimulation (Fig. 2). The number of cells with a large nucleus and nucleolus and with pale cytoplasm, containing a little Gomori-positive material (types Ia and Ib after M. N. Yurisova) was increased. Processes of cells packed with neurosecretory material could be traced over a long distance. Often varicose expansions of the fibers were observed. The mean diameter of the nucleoli of the neurosecretory cells was increased. From 34.4 ± 1.0 conventional units in the control and on the side opposite to stimulation it increased after stimulation to 40.5 ± 0.8 conventional units. The nucleus stimulated also was activated. This was manifested by an increase in the synthesis, transport, and liberation of neurosecretory material from the posterior lobe of the pituitary. No significant changes were found in PVN.

The uniformity of the responses of the neurosecretory cells of the accessory groups and of SON and the immunohistochemical data in the literature suggest that cells of the accessory group, like most cells of SON, produce vasopressin, some of which accumulates in the posterior lobe of the pituitary whereas some acts as a mediator outside the hypothalamus.

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