

EFFECT OF SUBCUTANEOUS EXTERIORIZATION OF THE KIDNEY ON THE HYPOTHALAMUS

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Subcutaneous exteriorization of the left kidney in rats for 7-10 days was accompanied by an increase in area of neurons of the ipsilateral supraoptic nucleus compared with the contralateral. Similar results were obtained by subcutaneous exteriorization of the right kidney. No response was observed in the paraventricular nuclei.

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The resorption of water by the renal tubules is known to be under the control of antidiuretic hormones produced by the cells of the supraoptic nucleus of the hypothalamus. It is also known that ischemia of the kidneys produced by clamping their blood vessels or by subcutaneous exteriorization of the kidneys through an incision in the spinal muscles, increases the secretion of vasopressin by the hypothalamus.

Under these circumstances it is natural, therefore, to expect a marked response in the supraoptic nucleus of the hypothalamus. In this connection the response of the supraoptic nucleus to exteriorization of one kidney (left or right) beneath the skin in the region of the spine was investigated.

EXPERIMENTAL METHOD

Experiments were carried out on male rats weighting 180-250 g. The operation of exteriorization of the kidney was carried out under ether anesthesia through an incision 1.5-2 cm below the border of the last rib. The perirenal fatty areolar tissue was separated by blunt dissection and the kidney brought out into the incision. When sutures were applied beneath the exteriorized kidney, a small opening was left through which the ureter and the neurovascular bundle of the kidney passed. A continuous suture was applied to the skin wound. A similar mock operation (without exteriorization of the kidney) was performed at the same time on the control animals.

The animals were sacrificed 7 or 10 days later by decapitation, the brain was removed, and the region of the hypothalamus with the subjacent part of the brain, shaped like a four-sided prism, was excised. The material was fixed in Bouin's fluid for 5-7 days and embedded in celloidin-paraffin.

Serial sections, 5 μ in thickness, were stained with chrome hematoxylin by Gomori's method and counterstained with acid fuchsin by Polenov's modification [6]. Since the degree of swelling of the cytoplasm of a gland cell can be used as the criterion of its secretory activity, the dimensions of the investigated hypothalamic neurosecretory cells of the supraoptic and paraventricular nuclei were determined by the method described previously [4].

EXPERIMENTAL RESULTS

Preliminary investigations revealed no significant or persistent differences in size between the cells of the supraoptic nucleus (and also of the paraventricular nucleus) of the right and left sides of the hypothalamus in intact animals.

After subcutaneous exteriorization of one kidney, swelling of most cells was observed in the supraoptic nucleus on the ipsilateral side of the hypothalamus, and only a few Gomori-positive granules remained in them, mainly in the peripheral parts of the cytoplasm; sometimes vacuoles were observed in the cytoplasm (Fig. 1A). Only isolated cells were distinguished by a large quantity of Gomori-positive substance. The nuclei of such cells were slightly flattened.

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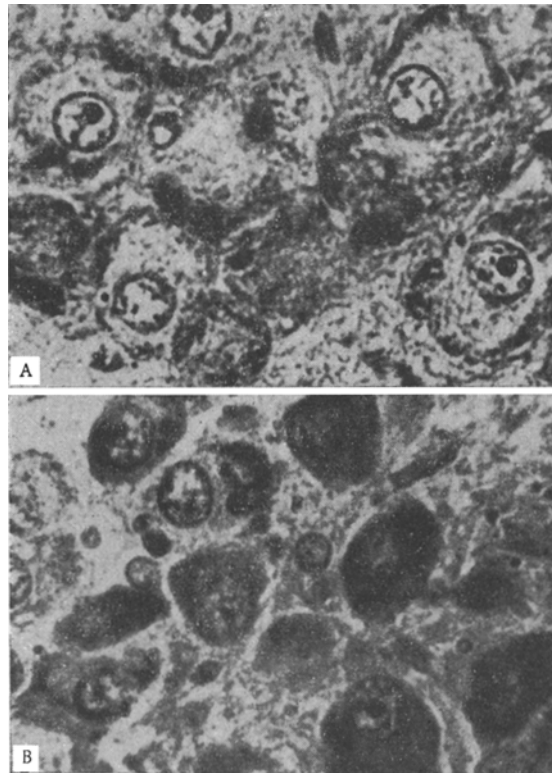


Fig. 1. Supraoptic nucleus of left (A) and right (B) sides of hypothalamus after exteriorization of left kidney. Fixed in Bouin's fluid, stained with chrome hematoxylin and fuchsin by Polenov's modification. 500 \times .

On the contralateral side (Fig. 1B) most neurons had flattened and irregularly shaped nuclei, with a large quantity of Gomori-positive neurosecretion. One or two large cells, almost without neurosecretion, were present. The commonest cells were almost completely packed with neurosecretion, as a result of which their cytoplasm appeared dark and heterogeneously stained.

Comparison of the general dimensions of cells of the right and left supraoptic nuclei shows that neurons of the ipsilateral nucleus were much larger and their activity as regards secretion of Gomori-positive material was higher than on the contralateral side.

The mean area of cross section of cells of the supraoptic nucleus on the ipsilateral side was greater than normal, whereas on the contralateral side it was less than normal (Table 1). Similar results were obtained after subcutaneous exteriorization of the right kidney.

So far as the paraventricular nuclei on both sides are concerned, they showed no reaction (no visible changes compared with normal were found in their cells as regards size or content of Gomori-positive neurosecretion).

Hypothalamic factors are known to influence not only peripheral endocrine glands (hypothalamo-pituitary mechanisms) but also organs responsible for vegetative functions (kidneys, blood vessels, mammary glands), a matter of prime importance for the adaptive and defensive reactions of the body to constantly changing conditions of existence and to pathogenic and other harmful agents [1, 2, 7, 8]. The hypothalamus, in turn, is exposed to influences from these organs [9, 10, 14, 16].

Halasz and Szentagothai [12, 15] have shown that the response of the hypothalamus to procedures directed toward one adrenal gland develops assymmetrically. This principle was confirmed experimentally by Anan'eva [5], who investigated the effect of procedures applied to one uterine cornu (in rabbits) on the hypothalamus. A reaction was observed in cells of the supraoptic nucleus on the contralateral side of the hypothalamus, while activation of these cells on the ipsilateral side was comparatively moderate.

TABLE 1. Changes in Area (in μ^2) of Cross Section of Neurons of Supraoptic and Paraventricular Nuclei of Hypothalamus Following Unilateral Subcutaneous Exteriorization of Kidney

Procedure	Supraoptic nucleus		P	Paraventricular nucleus		
	left	right		left	right	
Control (mock operation)	368.0 (345.2-381.8)			332.7 (287.0-315.4)		P
Subcutaneous exteriorization of left kidney	394.5 (336.3-449.0)	312.4 (299.7-336.3)	< 0.001	253.0 (230.7-274.5)	250.1 (248.0-278.6)	> 0.1
Subcutaneous exteriorization of right kidney	357.5 (348.1-410.5)	442.6 (426.2-521)	< 0.001	347.4 (326.6-368.2)	353.6 (332.5-374.7)	> 0.1

The presented experiments showed that the reaction of the hypothalamus to procedures applied to the kidneys also develops asymmetrically: in this particular case, however, predominantly on the ipsilateral side.

The asymmetry of these reactions indicates that afferent impulses arriving from these peripheral organs play an important role in the mechanism of influences exerted on the hypothalamus by the effector organs under its control.

The response of the neurosecretory cells of the anterior hypothalamus to subcutaneous exteriorization of one kidney is limited selectively to the supraoptic nuclei and not reflected on the paraventricular nuclei. This difference corresponds to previous observations showing that the neurosecretory cells of the supraoptic and paraventricular nuclei of the hypothalamus, despite the fact that they produce identical Gomori-positive granules, respond differently to different procedures and, consequently, thus exhibit some degree of functional differentiation [3, 11, 13].

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