CHANGES IN THE HYPOTHALAMO–HYPOPHYSEAL SYSTEM OF DOGS AFTER CASTRATION

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A cytophotometric analysis revealed a decrease in the content of neurosecretion in the hypothalamo–hypophyseal system of castrated dogs (1.5-2 years after the operation). The vasopressor activity of the cerebrospinal fluid of these dogs was increased.

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Changes in the hypothalamic neurosecretory system (HNS) after castration have been inadequately studied and available data are conflicting. Some workers observed an accumulation of neurosecretion [8, 9, 11, 13, 14], while others found no changes under these conditions [6, 7] or described a subsequent decrease in the content of neurosecretory material in the anterior hypothalamus and neurohypophysis [4, 12]. In the investigations cited above the arterial pressure (AP) of the castrated animals was not measured, yet this is a parameter of essential importance [2]. Furthermore, the content of neurosecretion was determined visually, with the possibility of subjective errors.

The object of the present investigation was to study the HNS by objective methods (cytophotometry and planimetry) and to compare the results obtained with the AP level and the vasopressor activity of the cerebrospinal fluid (CSF).

EXPERIMENTAL METHOD

The AP of sexually mature male dogs was measured before and after (for 1-2 years) castration by auscultative and sphygmotensiographic methods [1]. The vasopressor action of the CSF of intact (7) and castrated (6) animals was determined by tests on cats. Neurosecretion was stained in serial paraffin sections of the hypothalamus and pituitary (5 μ) by Gomori's method in the modifications of Gabe [10] and Polenov [5]. The content of neurosecretion in the cells was determined in sections passing through the central part of the supraoptic nucleus (SON) by staining with paraldehyde – fuchsin. From the results of cytophotometric measurements of the content of neurosecretion, the cells were classified among the types described below (representing different functional states of the neurosecretory cell) and their relative percentages of the total number of cells were calculated. The investigation was carried out with the aid of a modified cytophotometer [3] with an antimony oxide photocathode, highly sensitive in the range of wave-

TABLE 1. Results of Measurement of Arterial Pressure in Dogs

Dog	Initial			After castration			
	systolic	diastolic		systolic	P	diastolic	P
Dick	117,9±1,2	71,1±0,9	25	150,8±3,3	<0,001	100,0±1,36	<0,001
Sharik	114,7±1,5	69,5±1,5	21	155,0±6,1	<0,001	108,7±5,5	<0,001
Druzhok	110,0±2,6	72,0±2,3	14	159,0±4,3	<0,001	103,6±2,7	<0,001
Tom	118,3±3,3	71,1±1,8	13	149,8±3,3	<0,001	117,6±4,2	<0,001
Belyi	120,4±1,4	63,4±2,7	17	148,5±3,8	<0,001	91,2±5,9	<0,001
Rex	117,0±6,6	76,1±1,6	29	144,1±3,1	<0,001	107,7±4,4	<0,001

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TABLE 2. Effect of CSF of Intact and Castrated Dogs on Arterial Pressure of Recipient Dogs

Dogs	Arterial pressure of recipients	
	before injection of CSF	after injection of CSF
Intact	130.0 ± 6.0	131.3 ± 5.2
Castrated	138.3 ± 2.8	151.9 ± 3.4

TABLE 3. Content of Neurosecretion in Posterior Lobe of Pituitary and in Supraoptic Nucleus of Intact and Castrated Dogs.

Dogs	Content of neurosecretion in posterior lobe of pituitary	Percentage of cells in supraoptic nucleus			
		with high content of neurosecretion (40.0 ± 0.3)	with moderate content of neurosecretion (29.4 ± 0.5)	with low content of neurosecretion (17.7 ± 0.5)	degenerating
Intact	49.7 ± 1.0	48.5 ± 1.9	39.0 ± 1.5	9.0 ± 0.8	3.4 ± 0.6
Castrated	29.7 ± 0.4	22.8 ± 3.6	33.3 ± 2.5	27.3 ± 4.4	16.5 ± 0.9
P		< 0.001	> 0.05	< 0.01	< 0.001

lengths from 3500 to 1000 Å. The current from the output of the photomultiplier was recorded on a M-198/1 microammeter. The area of section of the neurons was also determined in square microns by means of a drawing apparatus and planimeter.

EXPERIMENTAL RESULTS

The AP of the intact dogs investigated varied within the range 110-130/60-85 mm Hg (Table 1). Postcastration hypertension developed differently in the individual dogs, often very slowly, over a period of 1.5-2 years (the dogs Dick and Rex), while in some dogs the pressure reached a high level after 12-13 months. At the end of these periods the AP of the castrated dogs was higher than initially: 155-170/90-110 mm Hg. Occasionally a temporary decrease in AP was observed. Fluctuations of the diastolic pressure were less marked. The CSF of the intact dogs was virtually without hypertensive action, while the CSF of dogs with marked postcastration hypertension had a definite pressor effect (Table 2).

A similar effect was observed after injection of 3-4 microunits of pituitrin P.

Cells of the HNS differed in their content of neurosecretory granules. Some neurons were intensely stained with paraldehyde — fuchsin; they contained large quantities of Gomori-positive material (40 ± 0.3 conventional units). In intact dogs these cells constituted a very numerous group. In dogs with postcastration hypertension the proportion of cells of this type fell by more than 50% (Table 3).

No significant changes were found in neurons with a moderate content of neurosecretion. A characteristic feature of the SON of dogs with postcastration hypertension compared with intact animals was a sharp increase (threefold) in the content of palely stained neurons, poor in Gomori-positive material (17.7 ± 0.5 units). The cells were large and swollen and they reached 640 μ^2 in area. Optically empty vacuoles were frequently seen in their cytoplasm. However, the mean area of section of neurons of the SON in the castrated dogs (320.2 μ^2) did not exceed that in the intact animals (330.7 μ^2). The explanation of this is that the content of degenerating cells with pycnotic nuclei and small, angular, shrunken bodies (area 170-200 μ^2) was very much greater in the SON of the experimental animals, and this was reflected in their mean size. Similar changes were found in the paraventricular nucleus. In the posterior lobe of the pituitary of normal dogs, Gomori-positive material was present as numerous clumps or granules and as larger aggregations — Herring's bodies. The content of Gomori-positive material in the posterior lobe of the pituitary of the castrated dogs was much reduced, as confirmed by the photometric data (Table 3). Small and large granules were concentrated around the blood vessels.

Hence, in postcastration hypertension, a decrease in the content of neurosecretion in the HNS was observed. It can be concluded from a comparison of these changes with the high AP and the observed

secretion of vasopressin that deprivation of cells of the SON and posterior pituitary of Gomori-positive material took place through increased liberation of neurosecretion. Some cells developed degenerative changes as a result of stress.

The results obtained indicate the development of significant histophysiological changes in the HNS after castration, indicating that the HNS is a link in the complex mechanism of hypertension under these conditions.

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