EFFECTOR INNERVATION OF MELANOPHORES OF ARTERIES AT THE BASE OF THE BRAIN

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During electrical stimulation of the vagus and sympathetic nerves, and in solutions of acetylcholine and noradrenalin in vitro, melanophores of arteries at the base of the cat brain change their size and shape. It is concluded that these cells have a double effector innervation.

KEY WORDS: melanophores; stimulation of nerves; effector innervation.

Cholinergic and adrenergic nerve fibers have been described on melanophores of the arteries at the base of the mammalian and human brain [3]. In the lower vertebrates these nerves control the mobility of the chromatophores and modify their size and shape [4]. The role of effector nerves on the mammalian melanophores is unknown.

The object of this investigation was to study the responses of melanophores of the brain arteries during stimulation of sympathetic and parasympathetic nerves.

EXPERIMENTAL METHOD

Experiments were carried out on 25 kittens of a predominantly black or gray color and aged 6-8 weeks. The choice of kittens as the test object is due to the high content of melanophores in the adventitia of their cerebral arteries [1]. In one group of kittens (five animals) anesthetized with ether, the central end of the divided right vagus nerve was stimulated by an electric current with an initial voltage of 3 V and repeated stimulation from an induction coil at 13 cm for 30 sec. In another five animals the superior cervical sympathetic ganglion on the same side was stimulated [2]. At the end of the experiment 10% formalin was injected beneath the base of the brain. In five control experiments (control 1) the same manipulations were carried out except for stimulation of the nerves (skin incision, division of muscles, dissection and isolation of the nerves, anesthesia).

Besides during stimulation of the nerves, the behavior of the chromatophores also was studied in

TABLE 1. Size and Shape of Melanophores in Control and Experimental Series

Character of treatment	Number of experiments	Area of cross section (in μ^2)			Percentage of "reticular" cells			Percentage of "granular" cells		
		M	*m*	*P*	*M*	*m*	*P*	*M*	*m*	*P*
Control 1	5	601	31	—	26	1,3	—	17	1,1	—
Control 2	5	713	21	—	34	1,4	—	19	1,2	—
Stimulation of vagus nerve	5	791	20	0,00	46	1,5	0,00	12	0,9	0,01
Stimulation of sympathetic nerve	5	611	16	>0,5	25	1,6	0,5	34	1,2	0,00
Effect of acetylcholine	5	880	31	0,00	61	1,6	0,00	7	0,8	0,00
Effect of noradrenalin	5	499	29	0,00	9,6	0,9	0,00	49	1,5	0,0C

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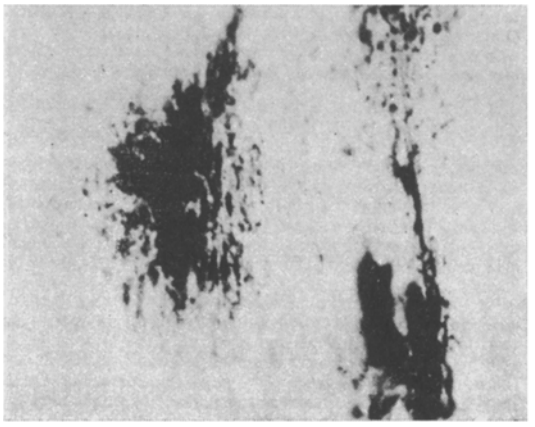

Fig. 1

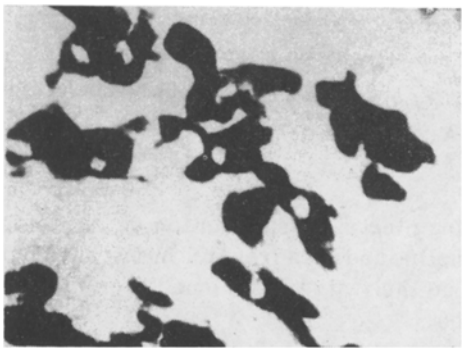

Fig. 2

Fig. 1. Anterior cerebral artery. Reticular melanophore. Stimulation of central end of vagus nerve by induction current. Unstained preparation, 1200 ×.

Fig. 2. Anterior cerebral artery. Granular melanophores. Stimulation of superior sympathetic ganglion. Unstained preparation, 1200×.

solutions of acetylcholine (five kittens) and noradrenalin (1 : 10,000; five kittens).

The brain arteries were removed from the decapitated kittens together with the pia mater, which was divided into right and left halves, immersed separately in mediator solution and in physiological saline (control 2) at 37°C. After exposure for 30 min to the solutions, 50 ml of 20% formalin was added.

EXPERIMENTAL RESULTS

The observations showed that stimulation of the parasympathetic and sympathetic nerves evoked two opposite phenomena (Figs. 1 and 2). In the first case the melanophore increased in size, its boundaries became indistinct, and its shape became reticular [4]; in the second case, the parameters of the cross section of the cell decreased in size and the boundaries became clear. Under low power of the microscope the melanophore had the appearance of a dark, homogeneous dot, a shape which cannot be described exactly as a granule [4]. However, by no means all the cells in the experiments became either "reticular" or, on the contrary, "granular." Intermediate forms were observed between them, and their great diversity was also noted in the control material. The reliability of the results obtained in the experimental series was thus assessed with reference to two criteria: 1) The mean size of the cross section of the chromatophore was determined by the equation $S = LB$, where L is the greater and B the lesser diameter; 2) the relative number of "reticular" and "granular" chromatophores was determined in 100 cells of the middle and anterior cerebral arteries together. The results of the control and experimental observations, subjected to statistical analysis, are given in Table 1.

It follows from Table 1 that during stimulation of the central end of the divided vagus nerve there is a significant increase in number of reticular and a decrease in the number of granular chromatophores, whereas the area of cross section of the cell increases. An identical, but more sharply defined response of chromatophores was observed in the experiments in vitro with acetylcholine.

During stimulation of the sympathetic nerve the number of granular chromatophores increased whereas the number of reticular chromatophores remained unchanged; the mean area of cross section of the cell was indistinguishable from the control. On this basis it can be concluded that the sympathetic innervation has a weaker action on chromatophores than the parasympathetic innervation. Besides the formation of many granular cells, in noradrenalin solution the number of reticular chromatophores increased, as also did the area of cross section of the cell. Consequently, compared with stimulation of the sympathetic nerve, the chromatophores responded uniformly in vitro, but more strongly.

The results thus indicate that melanophores of the arteries at the base of the cat brain have a double parasympathetic (cholinergic) and sympathetic (adrenergic) effector innervation.

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