EFFECT OF INTRAOCULAR INJECTIONS ON THE METABOLIC RESPONSE OF THE GANGLION CELLS

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UDC 612.822.2-087.45

The dry weight of the ganglion cells of the retina was determined by interference microscopy in mice with intact eyes and mice into whose eyes physiological saline had been injected. By contrast with the control animals in which the dry weight of the ganglion cells showed definite changes during photic stimulation, in the experimental animals the protein mass of the cells showed only negligible changes. The absence of fluctuation in protein content was evidently due to stress caused by the injection.

Injection of labeled precursors into the immediate proximity of cells to be investigated is a method which is becoming increasingly used to study the metabolism of nerve cells [3-8, 10, 11]. Local injection has many advantages: absence of a blood-brain barrier, low dose of isotope injected, low content of labeled precursors in the blood stream. Cells can be labeled close to the site of the injection only, and the fate of synthesized materials, their distribution and rate of spread along the processes of the neutron can be determined [7, 8, 11].

The ganglion cells of the retina are a convenient model for the study of the nerve cell and its axons. The labeled precursor is injected into the eye. In this way only the cells of the iris and retina, cornea, and ciliary body are labeled. The glia and connective-tissue structures of the optic nerve are unlabeled, and the appearance of an autoradiographic track in this region must indicate the migration of materials synthesized in the ganglion cells [9, 12-14].

Investigations have shown that the ganglion cells of the retina respond to an increased functional load (intermittent photic stimulation) by periodic changes in their dry weight, almost sinusoidal in pattern [1, 2].

The object of the present investigation was to determine whether the injection has any side effect on the metabolic response of the ganglion cells, and to determine the limits of use of local injections for studying functional changes in the neuron.

EXPERIMENTAL METHOD

After dark adaptation for 2 h, 28 2-month male (CBA × C57BL6) hybrid mice were exposed to the action of an intermittent light for 1 h (intensity of illumination 100 lx, frequency of flashes 2 Hz). The animals were sacrificed at intervals of 5-10 min during the period of illumination. To determine the action of the injection on the metabolic response of the ganglion cells the animals of one group (experimental) received an injection of 3 μl physiological saline into the eye 10 min before sacrifice, after preliminary instillation of procaine into the eye for anesthesia, while the other group of animals received no injection and acted as the control. The eye was fixed in a mixture of formalin, alcohol, and acetic acid (9:3:1). The dry weight of the ganglion cells of the retina was determined by interference microscopy [1].

Laboratory of Cytology, Institute of Biology of Development, Academy of Sciences of the USSR, Moscow. (Presented by Academician of the Academy of Medical Sciences of the USSR, A. P. Avtsyn.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 72, No. 11, pp. 87-88, November, 1971. Original article submitted March 30, 1971.

EXPERIMENTAL RESULTS

Changes in the dry weight of the ganglion cells during functional stimulation are shown in Fig. 1. In the control animals there was a marked increase in the dry weight of the ganglion cells after 20 and 40 min of photic stimulation (Fig. 1A). In the cells of the experimental animals, the changes in dry weight were very slight (Fig. 1B). Consequently, the puncture of the eye modified the metabolic response of the ganglionic neurons to an increased functional load, most probably on account of stress.

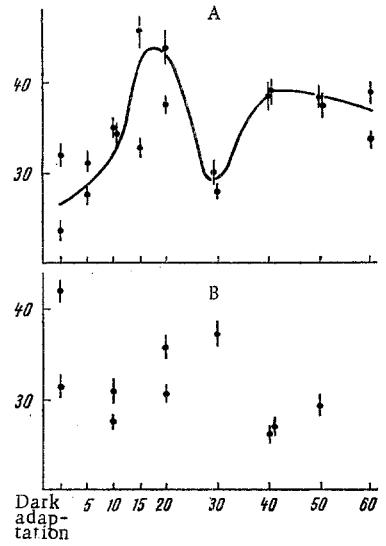

Fig. 1. Changes in dry weight of ganglion cells of the mouse retina during photic stimulation under normal conditions (A) and after injection of physiological saline into the eye (B). Abscissa, duration of photic stimulation (in min); ordinate, dry weight of ganglion cells (in conventional units).

It can be concluded from these results that local injections are not strictly applicable for the investigation of metabolic processes taking place in short time intervals, when the adequate response of the neuron may be distorted by stress. This applies, for example, to determination of the intensity of synthesis by means of a radioactive label. However, such limitations evidently cannot apply to the study of processes of longer duration than the state of stress, such as the migration of labeled material along the axons of nerve cells, the renewal of materials in the soma of the neuron over a long period of time, the study of the precursor pool, and the reutilization of various substances.

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