CONSTANT POLARIZATION POTENTIALS AND ADSORBENT PROPERTIES OF THE SALIVARY GLAND AFTER DIVISION AND STIMULATION OF THE LINGUAL AND SYMPATHETIC NERVES IN THE RABBIT

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An earlier investigation by the author [5] showed that after removal of the superior cervical sympathetic ganglion in the rabbit, the adsorbent properties of the cells in the submaxillary gland are depressed and passive hyperpolarization develops. These changes were retarded as a result of an excitation deficiency [3].

Reflex secretion of saliva is brought about by afferent impulses from the receptors of the oral cavity, traveling along the lingual and glossopharyngeal nerves. The object of the present investigation was to discover the effect of division and stimulation of the lingual nerve on the amplitude of the constant polarization potentials (CPP) and the adsorbent properties of the submaxillary gland in the rabbit.

EXPERIMENTAL METHOD AND RESULTS

The methods described previously [5] were used in the investigation.

Division of the lingual nerve. After the background level of the CPP had been established for the submaxillary gland, the lingual nerve, which had been dissected beforehand, was divided distally. In 17 of the 20 experiments passive hyperpolarization developed in the submaxillary gland after division of the lingual nerve, and depolarization developed in the other 3 experiments. The electropositive potential began to increase 2-18 (mean 5.8±1.19) min after division of the lingual nerve. The duration of the passive hyperpolarization varied from 30 to 288 (mean 150.2±14.7) min, and its amplitude reached 1.5-5.1 (mean 2.4±0.29) mV.

The mean curves of development of passive hyperpolarization of the submaxillary gland of the rabbit after removal of the superior cervical sympathetic ganglion and after division of the lingual nerve are shown in Fig. 1. Comparison of the curves shows that passive hyperpolarization after division of the lingual nerve was more protracted, but was marked by a smaller rise of electropositive potential.

In a separate series of experiments the left salivary glands were stained simultaneously in situ after division of the ipsilateral lingual nerve. The cells of the submaxillary gland on the side of the divided lingual nerve were found to adsorb 25% less of the vital dye (neutral red) than the cells of the control gland: the mean value of E× 1000 in the control series was 619±19 and in the experimental 470±23. It may thus be concluded from the results of the experiments in which the lingual nerve was divided that, in the presence of a reflex deficiency of afferent excitation the salivary gland reacts by passive hyperpolarization and by a decrease in the adsorption of dye. This conclusion is in agreement with the results obtained by A. D. Pshedetskaya [2], working with skeletal muscle deprived of its efferent nerve supply, and by the author [5], working with the salivary gland deprived of its sympathetic connections.

Stimulation of the lingual nerve. The central end of the lingual nerve was stimulated for 5 min through buried electrodes with an intermittent induction current with a frequency of 20 cps. According to Ya. D. Finkinshtein's findings [4], this is the optimal frequency for stimulating the secretion of a salivary gland. Meanwhile observations were kept on the flow of saliva from a cannula inserted into the efferent duct of the gland. In all ten experiments depolarization developed in the submaxillary gland in response to stimulation of the central end of the lingual nerve. The electropositive potential of the gland continued to fall

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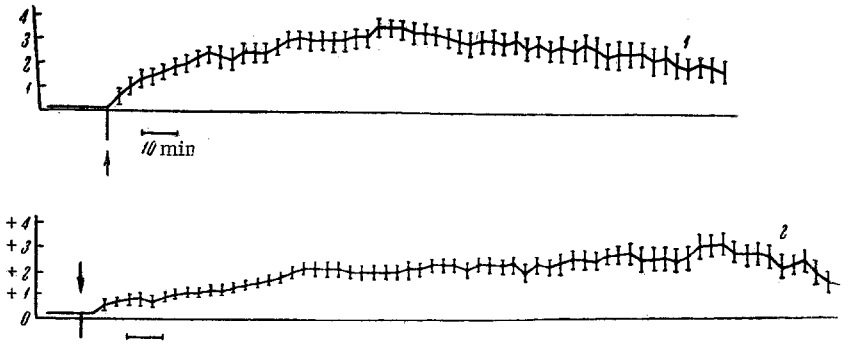

Fig. 1. Development of passive hyperpolarization of the submaxillary gland after removal of the superior cervical sympathetic ganglion (1) and after division of the lingual nerve (2). Along the axis of abscissas – time (in min), along the axis of ordinates – polarization (in mV). The arrow indicates the time of the corresponding procedure. Vertical lines – twice the standard error.

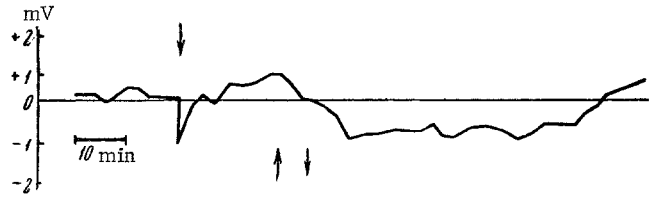

Fig. 2. Developement of depolarization in response to stimulation of the lingual nerve. The arrow above indicates the time of division of the lingual nerve, and the arrows below the beginning and end of stimulation of its central end. Rest of the legend as in Fig. 1.

48–100 min after stimulation ceased. The character of the change in the CPP of the submaxillary gland during and after stimulation of the lingual nerve is illustrated by one of the experiments (Fig. 2).

Against the background of the depolarization caused by ipsilateral stimulation of the lingual nerve, both glands were stained intravitally. The contralateral gland was used as the control. In this group of experiments the mean value of E × 1000 for the control glands was 563±24, compared with 731±35 for the glands on the side of stimulation. D. N. Nasonov and I. P. Suzdal'skaya [1] found that mouse pancreas cells, in a state of excitation after feeding, absorb 20.9% more vital dye than cells in a resting state. In the present experiments excitation of the submaxillary gland evoked by stimulation of the lingual nerve was also accompanied by an increase in absorption of dye by 30% compared with the control level.

The author's previous experiments [5] showed that stimulation of the sympathetic trunk led to active hyperpolarization in the submaxillary gland, accompanied by an increase in the absorbent properties of the gland cells. The mean value of E×1000 for the control glands in these experiments was 400±25 and for glands in a state of active hyperpolarization 596±37.3. The level of absorption was 35% higher than in the control glands.

A deficiency of reflex excitation caused by partial deafferentation of the oral mucosa thus leads to the development of passive hyperpolarization of the salivary gland and to a decrease in its ability to absorb neutral red. Removal of the superior cervical sympathetic ganglion is followed by similar changes. Stimulation of the central end of the lingual nerve leads to depolarization of the salivary gland and to an increase in its absorbent properties. In response to stimulation of the sympathetic nerve (i.e., to the excessive secretion of synaptic adrenalin), active hyperpolarization of the gland develops and absorption of the dye is increased.

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