RESPONSE OF THE SUBMANDIBULAR SALIVARY GLANDS OF MICE TO REPEATED AMPUTATION OF THE LOWER INCISORS

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Repeated amputation (11 times) of the lower incisors in noninbred male albino mice causes marked hypertrophy of the submandibular salivary glands. The size of the acini of the gland is doubled and the area of cross section of its convoluted ducts is reduced by one-third.

The salivary glands of mammals cannot respond by compensatory hypertrophy to the removal of one or more of them [1, 3]. At the same time, it has been shown that salivary gland tissue can respond by marked hypertrophy to other experimental procedures. In particular, the weight of the submandibular salivary glands in rats rises sharply in response to repeated amputation of the lower incisor teeth [4, 5]. The increase in mass of the gland under these experimental conditions is due mainly to hypertrophy of the acini [2]. However, these processes are temporary in character, and on removal of the causes of the hypertrophy the salivary glands undergo regression. The character of the morphological changes accompanying hypertrophy of the salivary glands and, in particular, of the convoluted ducts, the specific portion of the glands in rodents, is not yet known, nor is it clear whether the phenomenon of salivary gland hypertrophy in response to repeated amputation of the lower incisors is characteristic of rats only or whether it is a more general property of all rodents.

The object of the present investigation was to study the reaction of the submandibular salivary glands in mice to repeated amputation of the lower incisors.

EXPERIMENTAL METHOD

Experiments were carried out on 18 noninbred male albino mice weighing 25.5-35 g. In 8, under ether anesthesia the lower incisors were amputated 11 times (at intervals of 1-2 days) at the level of the gum margin, with injury to the pulp of the teeth. Ten mice acted as controls. The animals were killed with ether vapor 24 h after the last amputation, when the right submandibular salivary gland was removed together with the sublingual gland and weighed on torsion scales. The material was fixed in Carnoy's fluid and embedded in paraffin wax. Sections 5-7 μ in thickness were stained with hematoxalin-eosin and impregnated with silver by the Gomori method to reveal the boundaries of the acini. The weight of the experimental glands was expressed as percentages of the weight of one gland in the control animals. To determine the area of the structural units of the gland, 200-370 acini and 100-160 transversely divided convoluted ducts were drawn for each mouse on squared paper with a drawing apparatus of the Edinger type (objective 20, ocular 20). The drawings were cut out and weighed on torsion scales and the area of the structures concerned was expressed in conventional units, i.e., in mg of paper of standard thickness. The ratio between the areas of ducts and of acini in the gland was determined from the results of measurements in ten fields of vision for each gland. The numerical results were subjected to statistical analysis by the Fisher–Student method.

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TABLE 1. Change in Weight and Size of Structural Units of Submandibular Salivary Gland of Mice after Repeated Amputation of Lower Incisors

Indices studied	Control	Expt.	Increase in weight of gland (in % of control)
Absolute weight of gland (in mg)	75,3	94,1	25 $P=0,002$
Relative weight of gland (in %)	0,240	0,490	104,2
Size of one acinus (in conv. units)	6,0	11,1 $P=0,0001$	—
Size of one transversely divided convoluted duct (in conv. units)	16,0	11,1 $P<0,001$	—

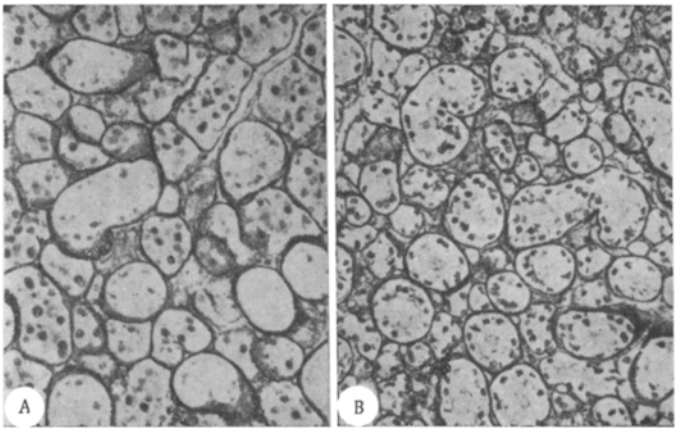

Fig. 1. Section through submandibular salivary gland of experimental (A) and control (B) mice. Acini and nuclei of secretory cells are hypertrophied in the experimental animal. Impregnation with silver by Gomori's method, 400 ×.

EXPERIMENTAL RESULTS

Repeated amputation of the lower incisors in mice, as histological and morphometric analysis (Table 1) showed, induced hypertrophy of the submandibular salivary glands. The absolute weight of the submandibular salivary glands of the experimental animals was increased by 25% compared with the controls ($P = 0.002$).

By contrast with rats, in mice amputation of the lower incisors leads to considerable wasting of the animals, so that the relative weight of the glands was increased to an even greater degree (by 104.2%). Comparison of the results of this investigation with others described in the literature shows that the change in absolute weight of the submandibular salivary glands of mice in response to amputation of the incisors is less marked than in rats. Nevertheless, this relatively small increase in weight of the gland is accompanied by very substantial structural changes.

After amputation of the lower incisors in mice there was marked hypertrophy of the acini. The area of one acinus in the control was six conventional units, but in the experimental animals it was 11.1 conventional units, i.e., the area was almost doubled. This hypertrophy, as Fig. 1 shows, was accompanied by hypertrophy of the nuclei of the acinar epithelium. According to the literature, hypertrophy of the submandibular salivary glands after amputation of the lower incisors in rats was also due mainly to hypertrophy of the acini.

However, the greatest change in the mice took place in the convoluted ducts. The changes in this part of the gland in rats after amputation of the lower incisors received little attention. In mice, very definite hypertrophy of the acini was accompanied by a marked decrease in the size and number of convoluted ducts

in the field of vision. For instance, the mean area of cross section of the ducts in the experimental mice was 11.1 conventional units, compared with 16 conventional units in the control animals. The size of the convoluted duct (its area of cross section) was reduced in the experimental animals by almost one-third. The ratio between the part of the gland occupied by ducts and the part occupied by acini in a field of vision also changed. In the control mice ducts accounted for 40.8% of the field of vision of the submandibular salivary gland, compared with 15.6% in the experimental animals.

The mitotic activity of the acinar epithelium and cells of the convoluted ducts of the submandibular salivary gland of the experimental animals was the same at these times of observation as in the control animals.

To ascertain whether proliferation of the cells plays a role in the enlargement of the salivary glands or whether this is due entirely to their hypertrophy, investigations must be carried out in the earlier periods after amputation.

The results so far obtained thus show that the submandibular salivary gland in noninbred male albino mice, just as in rats, responds by hypertrophy to repeated amputation of the lower incisors. However, this increase in size is less marked than in rats and it is accompanied not only by hypertrophy of the acini, but also by a decrease in area of cross section of the convoluted ducts.

LITERATURE CITED

1. A. G. Babaeva, in: Regeneration and Cell Multiplication in Animals [in Russian], Moscow (1964), p. 78.
2. C. S. Handelman and H. Wells, Am. J. Anat., 112, 65 (1963).
3. B. B. Milstein, Brit. J. Exp. Path., 31, 664 (1950).
4. H. Wells and P. L. Munson, Am. J. Physiol., 199, 63 (1960).
5. H. Wells, S. I. Zackin, P. Goldhaber, et al., Am. J. Physiol., 196, 827 (1959).