COMPARATIVE STUDY OF DISTRIBUTION OF MITOSES IN REGENERATING SUBMANDIBULAR GLAND OF RATS SOON AFTER RESECTION AND BURNING

T. P. Poradovskaya

UDC 616:316.1-001.17+616.316.1-089.87-07:616.316.1-003.93-018.15-076

The distribution of mitoses in the regenerating submandibular gland of rats was studied in the early stages after resection and burning. The investigation showed that dividing cells are present both by the wound surface and some distance from it. However, because of the larger area of the intact gland tissue compared with the wound surface, the number of dividing cells in the former was three times greater than the wound surface after resection and 3.5 times greater than after burning.

The ability of the salivary glands to undergo reparative regeneration has been known for a long time [1-3, 8, 9], but the method of their regeneration is still undecided. Some workers consider that regeneration of the gland takes place through an outgrowth of tissues from the wound surface [4-6, 8, 9]. An argument in support of this view is the stimulation of proliferation in the gland at the site of injury demonstrated during recent years [4-6].

Other workers have ascribed the principal role in restoration of the gland mass after resection to regeneration hypertrophy [1, 2, 7].

The object of the present investigation was to compare the distribution of mitoses in the regenerating submandibular gland after its resection (series I) or burning (series II), and to determine whether the difference between results obtained by different workers is due to differences in the experimental conditions used.

EXPERIMENTAL METHOD

The test object was the submandibular salivary gland of male albino rats weighing 150-205 g. One third of the gland was removed from 40 rats (series I). A burn was inflicted on the lower pole of the gland in the other 40 animals by means of a red-hot needle 1 mm in diameter (series II).

The reaction of the gland was studied 24, 48, 72, and 120 h after injury. The time of the operation was varied so that all the experimental and 20 control animals were sacrificed at the same time of day: 8-9 A.M. (series I) and 9-10 A.M. (series II).

The size of the necrotic area after the burn was determined by the graphic reconstruction method. To determine the mitotic index (MI) the number of mitoses was counted in 19,000 cells for each animal under the BMI-3 binocular microscope (objective 90, ocular 7) with an opening in the diaphragm measuring 7×7 mm.

Department of Biology and General Genetics and Laboratory of Growth and Development, Institute of Medical Genetics, Academy of Medical 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. 70, No. 12, pp. 73-75, December, 1970. Original article submitted May 28, 1970.

TABLE 1. Mitotic Activity of Epithelial Cells of Terminal Divisions and Ducts of Submandibular Salivary Gland after Resection and Burning at a Distance from Wound Surface

Group of animals	Type of interference					
	resection			burning		
	number of animals	MI in cells (in ‰)		number of animals	MI in cells (in ‰)	
		acini	ducts		acini	ducts
Control	10	0.27	0	10	0.16	0
Experimental						
after 24 h	10	0.48	0.21	10	0.11	0.08
" 48 h	10	2.20	0.21	10	0.80	0.41
" 72 h	10	0.88	0.32	10	1.86	0.28
" 120 h	10	0.25	0.016	10	0.50	0.02

Note. MI denotes mitotic index.

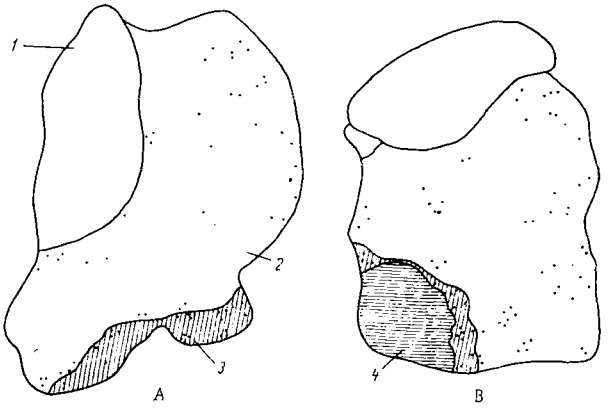

Fig. 1. Distribution of mitoses in submandibular salivary gland of rat 48 h after resection of one third of the gland (A) and 72 h after burning (B): 1) sublingual gland; 2) submandibular gland; 3) wound surface; 4) zone of necrosis.

In addition, for six rats of each group in both series the mean total number of mitoses per section of the gland was determined. By means of an Edinger's drawing apparatus the mitoses were transferred to a projection on the gland on paper, so that their distribution relative to the wound surface could be assessed.

EXPERIMENTAL RESULTS

Resection of the Gland (Series I). Histological analysis of the submandibular salivary glands showed that resection was followed by considerable necrosis of gland tissue on the wound surface and by all the phenomena of an inflammatory reaction 24 and 48 h after the operation. The zone of inflammation was slightly reduced in size 72 h after resection. Epithelial bands growing in a distal direction could be seen on the wound surface at this time.

Determination of MI of the epithelial cells at a distance from the site of injury shows that the number of mitoses in the acinar and duct epithelium began to increase 24 h after the operation and reached a maximum in the acinar cells on the second day and in the duct epithelium on the third day after resection.

The number of mitoses in the acinar cells at a distance from the wound surface 48 h after resection was 7 times greater than in the control (Table 1).

Proliferation of the terminal divisions and ducts was also observed on the wound surface during this period. Mitoses were slightly more numerous on the wound surface in many animals than at a distance from it (MI = 2.6 ‰ after 72 h). However, comparison shows that the total number of dividing cells at a distance from the wound surface was much greater than their number in the immediate vicinity of the zone of injury. It is clear from Fig. 1 that the absolute number of mitoses at a distance from the wound surface was much higher than close to it. By 120 h after the operation, the intensity of proliferation was lower not only in the zone of inflammation, but throughout the whole gland.

Burn of the Gland (Series II). The method of graphic reconstruction showed that following burning and subsequent necrosis about one third of the gland (28% of its volume) died.

The intensity of inflammation after burning was much greater than after operative removal of the gland tissue, and the zone of necrosis was more extensive. Otherwise the changes accompanying both types of lesion were identical in character. The number of dividing cells increased progressively 24 h after burning to reach a maximum in the acinar cells 72 h, and in the duct cells 48 h, after burning.

Determination of the total number of mitoses per section in these experiments also showed that restoration of the cell population of the organ took place mainly from the intact gland tissue located some distance from the wound surface. The number of mitoses at a distance from the site of injury was several times greater than close to it (Fig. 1).

It can thus be concluded from these results that the whole parenchyma of the salivary glands, and not merely the tissue adjacent to the wound surface, take part in the response reaction to trauma. Because of the greater area of the intact gland tissue compared with the area of the wound surface, the cell population of the organ is restored mainly through regeneration hypertrophy. However, a final conclusion regarding the method of regeneration can be drawn only after comparison and quantitative assessment of the end result of these processes, i.e., comparison of the degree of increase in the total mass of the organ and of the tissues formed at the wound surface.

LITERATURE CITED

1. A. G. Babaeva, Byull. Éksperim. Biol. i Med., No. 10, 113 (1960).
2. A. G. Babaeva, in: Regeneration and Cell Proliferation in Animals [in Russian], Moscow (1964), p. 78.
3. E. Sh. Gerlovin, in: Histogenesis and Reactivity of Tissues [in Russian], Leningrad (1958), p. 132.
4. P. P. Gusak, Arkh. Anat., No. 12, 38 (1965)
5. P. P. Gusak, Arkh. Anat., No. 8, 85 (1965).
6. P. P. Gusak, Results of a Study of Reparative Regeneration of the Large Salivary Glands, Author's Abstract of Candidate's Dissertation, Kishinev (1966).
7. A. A. Ovsepyan, in: Proceedings of an Interinstitute Conference on Regeneration and Transplantation of Mammalian Organs and Tissues [in Russian], Erevan (1968), p. 60.
8. V. Podvysotskii, Russk. Med., No. 4, 73 (1887).
9. V. Podvysotskii, Russk. Med., No. 5, 91 (1887).