REACTION OF THE ACINAR EPITHELIUM OF THE SUBMANDIBULAR SALIVARY GLAND OF RATS TO INJURY

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Changes in the area of the acinar cells and nuclei in the regenerating submandibular gland of rats were studied 120 h and 1.5 months after resection or burning. The area of the acinar epithelial cells of the experimental animals 120 h after these procedures was found to be increased by 26 and 30% above the control level. The excess over the control 1.5 months after resection or burning was 37 and 54% respectively.

Previous investigations showed that the whole parenchyma of the submandibular salivary gland participates in the response to resection or burning. Recovery takes place mainly by regeneration hypertrophy. Increased proliferative activity is observed uniformly throughout the organ, and not only on the wound surface [3].

Regeneration hypertrophy of many organs takes place not only through proliferation, but also through hypertrophy of the cells [4-6].

So far as changes in the size of the cells of the regenerating salivary gland are concerned, cellular hypertrophy has been reported in the early stages after injury in isolated studies [1, 2]. The role of cellular hypertrophy in the later stages of regeneration of the salivary glands remains unknown.

The object of the investigation described below was to study changes in the dimensions of the cells and nuclei of the acinar epithelium in the submandibular salivary gland of rats during its regeneration in the late stages after resection or burning.

TABLE 1. Changes in Area of Acinar Cells of the Submandibular Salivary Gland 120 h and 1.5 Months after Resection or Burning of the Gland in Male Albino Rats

Type of operation	120 h				1½ months			
	No. of animals in exper.	area (in μ^2)	increase in area (in percent relative to control)	P	No. of animals in exper.	area (in μ^2)	increase in area (in percent relative to control)	P
Control . . .	7	83,5	—	—	7	85,2	—	—
Resection of gland	7	105	26	0,01	7	117	37	0,001
Burning of gland	7	108,7	30	0,001	7	131	54	0,001

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TABLE 2. Changes in Area of Acinar Cell Nuclei in the Submandibular Salivary Gland 120 h and 1.5 Months after Resection or Burning of the Gland in Male Albino Rats

Type of operation	120 h				1½ months			
	No. of animals in exper.	area (in μ^2)	increase in area (in percent relative to control)	P	No. of animals in exper.	area (in μ^2)	increase in area (in percent relative to control)	P
Control	7	22,2	—	—	7	21,7	—	—
Resection of gland	7	26,5	20	0,001	7	27	26	0,001
Burning of gland	7	26,8	21	0,002	7	25,7	21	0,002

TABLE 3. Changes in Number of Binuclear Cells in the Acinar Epithelium of the Submandibular Salivary Gland in Male Albino Rats 1.5 Months after Resection or Burning

Type of operation	No. of animals in exper.	No. of binuclear cells per thousand acinar cells		P	Decrease in number of binuclear cells (in percent of control)
		abs	%		
Control	7	89,7	9	—	—
Resection of the gland	7	53,0	5,3	0,0001	41
Burning of the gland	7	30,0	3	0,0001	67

EXPERIMENTAL METHOD

The submandibular salivary gland of male albino rats weighing 150-240 g was investigated. One-third of the gland tissue was removed from 20 rats, and in another 18 animals a burn was inflicted on the lower pole of the gland by means of a hot needle 1 mm in diameter, as a result of which one-third of the gland tissue also died. The control consists of 26 intact animals. The reaction of the gland was studied 120 h and 1.5 months after injury. The experimental and control animals were sacrificed at the same times. The glands were removed, weighed on torsion scales, and fixed in Carnoy's mixture. Sections 4μ in thickness were stained with hematoxylin-eosin.

The area of the acinar epithelial cells was determined by means of an Abbe apparatus (objective 40, ocular 20, height of the extended tube 190 mm). The cell outlines projected on standard paper were drawn and the drawings were cut out and weighed on torsion scales. Knowing the weight of 100 μ^2 of the same paper (the weight of a square drawn under the same magnfication by means of an objective micrometer), the gravimetric indices for the area of the cells could be converted into square microns. Altogether 100 acinar cells in the intact part of the gland were measured for each experimental and control animal. The area of the nuclei was calculated in the same way (objective 90, ocular 20, height of the extended tube 190 mm). The number of binuclear cells in the acinar epithelium was determined by counting 2100 cells for each experimental and control animal under the MBI-3 binocular microscope (objective 90, ocular 7) with an aperture 7 × 7 mm in the diaphragm. The Fisher–Student method was used for statistical analysis of the numerical results.

EXPERIMENTAL RESULTS

The results are shown in Tables 1 and 2. Regeneration of the salivary gland after both resection and burning was accompanied by an increase in area of the cells and nuclei of the acinar epithelium. For instance, 5 days after injury the area of the cells was increased by 26-30% and that of the nuclei by 10-21% compared with the control. The results are in agreement with observations made by workers who described an increase of 30-35% in the area of the acinar cells and an increase of 30% in the area of their nuclei in the submandibular salivary gland of mice on the 3rd day of regeneration [1, 2]. In the early stages of recovery no significant difference could be found in the dimensions of the cells and nuclei of the glands after burning compared with the corresponding values after resection. Earlier observations [3] showed that after 120 h there is a marked decrease in mitotic activity of the acinar epithelium (mitotic index 0.25-0.5‰ compared with 2.2-1.86‰ at the time of its maximum), and for this reason the observed increase in area of the cells and nuclei cannot be explained entirely by their preparations for division.

With an increase in the period of recovery there was a progressive increase in size of the acinar cells, especially after burning. The differences between the dimensions of the cells of the terminal portions of the gland after burning compared with the dimensions of the acinar cells after resection were close to significant ($P = 0.069$). The increase in size of the nuclei in the acinary cells of the submandibular gland after burning and after resection was approximately the same and it remained at a steady level (20-21%) throughout the period of observation.

This great increase in area of the cells is in some disagreement with the relatively small increase in weight of the submandibular salivary gland after these operations [3]. To study the possible reasons for this discrepancy the number of binuclear cells was counted. As Table 3 shows, the process of regeneration of the submandibular salivary gland is accompanied by a decrease ($P = 0.001$) in the number of binuclear cells. Meanwhile there is other evidence to show that the area of a binuclear cell is slightly less than the combined areas of two mononuclear cells [4]. The somewhat greater degree of cellular hypertrophy was evidently due to a decrease in the number of binuclear cells.

It was concluded from these results that restoration of the submandibular salivary gland is due to regeneration hypertrophy, which is characterized in the salivary glands not only by hyperplasia of the acinar epithelium but also, and more especially, by persistent hypertrophy of its cells and nuclei.

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