

## REGENERATION OF THE PAROTID GLAND OF A GUINEA PIG

A. G. Babaeva

From the Laboratory of Growth and Development (Head — Prof. M. A. Vorontsova) of the  
Institute of Experimental Biology (Director — Prof. I. N. Maisky) of the  
Academy of Medical Sciences of the USSR, Moscow

(Received September 14, 1956. Presented by Active Member of the  
Academy of Sciences of the USSR N. N. Zhukov-Verezhnikov)

The regeneration of salivary glands has served as the subject of investigation a number of times.

Podwysozki [9] (1887), Ribbert [10] (1895), Carraro [7] (1909), Milstein [8] (1950), Gerlovin [3] (1955) in experiments on the submaxillary salivary gland of rabbits, rats and cats proved its ability to regenerate. It is considered to be established that the regeneration of the salivary gland takes place due to the proliferation of its ducts, and that the newly formed tissue is not functionally of full value.

The ability of the parotid gland to regenerate has hardly been studied. In a single investigation, belonging to Koropov [4] (1949), the conclusion is made that the parotid gland of dogs is unable to regenerate.

The parotid gland of the guinea pig was selected by us as the subject of investigation.

The regenerative ability of the parotid gland was studied when the paired organ was removed, which, according to literature data, facilitates regeneration—Ingle and Higgins [6] (1939), Artemyeva [1] (1951). The right salivary gland was always removed. The left parotid gland was resected at the level of the lower edge of the lower jaw. In order to study the histological structure of the regenerating gland, the animals were killed 1, 3 and 7 days after the operation and at various lengths of time after the operations up to one year. The glands were fixed by the usual histological fixatives and embedded in paraffin. In all, 17 animals were used.

As study of the histological preparations showed, deep destructive processes are observed after partial resection of the gland in the area directly adjacent to the place where the cut was made. Along with this, weaker degenerative changes in the secretory cells even in areas distant from the cut were found. The maximum changes were observed on the 3rd day after operation. By the 7th day, the indicated degenerative changes disappear.

From the first days after the operation, regenerative processes occur in the gland together with destructive ones. They are first evident in the appearance of a greater number of mitoses in the secretory cells of the terminal areas and in the cells of the principal excretory duct. As a result of the intensive proliferative processes which occur, an enlargement of the remaining portion of the gland is observed. Even by the end of the first month after the operation the regenerating gland approaches the glands of the control animals in its absolute and relative weight. The same phenomenon is characteristic of later dates of fixation also. The relative weight of the salivary glands of the experimental animals was 0.107%, i. e., it reached the average value of the relative weight of the salivary glands of the control animals of the same weight (0.099%) or of the same age (0.107%).

In addition to the increase in size, an enlargement of the linear dimensions of the gland was also observed. Before the operation, the distal end of the gland was 1 cm below the edge of the jaw on the average. By the end of the first month after the operation, the distal edge of the gland was on the average 0.5 cm below the edge of the jaw, i. e., below the amputation level.

In histological investigation and graphic reconstruction of the gland it was found that the area of the gland which is located distal to the level of the amputation consisted of 2 parts: one part was of completely normal structure, the second, located around the principal excretory duct, had atypical structure. The latter is well described by many authors who turned their attention principally to this part of the gland when studying regeneration.

The atypical structure of the part of the gland which is adjacent to the duct is evident in the fact that its terminal sections consist of 8-16 cells, while in the normal gland they consist of 3-8 cells usually. Their size is greater: thus, 10-15 terminal sections fit into one field of vision (ocular 7, objective 40) of the normal gland, while in the atypical part of the gland, only 4-6 fit. The sizes of the cells in the terminal sections of this part of the gland are considerably less than in the terminal sections of the normal gland.

The presence of normal glandular tissue below the level of the amputation cannot be explained, as we believe, by the fact that the initially atypical structure of the regenerating gland assumed normal structure. This hypothesis is unlikely, since we did not observe transitional forms between the terminal sections with atypical and normal structure and, in addition, part of the gland which is adjacent to the principal excretory duct preserves its atypical structure for a long time. The assumption remains that the regeneration of the gland is only partial and takes place in only an insignificant degree due to the proliferation of the ducts, but chiefly to the regenerative hypertrophy—Vorontsova [2], (1953) i. e. due to multiplication of the secretory cells and to the formation of new acini. The fact that a comparatively large number of mitoses is present in the secretory cells, which does not lead to a noticeable increase in the number of cells in the terminal section nor to an increase in their dimensions, indicates this. Since the tissues surrounding the gland adjoin it closely, the increase in linear dimensions occurs chiefly downward, where the excised area of the gland was previously located.

The majority of authors consider that the regenerated portion of the gland is unable to function. This statement requires detailed verification. In the light of our data, this problem should be subdivided. As regards that section of the gland which preserves a normal structure, its function, apparently, does not arouse doubt. As regards the section which is of atypical structure, according to our observation, the ducts of this portion of the gland always contain some amount of secretion. The latter circumstance indicates that the regenerated cells secrete, although it is difficult to say on the basis of morphological data how complete their functional activity is. The secretion also has the ability to overflow into the oral cavity, since the ducts of the regenerated area are connected with the duct of the normal part of the regenerated gland, as data from the graphic reconstruction of the glandular ducts indicate.

The data we obtained show that the parotid gland of guinea pigs has a fairly high capacity to regenerate. This is evidenced in the fact that the original weight and dimensions of the gland are re-established within a comparatively short time (within a month). The regeneration occurs basically due to the formation of glandular tissue which has the same structure as the normal.

At the same time, the observed regeneration cannot be regarded as fully complete. Part of the regenerated gland which is adjacent to the excretory duct preserves an atypical structure. In addition, complete regeneration of the original shape of the gland is not observed.

The fact that the regenerated gland consists of two heterogeneous parts allows explanation to a certain extent of the statements of the majority of authors who consider that the regeneration of the gland occurs due to proliferation of the ducts and that the regenerating gland is not functionally fully complete. Apparently, these authors turned their attention primarily to that part of the gland which is characterized by atypical structure.

#### SUMMARY

After the removal of the right parotid gland in guinea pigs and partial resection of the left gland, the regeneration of the left gland was observed. Three weeks after operation the resected gland recovered its initial weight and size, chiefly through the proliferation of secretory cells in the terminal areas and the formation of glandular tissue of normal structure. The part of the gland adjacent to the main secretory duct, regenerated by means of proliferation of the glandular ducts, and for a long time retained atypical structure.

#### LITERATURE CITED

- [1] N. C. Artemyeva, *Byull. Eksptl. Biol. i Med.* 1952, Vol. 33, No. 5, pp. 68-71.

- [2] M. A. Vorontsova, Regeneration of Lost Organs of Animals and Man,\*Moscow, 1953.
- [3] E. Sh. Gerlovin, in the book: Abstracts of the Materials of the Second Scientific Conference on the Problem of the Morphology and Physiology of Growth,\*1955, pp. 30-42.
- [4] V. M. Koropov, Materials on the Pathological Physiology of the Salivary Glands,\*Moscow, 1949.
- [5] A. M. Ugolev, in the book: Experience in Studying the Regulation of Physiological Functions,\*Moscow-Leningrad, 1953, Vol. 2, pp. 239-246.
- [6] D. J. Ingle and G. M. Higgins, Endokrinologie 1939, Bd. 24, S. 379-382.
- [7] A. Carraro, Frankfurt, Z. Pathol., 1909, Bd. 3, S. 26.
- [8] B. B. Milstein, Brit. J. Exp. Path., 1950, 31, 5, pp. 664-669.
- [9] W. W. Podwysozki, Beitr. pathol. Anat., 1887, Bd. 2, S. 19.
- [10] H. Ribbert, Arch. Entwicklungs mech. Organ. 1898, Bd. 6, H. 4, S. 537-555.

---

\* In Russian.