PLASTICITY OF THE WALL OF THE ALIMENTARY TRACT

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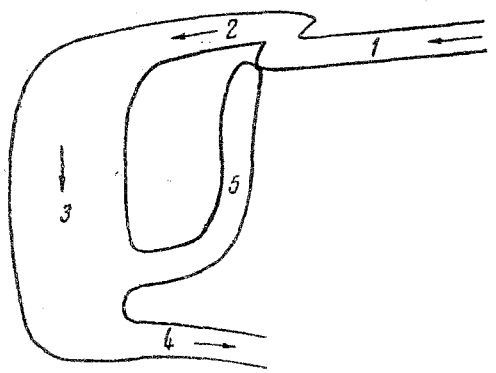
Experimentally produced changes in the function of an organ should lead to a reconstruction of its histological structure. The present paper is devoted to a study of this question.

Our object of study was the appendix of rabbits, as being an organ possessing distinctive functions, and having points of resemblance to the human appendix.

We produced a considerable change in the functional state of the appendix by performing a side-to-side anastomosis of the blind end of the appendix to the small intestine (see Figure). The small intestine was ligated caudal to the anastomosis, with thick silk, so that tis contents passed into the caecum through the appendix, thus placing it under functionally abnormal conditions [1].

The rabbits withstand the operation well, and survive for long periods of time after it. Thus Rabbit No. 97 was killed two years after the operation, Rabbit No. 84 and others 1 1/2 years after, and Rabbit No. 107 and others 1 year after. The operated rabbits do not differ superficially from normal ones, and they reproduce successfully. They put on fat in much the same way as normal rabbits, even when about 85% of the length of the small intestine is by-passed. Thus we see that the animals readily adapt themselves to the new conditions of functioning of the alimentary tract.

We studied the mucous, submucous or lymphoid, muscular, and serous coats of the appendix.



Diagrammatic representation of the appendicular-ileal anastomosis. 1) Small intestine 2) Appendix 3) Caecum 4) Large intestine 5) By-passed section of small intestine.

In the normal animal, the submucous coat is always 3 or 4 times as thick as the mucous one. Thus in Rabbit No. 137 the thickness of the submucous coat amounted to 75-80% of the total thickness of the appendicular wall, that of the mucous coat not exceeding 15-20%; the corresponding figures for Rabbit No. 140 were 70-75% and 20-25%. The thickness of the wall of the appendix was from 1.5 to 3 mm., in both normal and operated animals.

After 3-4 months, the appendix of the operated rabbits had a different appearance; the walls had become thinner and of tighter texture, and externally resembled those of the ileum.

A histological study showed that reconstruction of the appendix in the operated animals involved earlier differentiation of the nerve cells of the ganglia of the myenteric plexus, as well as a certain diminution

of the lymphoid tissue, with greater development of the glands. Three months after the operation the relative thicknesses of the mucous and submucous coats have undergone a marked change, being now approximately equal. Thus in Rabbit No. 68 the thicknesses of the mucous and submucous coats were each about 45% of the total thickness of the wall of the appendix. No significant change in the thickness of the muscular coat could, however, be perceived 3-4 months after the operation.

The next experiments were on the small intestine of dogs. In order to produce a considerable change in the functional state of the small intestine we made an isolated loop 5-15 cm long, with a side-to-side anastomosis of the intestine above and below the by-passed section, which took no part in digestion and absorption of food.

The isolated section of intestine, examined a year after the operation, was of smaller diameter than the functional part, and had a thinner wall. Its blood supply was greatly reduced, and it was paler than the functioning intestine.

Microscopic examination of the by-passed intestine showed that no change had taken place in the muscular coat but that the mucous and submucous coats had undergone modification; reduction of connective tissue in the mucous coat was most clearly shown by the villi, the diameter of which was about half of that prevailing in the functional parts of the intestine. The epithelial cells were only half the height of those of normal intestine. No change was seen in the serous investment of the loop.

In evaluating these results, it should be borne in mind that the experiment was done on an adult animal, all the tissues and organs of which had already largely completed their development, and that reduction of muscle activity is not a sufficiently powerful morphogenetic factor. It is known from studies of bone and muscle tissues that hypertrophy due to work develops much faster than does atrophy from disuse. This view is further illustrated by a comparison of the results of our experiments on inclusion of the appendix into the main stream of the alimentary tract with those on the exclusion of part of the intestine of dogs.

One observation made by us, on Dog No. 33, which we were unfortunately unable to repeat, is of interest. A blind length of intestine, initially only 1-2 cm in length, grew to a length of 18 cm, with a diameter of 6 cm, during 2 months. This represents an increase in its surface area of about a 100-fold, and this without any distension, as the thickness of the wall was unchanged.

It appears from the results of our experiments that changes in the conditions of functioning of an organ, in our case the appendix and the small intestine, causes changes in its structure, and hence that tissues of adult animals possess a considerable degree of plasticity; function plays a leading role in the process of anatomical and histological reconstruction of the organs. The study of the plasticity of the walls of the small intestine is of practical, as well as of theoretical interest, in view of the frequency of surgical operations on this organ.

LITERATURE CITED

[1] A. E. Sholpo, Communications presented at the XX Scientific Conference of Saratov Medical Institute (In Russian) (Saratov, 1953), pp. 189-190.