

REGENERATION OF GASTRIC MUSCLE TISSUE UNDER VARIOUS EXPERIMENTAL CONDITIONS

N. I. Verzhbitskaya

UDC 612.73:612.32.014.482]:612.6.03

Regeneration of the smooth muscle tissue of the stomach was studied in albino rats after trauma (removal of part of the serous and muscular coats of the stomach). Preliminary irradiation of the animals to produce radiation sickness was found to disturb and retard regeneration of the gastric musculature.

* * *

The results of numerous experiments [1, 2, 4-9] show peculiarities in the healing of wounds in irradiated animals. In an earlier paper [3] we reported that reactivity of the gastric musculature is modified by whole-body x-ray irradiation.

In the present investigation posttraumatic regeneration of gastric muscle tissue after combined trauma was studied.

EXPERIMENTAL METHOD

Experiments were performed on 130 sexually mature noninbred albino rats. The animals of group 1 were anesthetized with ether and part of the serous and muscular coats of the stomach (diameter of injury 5 mm) were excised down to the submucosa. The rats of group 2 were irradiated under the following conditions: voltage 136 kV, filter Al 4 mm, dose rate 28 R/min. Irradiation was given as a single dose under whole-body conditions (720 R). Additional mechanical trauma (just as in the case of the rats of group 1) was inflicted on the animals 24 h after irradiation. Intact animals served as controls. The rats were sacrificed 1, 3, 5, 7, 14, 21, 30, 40, 50, 60, 70, and 90 days from the beginning of the experiment. Pieces of stomach for investigation were fixed in Carnoy's and Bouin's fluids and 12% neutral formalin and embedded in paraffin wax. Serial sections were stained with hematoxylin-eosin, by the methods of Feulgen, Yasvoin, Van Gieson, Einarson, Brachet, and Hotchkiss, and impregnated with silver by Foot's method.



Fig. 1. General appearance of stomach wall at site of mechanical injury 85 days after trauma. Van Gieson. Objective 8, ocular 7.

EXPERIMENTAL RESULTS

In the animals of group 1, 3-5 days after mechanical trauma, the wound crater was filled with granulation tissue in which blood and connective-tissue cells with a high RNP content and individual muscle cells were seen. Mitoses were present in the connective-tissue and muscle cells both in the granulations and in the adjacent muscle tissue. After 7 days the granulation tissue was similar in character but its volume had increased. Mitoses were found in connective-tissue and muscle cells and the nuclei stained intensively by Einarson's and Feulgen's methods. The zone of regeneration 14-21 days after the operation consisted of connective-tissue, and the DNP and RNP content of its cells was lower than in the earlier periods, mitoses were extremely rare, and argyrophilic and collagen fibers were found

Department of Histology and Embryology, Kalinin Medical Institute (Presented by Active Member of the Academy of Medical Sciences of the USSR N. A. Kraevskii). Translated from *Byulleten' Éksperimental'noi Biologii i Meditsiny*, Vol. 65, No. 5, pp. 99-102, May, 1968. Original article submitted March 24, 1967.

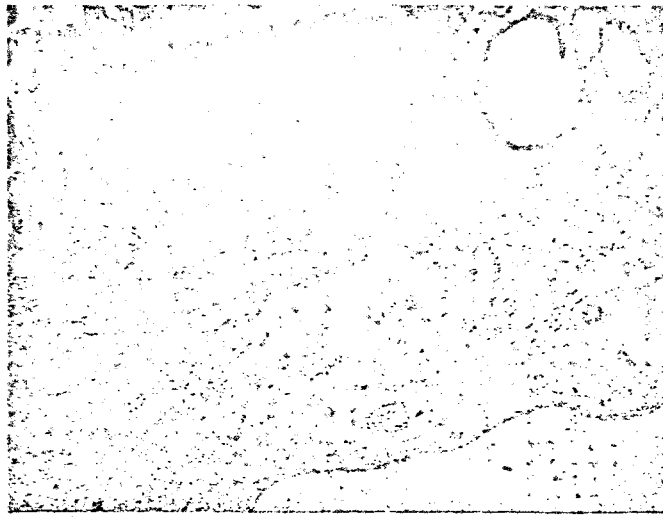


Fig. 2. Rat's stomach 21 days after combined trauma. Hotchkiss. Objective 40, ocular 7.

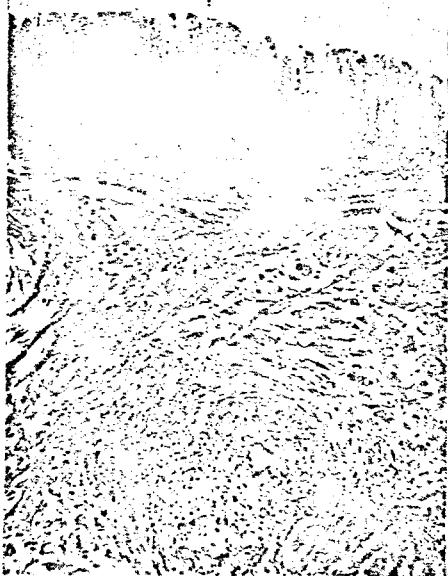


Fig. 3. General appearance of stomach wall at the site of injury 90 days after combined trauma. Van Gieson. Objective 8, ocular 7.

in the ground substance. In areas next to the wound destructive changes gradually disappeared. The zone of regeneration showed little change 30-50 days after injury, because accumulation of muscle cells in it took place slowly. The source of proliferation consisted of muscle cells capable of division and cambial connective-tissue cells. In the central part of the regenerating zone 75-90 days after operation connective-tissue structures were predominant but the number of muscle cells at the edge of the wound had increased. The mucous membrane above the wound and the adjacent muscle tissue had become normal in structure (Fig. 1). The animals of group 2 developed radiation sickness.

After combined injury the local tissue reaction was ill defined, but 2-3 days later extensive foci of necrosis appeared in the region of the wound. The leukocyte response was suppressed, and 5-7 days after injury the granulation tissue contained connective-tissue cells together with individual muscle cells and a few immature blood cells. Mitoses were found in the muscle and connective-tissue cells, but many mitoses were aberrant. Fourteen days later, the granulation tissue was coarser in structure, its cells contained less DNP and RNP, and foci of necrosis and hemorrhages appeared in the granulations and muscle tissue adjacent to the wound. After 31 days, the coarsening of the connective-tissue in the zone

of regeneration sometimes led to ulceration of the stomach wall and to the formation of cystic overgrowths of the epithelium at the edge of the wound (Fig. 2).

After 50-60 days the number of cells and blood vessels in the zone of regeneration was reduced, and later still (70-75 days after operation) the collagen fibers in the scar frequently showed fragmentation and loosening of their arrangement. The experimental results show that 80-90 days after operation a scar formed at the site of injury, the ground substance of which consisted of collagen fibers running in different directions (Fig. 3). At the former wound edge, cysts appeared in the zone of regeneration, lined by cubical undifferentiated epithelium. The thickness of the stomach wall was greater than normal, because of the formation of numerous granulomas.

LITERATURE CITED

1. V. V. Brunst, *Uspekhi Sovr. Biol.*, 6, No. 3, 463 (1937).
2. I. B. Bychkovskaya, *Byull. Éksperimen. Biol. i Med.*, No. 10, 53 (1952).
3. N. I. Verzhbitskaya, *Trudy Kalininsk. Med. Inst.*, 11, 149 (1965).
4. V. I. Evsyukov, *Byull. Éksperim. Biol. i Med.*, No. 2, 106 (1965).
5. N. V. Kozlova, *Byull. Éksperim. Biol.*, No. 8, 94 (1959).
6. N. A. Kraevskii, L. A. Afrikanova, and A. S. Petrova, in: *Proceedings of the 4th Conference on Regeneration and Cell Multiplication* [in Russian], Moscow (1964), p. 70.
7. E. M. Pil'shchik, *Byull. Éksprim. Biol. i Med.*, No. 7, 90 (1959).
8. G. S. Strelin, in: *Essays on the Problem of Regeneration* [in Russian], Moscow (1966), p. 151.
9. B. P. Tokin, *Regeneration and Somatic Embryogenesis* [in Russian], Leningrad (1959).