

ACID PHOSPHATASE ACTIVITY DURING REGENERATION OF THE SKIN IN RATS AND ITS RESPONSE TO ADRENALECTOMY AND ADRENAL HYPERFUNCTION

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Comparatively few histochemical investigations have been made of the acid phosphatases during regeneration of organs and, in particular, in the presence of hormonal changes, and the results obtained are often contradictory.

In studies of wound healing in rabbits and tritons [2, 3], high acid phosphatase activity was observed in the course of regeneration marked by predominance of proliferative processes.

Other investigators [1, 5, 6], on the other hand, found high acid phosphatase activity when destructive processes were predominant.

It has been reported that the acid phosphatase reaction in the regenerating liver is more marked after administration of cortisone than in controls [4].

In the present investigation the activity and localization of acid phosphatase were studied during the healing of skin wounds in albino rats after adrenalectomy or in the presence of adrenal hyperfunction.

EXPERIMENTAL METHOD

Three series of experiments were conducted on 72 male albino rats weighing 160-200 g kept on a diet of protein and carbohydrate.

In series I adrenalectomy was performed bilaterally, and 12 days later a wound measuring 0.5×1.5 cm was inflicted. Similar wounds were inflicted on the animals of series II, and cortisone was injected daily in a dose of 2.5 mg, intramuscularly until the end of the experimental period. In series III wounds were inflicted on the animals and desoxycorticosterone acetate (DOCA) was then injected daily in a dose of 2.5 mg. Control rats had wounds inflicted only. The animals were sacrificed in groups of six after 5, 10, and 15 days. The material was taken from the animals immediately after decapitation and fixed at once in acetone, cooled to 4° , for 2 days. Sections were cut on a freezing microtome. Acid phosphatase was detected by Gomori's method.

EXPERIMENTAL RESULTS

In the intact rats active acid phosphatase was found in the cell nuclei of the stratum basale of the epidermis, the hair follicles, the hair papillae, and the sweat and sebaceous glands.

In the control animals on the 5th day enzyme activity was detected in the border zone of the wound in the cell nuclei of the accessory structures of the skin, the nuclei of the stratum basale of the epidermis, the nuclei of the fibroblasts, in the fibrous structures, and in the ground substance. The cell nuclei of the subcutaneous cellular tissue in the floor of the wound, which stained dark brown, and also the nuclei of the subcutaneous muscle, which stained diffusely and light brown in color, stood out especially clearly. In the wound contents the nuclei of the fibroblasts and macrophages, in whose cytoplasm acid phosphates was found also, were stained less intensely.

On the 10th day (see Fig. 1, I), the reaction of the tissue elements in the floor of the wound and of the subcutaneous wound was approximately the same, but the cells of the regenerating zone were less intensely stained than on the 5th day of observation and a weak reaction was found in the cytoplasm and the fibrous

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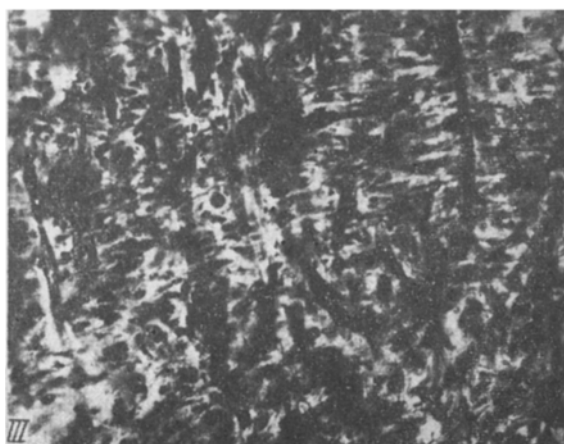
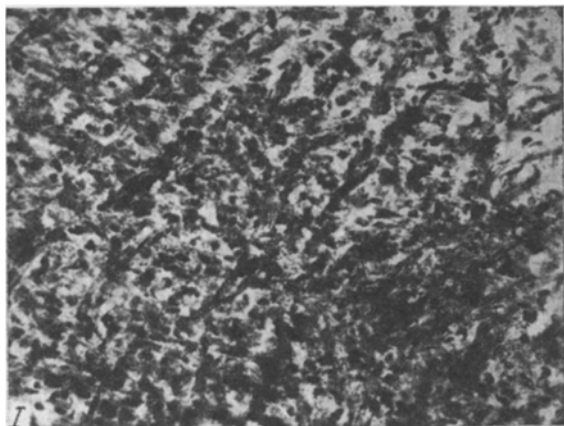


Fig. 1. Area of regenerating skin of a control (I) and adrenalectomized (II) rat and of a rat receiving cortisone (III) 10 days after wounding. Acid phosphates. Objective 20, ocular 10.

In the experiments of series III, against the background of administration of DOCA, in the early periods a moderate reaction for acid phosphatase was shown by the cells of the regenerating tissue and the subcutaneous muscle. On the 15th day the vacular reaction was intensified and the phosphatase activity of the nuclei of the connective tissue cells, which were more numerous than at the preceding times, was increased.

structures. Phosphatase activity in the epidermis was detected in the nuclei of the stratum basale spreading over the wound.

As the epithelium spread over the wound the intensity of staining of the nuclei diminished.

On the 15th day the reaction for acid phosphatase was weaker both at the edges of the wound and in the regenerating tissue. In the latter the cell nuclei were almost indistinguishable from the cytoplasm. In the epidermis covering the wound defect the acid phosphatase activity was lower than in the areas adjoining the wound.

In the experiments of series I on the adrenalectomized animals fewer cells with phosphatase activity were found 5 days after wounding and the nuclei of the endothelium and of the fibroblasts in the regenerating tissue reacted less intensively than in the control. On the 10th day the acid phosphatase activity both in the regenerating tissue and in the epidermis covering it had fallen lower still (see Fig. 1, II). The macrophages with phosphatase activity were far fewer in number than in the control animals. The subcutaneous muscle gave a weak reaction for phosphatase.

On the 15th day the cells in the regenerating tissue had acquired a diffuse, grayish-brown color and the nucleolus was just distinguishable. In the region of the edge and floor of the wound, the intensity of the reaction was appreciably weaker in the accessory structures of the skin and the fibroblasts.

In the experiments of series II in which cortisone was administered, on the 5th day after wounding a much more intensive staining reaction, amounting to a black color, than in the controls was observed in the nuclei of the endothelium, the fibroblasts, the accessory structures of the skin, and the stratum basale of the epidermis at the edge of the wound and in the regenerating tissue, and also in the nuclei of the subcutaneous muscle. The farther from the wound, the weaker the reaction became. The exception was the central zone of the wound, where no cells with acid phosphatase activity were seen.

On the 10th and 15th days the intensity of staining of the cells listed above remained as before; in addition, fairly high acid phosphatase activity was exhibited in the regenerating tissue by the fibrous structures and the ground substance (see Fig. 1, III).

Hence, in the intact skin, moderate acid phosphatase activity is found in the nuclei of the epidermal and connective-tissue cells. During posttraumatic regeneration phosphatase activity begins to be found in the fibrous structures adjoining the wound and differentiating into the regenerating tissue.

Adrenalectomy lowers the acid phosphatase activity by comparison with the control in the regenerating tissue cells and in areas of the skin adjoining the wound.

Administration of cortisone increases the phosphatase activity of the cells of the regenerating tissue and of the areas of skin adjoining the wound by comparison with analogous material from the control and adrenalectomized animals. After administration of DOCA slightly higher phosphatase activity is found in the macrophage system of the skin.

By comparison with the control, the phosphatase activity of the tissue components is not lowered during regeneration on the 15th day of observation when these hormones are given.

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