

EFFECT OF COAMIDE ON STRUCTURE OF NERVE CELLS IN THE SKIN AND MUSCLES OF IRRADIATED ANIMALS

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Administration of coamide to rats after whole-body x-ray irradiation in a dose of 800 R greatly reduces the severity of reactive and destructive changes in nerve cells of the skin and striped muscles and speeds up their regeneration.

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Investigations [1, 2, 6] have shown that reactive and degenerative changes develop in nerve cells of the skin under the influence of ionizing radiation, amounting in some cases to disintegration of individual fibers into granules of various sizes. Some workers [3, 4] have observed destructive changes in the nervous system and skeletal muscles.

Observations made in this institute have shown that under the influence of coamide (a compound of cobalt chloride and nicotinamide) the red and white cell and platelet counts are increased in irradiated mice, synthesis of nucleic acids, proteins, and lipids is restored to normal, and relatively more of the animals survived [5]. The healing of traumatic wound of the skin and skeletal muscles and of fractures of the long bones is also considerably accelerated [7].

EXPERIMENTAL METHOD

To study the effect of coamide on the nerve cells of the skin and striped muscle tissue in acute radiation sickness, experiments were carried out on 35 male albino rats weighing 200-250 g. The animals received whole-body irradiation in a single dose of 800 R on the RUM-11 apparatus under the following conditions: voltage 180 kV, current 10 mA, filter 0.5 mm copper, focus distance 30 cm, rate 18.5 R/min. The rats developed severe radiation sickness 4-5 days after irradiation, with a sharp decrease in the red and white cell and platelet counts in the circulating blood. The animals of this group acted as controls and their mortality was 43%.

The experimental group consisted of 18 animals starting treatment on the 5th day after irradiation. Coamide was given daily by intramuscular injection of 2-3 mg/kg body weight as a 1% solution for 20-25 days. The animals were decapitated on the 5th, 10th, 15th, 20th, 25th, and 30th days after trauma. A piece of skin and muscle tissue from the spinal region and from the medial surface of the thigh was taken for investigation. The pieces of tissue were fixed in 15% neutral formalin, and sections were impregnated with silver by the Bielschowsky-Gros method and subsequently gilded and stained with hematoxylin-eosin.

EXPERIMENTAL RESULTS

On the 5th day of irradiation pathological changes were found in the nerve cells of the skin in both the deep and superficial plexuses. Similar destructive changes in the nervous system were found in the skeletal muscle of the irradiated rats. Impregnation of nerve bundles, individual fibers, axons, and endings was irregular. Most fibers showed unusual and increased tortuosity.

The terminal portions of fibers of the motor end-plates were twisted like corkscrews. Many nerve fibers, including those approaching hair bulbs, were swollen, thickened irregularly in places, and contained varices and vacuoles. Some fibers had irregularly notched edges and were covered with tiny spinous processes.

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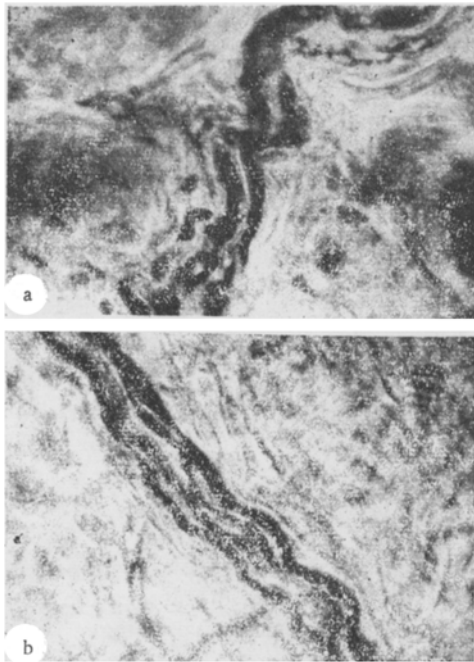


Fig. 1

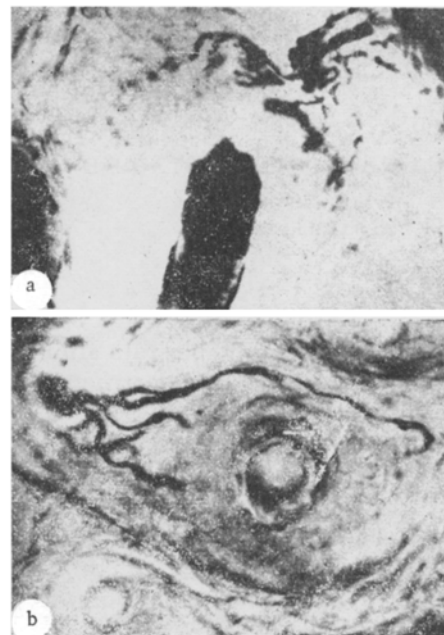


Fig. 2

Fig. 1. Cutaneous nerve bundle of a rat on 15th day of irradiation in a dose of 800 R. a) Control; fragmentation and disintegration of axons of individual fibers; b) experiment with coamide; argyrophilia, varicose thickenings, and places of narrowing of fibers. Here and in Figs. 2 and 3, silver impregnation by Bielschowsky-Gros method, 200 \times .

Fig. 2. Nerve elements of hair in rat's skin on 15th day of irradiation in dose of 800 R. a) Control; fragmentation and disintegration of individual fibrils; b) experiment with coamide; argyrophilia, narrowing and varicose thickening in some places.

On the 10th-15th day of irradiation all these degenerative and destructive changes in the control animals were more marked and more widespread in character. Nearly all types of nerve fibers and endings showed strong argyrophilia. Signs of fragmentation and disintegration of individual fibers and axons into networks of black granules of various sizes were observed (Fig. 1a). These changes affected the nerves of the hair and blood vessels and endings in the epidermis (Fig. 2a). The terminal branches of the motor end-plates were fragmented and most were broken up into separate granules of various sizes (Fig. 3a).

In the animals receiving coamide, changes in the nerve elements of the skin and muscle tissue differed considerably from those in the control rats. Although the argyrophilia was clearer, at the same time the tortuosity of the nerve fibers and endings was reduced. Swelling, varicose thickening and, in some places, sudden narrowing of most of the fibers persisted (Fig. 1b). In the nerves to the hair and sebaceous glands, the tortuosity of the fibers was relatively less marked, and the contrast of their hyperimpregnation was greater (Fig. 2b). The motor end-plates were well preserved, and fibrillary structures with some increase in their length could be detected (Fig. 3b).

On the 20th-30th day of irradiation fewer nerve elements of the skin and muscle tissue could be detected in the control rats. Destruction was intensified, and nerve bundles and axons of both motor and sensory fibers were frequently seen disintegrated into granules.

In the treated animals the well marked argyrophilia of the nerve fibers and endings had not disappeared by the end of the observations. However, the number of nerve elements visible did not diminish.

After the 20th-25th day of the experiment, signs of regeneration of individual nerve fibers could be seen, with the appearance of bulbs of growth, loops, a pale plexus around the hair follicles, and very fine branches of the motor end-plates. In the control animals these signs were ill defined and present only in isolated cases, but in the treated group they developed on a larger scale.

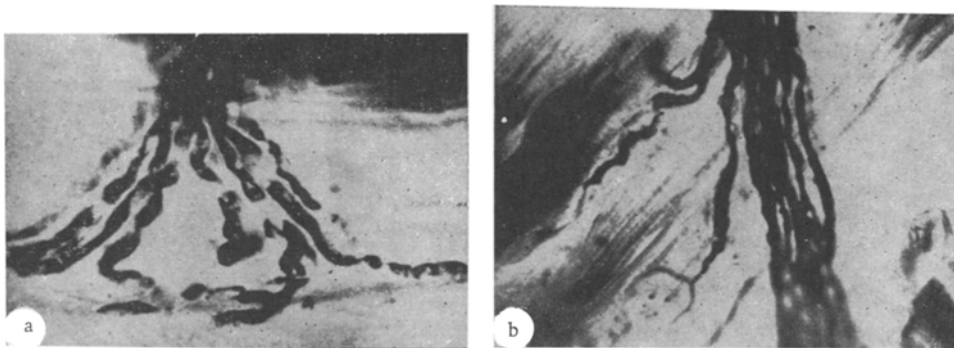


Fig. 3. Ends of nerve fibers to motor end-plates in striped muscle of rats on 15th day of irradiation in dose of 800 R. a) Control; nerve elements in stage of fragmentation into granules, motor end-plates have disappeared; b) experiment with coamide; argyrophilia of irregularly thickened fibers and preserved motor end-plates.

The results of these observations show that whole-body x-ray irradiation of albino rats in a single dose of 800 R causes considerable reactive and destructive changes in the nerve elements of the skin and striped muscle, amounting in some cases to breakdown of individual fibers into granules.

Administration of coamide after irradiation reduces the severity of the radiation damage to the nerve fibers and appreciably accelerates their regeneration.

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