EFFECT OF TETANUS AND BOTULINUS TOXINS ON THE CHRONAXY
OF IMMUNE AND NON-IMMUNE RABBITS

M. M. Gromakovskaya

From the Immunity Laboratory (Head - Professor K. T. Khalyapina) of the Department of Experimental Pathology of Infections and Immunity (Head - Active Member of the Academy of Medical Sciences of the USSR, P. F. Zdrodovsky) of the N. F. Gamaleya Institute of Epidemiology and Microbiology (Director - Active Member of the Academy of Medical Sciences of the USSR, Professor V. D. Timakov) of the Academy of Medical Sciences of the USSR, Moscow.

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The investigation of the differences in the clinical and immunological reactions of the immune and non-immune system to the administration of antigen has been described in the literature sufficiently. However, the physiological mechanisms which determine these differences, including the parameters of the excitability of the tissues and systems, have been studied little [1, 2, 3, 4]. In this connection, a comparative investigation of the chronaxy of the various tissues of the immune and non-immune animal during antigen administration represents considerable interest.

EXPERIMENTAL METHODS

The experiments were carried out on rabbits which were immune to tetanus and botulism and on non-immune ones, on which were made determinations of the subordinate chronaxy of the tibial muscle and of the sciatic nerve on the side on which the toxin was administered during several days before and after the administration of toxin; in addition, the chronaxy of the spinal cord and of the motor zone of the cerebral cortex were determined. The work was carried out on 34 rabbits - 13 immune ones and 21 non-immune. The chronaxy of the spinal cord was determined either through the skin after preliminary (several days in advance) excision of the spinous process and arch of one of the lumbar vertebrae, or with the help of needle electrodes which touched each other through the intervertebral space. Silver needle electrodes were used to determine the subordinate chronaxy of the muscles. The chronaxy of the motor zone of the cerebral cortex was determined either through the skin after the preliminary excision of the corresponding area of the skull bone, or with the help of platinum electrodes (0.3 mm in diameter), which were enclosed in a plastic sleeve passed through the trephined opening.

A condenser chronaximeter was used in the experiments. The chronaxy determination was carried out unipolarly. The inert electrode was inserted in the animal's rectum.

The experiment was carried out in the following manner. For several days prior to the administration of toxin, the chronaxy of the rabbits was determined, after which 0.25 - 0.3 ml of toxin was administered into the tibial muscle and the chronaxy was determined again during the hour. Later the chronaxy was determined daily. The rheobase was measured in volts, the chronaxy in microfarads with subsequent conversion into sigmas.

Experiments on rabbits not immune and immune to tetanus (series 1). The following doses of toxin were administered to the non-immune animals per 1 kg of weight.
The administration of 10 mouse MLD of tetanus toxin into the anterior tibial muscle caused the development of a weakly evidenced localized tetanus. The administration of 75 and 100 MLD per 1 kg of weight also led to the appearance of localized tetanus which changed into the generalized form only in some rabbits. The administration of 150 MLD per 1 kg of weight caused general tetanus with a subsequent fatal outcome.

The extent of the changes in the chronaxy level and the nature of the development of the clinical picture of the disease in the animal depended on the dosage of the administered toxin. Thus, with the administration of 10 mouse MLD of tetanus toxin per 1 kg of weight, large fluctuations of the chronaxy were not observed at any of the determined points. With the administration of 75 or 100 MLD per 1 kg of weight, however, considerable changes in chronaxy were noted. In the majority of experiments (9 out of 12), the rheobase and chronaxy changed in the same direction, i.e., when the rheobase increased, the chronaxy increased and vice versa.

In the first minutes after the administration of toxin, a slight shortening of the chronaxy developed, chiefly of the subordinate chronaxy of the muscle and nerve. In 24 hours, when there were still no signs of tetanus, a lengthening of the chronaxy was observed, which continued to increase in the subsequent days, reaching a considerable size in comparison with the normal. When the illness remained at the stage of localized tetanus, the chronaxy indicators returned to the original level 9-10 days after the administration of the toxin. In the case of generalized tetanus, the chronaxy suffered considerable changes, typified by an initial shortening with a subsequent sharp lengthening of it.

With the appearance of generalized tetanus, changes also appeared in the motor zone of the cerebral cortex which, as a rule, were absent from the phenomena of local tetanus. This fact indicates that, with the local form of tetanus, the change in the level of the process of excitability spreads chiefly to the motor neurons of the corresponding segments of the spinal column, while in generalized tetanus, the motor zone of the cerebral cortex is also attacked.

The immunization of the rabbits against tetanus was carried out by the administration of 1 ml of precipitated tetanus anatoxin subcutaneously, and 3-4 months later revaccination was carried out by the subcutaneous administration of the same amount of anatoxin. In the experiment shown in Fig. 1, the tetanus toxin was administered 8 months after revaccination. The AE titre of this rabbit 2\(\frac{1}{2}\) months before the experiment was equal to 1 AE.

For comparison, in some experiments immune as well as non-immune rabbits which were administered the same amount of toxin (75, 100, 150 mouse MLD each) were investigated simultaneously.

The administration of equal doses of toxin into a muscle had a different effect on immune and non-immune rabbits. While no signs of illness appeared in the immune animals, the non-immune rabbits fell ill either with localized or generalized tetanus; in the latter case death ensued in 5-6 days.

The difference was evident not only in the animal's condition but also in the changes in the indicators of chronaxy. The administration of a fatal dose of toxin into the muscle of an immune rabbit caused a slight change in the subordinate chronaxy of the muscle and nerve on the side of toxin administration. These changes disappeared on the 3-4th day; the chronaxy changes of the control non-immune animal were more sharply evident. It should be noted that the lengthening of the chronaxy of the muscle of a non-immune animal was not connected with its rigidity and consequently, with the loss of its contractility since: 1) the lengthening of the chronaxy occurred before the clinical signs of tetanus were found; 2) the tetany of the muscles of the affected extremity of the rabbits which survived the administration of tetanus toxin remained for a prolonged period, while the chronaxy of the muscles gradually returned to the original level (Fig. 1).

Experiments on rabbits, not immune and immune to botulism. In this group of experiments, rabbits were used which had been immunized one time by the subcutaneous administration of 1 ml of precipitated botulinus anatoxin type "A" and revaccinated by the subcutaneous administration of the same amount of anatoxin 8-9 months later. 5 immune and 4 non-immune rabbits were taken for the experiment. The level of the normal fluctuations of the chronaxy was determined in all the rabbits during 3-4 days prior to toxin administration.