DEPRESSION OF SCIATIC NERVE EXCITATION IN ANIMALS SENSITIZED BY SPECIFIC ANTIGEN

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Application of foreign serum to the sciatic nerve of control rats and guinea pigs depressed its excitability: the threshold and maximum strengths of stimulation were reduced. The same was observed when nonspecific serum was applied to the sciatic nerve of sensitized animals. Specific serum, on the other hand, lowered excitability of the nerve in sensitized animals, as shown by an increase in the threshhold and maximum of nerve stimulation.

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Local application of specific serum to a peripheral nerve of a sensitized animal is accompanied by depression of excitation of the nerve [1, 3, 5-7]. The criterion of changes in the level of excitation used in these investigations was an increase in the threshold strength of stimulation producing contraction of the corresponding muscle.

In a previous series of experiments on guinea pigs sensitized to horse serum, potentials of the gastrocnemius muscle were recorded in response to sciatic nerve stimulation [2]. After application of specific serum to the nerve, the threshold for direct stimulation of the muscle was increased by twice or three times. The strength of stimulation causing the appearance of a maximal integral potential was considerably increased. However, after application of serum to the nerve and irrigation of the nerve with serum, the possibility of its action on the myoneural junction and also on the muscle itself could not be ruled out, and this could modify the muscle response even though the nerve function remained unchanged [4].

To test this hypothesis and to study the level of excitation of a motor nerve in anaphylaxis directly, special experiments were carried out on 19 control and 52 sensitized animals (rats and guinea pigs).

EXPERIMENTAL METHOD AND RESULTS

Normal horse serum was used for sensitization, with bovine serum albumin in a few cases.

Guinea pigs were sensitized by two or three subcutaneous injections of antigen (1 ml of a 1:2 dilution) on alternate days, and rats by 3 intramuscular injections of antigen in a 1:1 mixture (0.3 ml of each) with Freund's complete adjuvant. Most experiments were carried out 18-30 days after the last sensitizing injection.

The sciatic nerve was dissected under superficial ether or nembutal (2.5 mg/100 g body weight) anesthesia. The animal's hind limbs were fixed in a frame by the knee and angle joints and by the sacral vertebrae. Stimulating electrodes were placed under the sciatic nerve. Recording electrodes were applied to the peripheral end of the divided peroneal nerve and covered with mineral oil.

The sciatic nerve was covered with a wick of cotton wool soaked in Ringer's solution and stimulated with square pulses (0.1 msec, 1/sec) from a type SIF-4 biostimulator, synchronized with triggering of the beam of a type ÉO-7 oscilloscope, from the screen of which the action potentials were photographed on film.

The threshold strength of nerve stimulation was determined in volts and the maximal stimulation giving an action potential of maximal amplitude was chosen. The segment of nerve resting on the stimulating electrodes and close to them was then covered with a thin layer of cotton wool soaked with serum, and irrigated with serum for 3-5 min.

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TABLE 1. Changes in Threshold and Maximal Strengths of Nerve Stimulation (in V) after Application of Serum

Parameter investigated	Unsensitized animals		Sensitized animals	
	rats (10)	guinea pigs (9)	rats (15)	guinea pigs (37)
Mean threshold strength of nerve stimulation				
before contact with serum	0,234	0,30	0,12	0,29
after contact with serum	0,158	0,22	0,17	0,48
Mean value of difference (M±m)	0,076±0,027 P=0,012	0,08±0,031 P=0,012	0,05±0,016 P<0,01	0,19±0,019 P<0,001
Mean maximal strength of nerve stimulation				
before contact with serum	0,59	1,31	0,54	1,6
after contact with serum	0,40	0,93	0,84	3,1
Mean value of difference (M±m)	0,19±0,059 P=0,01	0,39±0,096 P<0,01	0,30±0,090 P<0,01	1,5±0,169 P<0,001

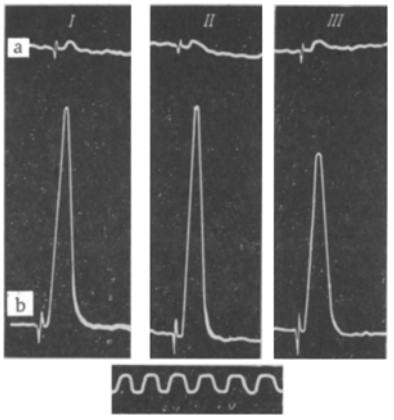

Fig. 1. Effect of specific serum on excitability of sciatic nerve of a sensitized guinea pig. Curves from left to right: I) initial nerve potentials; II) nerve potentials 15 min after application of serum to nerve in dilution of 1:2; III) potentials 20 min after application of whole serum; a) threshold strength of nerve stimulation: in I) 0.32 V; in II) 0.58 V; in III) 0.85 V; b) maximal strength of nerve stimulation: in I) 1.5; in II) 3 V; in III) 4 V. Time marker 1 msec.

Experiments carried out on 10 control rats and 9 control guinea pigs showed that excitability of the sciatic nerve rises sharply after application of horse serum, bovine serum, or egg albumin to it. This was shown by a decrease of the threshold and maximal strength of nerve stimulation, compared with initially (Table 1). The foreign serum evidently increases the excitability of the nerve through a nonspecific stimulant action.

In a series of experiments on sensitized rats and guinea pigs the nerve was first irrigated with nonspecific serum, such as bovine serum albumin, after sensitization with horse serum. After application of the nonspecific serum, just as in the control experiments, excitation of the nerve was increased for a short time. After rinsing the nerve with Ringer's solution, the effect of specific serum on the nerve was tested.

In 45 of 52 experiments, diluted serum (1:2, 1:4) was used to begin with. In 27 experiments, excitability of the nerve was reduced and in 5 it was unchanged. In 13 cases some increase in excitability of the nerve was observed. However, on subsequent contact between the nerve and undiluted serum, as a rule its excitability fell. In 7 experiments the nerve was treated from the beginning with whole specific serum, and in 7 cases depression of its excitation was observed. Subsequent application of specific serum to the nerve lowered its excitability even more. Direct evidence of depression of excitability of the nerve was an increase in the threshold and maximal strengths of nerve stimulation (Table 1).

The threshold and maximal strengths of nerve stimulation after contact with antigen were investigated in experiments carried out at different time intervals (from 15 to 60 min or more). Throughout the period of observation the level of excitation of the nerve remained depressed, except in 4 experiments.

In 85% of the experiments, immediately after application of specific serum to the nerve the amplitude of the maximal potential remained unchanged. However, in some experiments, after repeated application of serum antigen to the nerve, the amplitude of the maximal response was depressed below its initial value. Initial depression of nerve excitation was evidently followed by blocking of the low-threshold nerve fibers and, consequently, by a more severe disturbance of excitability of the nerve trunk as a whole (Fig. 1).

The results of these experiments in which action potentials of the sciatic nerve of sensitized animals were recorded indicate that specific serum acts directly on the nerve, depressing its excitability.

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