

CHANGES IN FROG SKELETAL MUSCLE ACTION POTENTIALS FOLLOWING HYPOPHYSECTOMY AND ADRENALECTOMY

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It has been shown previously [1, 2] that the voltage associated with the current of injury alters in response to hypophysectomy, adrenalectomy, or the injection of the corresponding hormones. The changes in the current of injury have been ascribed to disturbances of carbohydrate and phosphate metabolism resulting from the operations. The present work represents a study of the currents of injury as affected by removal of the hypophysis and adrenals.

METHOD

The experiments were carried out on the sartorius muscle of autumn and winter frogs, the muscle being removed at a definite time after hypophysectomy or adrenalectomy. Muscles removed before either operation were used as controls.

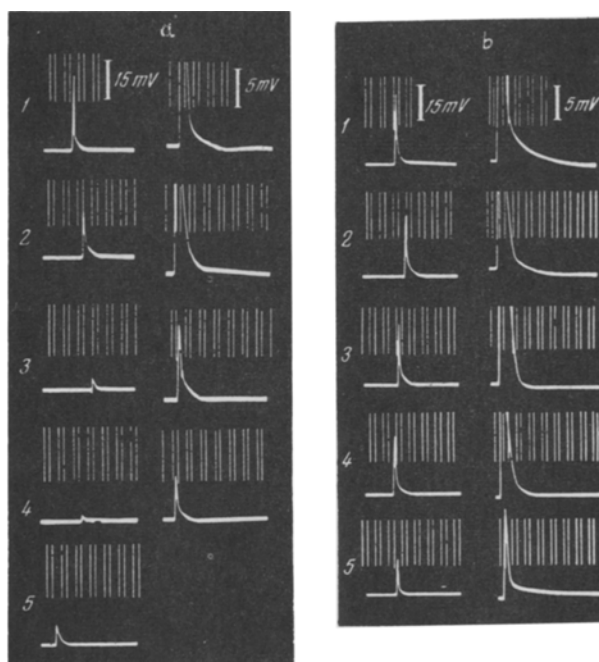


Fig. 1. Effect of adrenalectomy on action potentials. a) Experiment, b) control. 1) Initial recording; 2) after stimulating for 5 minutes; 3) after 10 minutes immersion in Ringer's solution; 4) after 60 minutes in Ringer; 5) after immersion for one day in Ringer; time marker 50 msec.

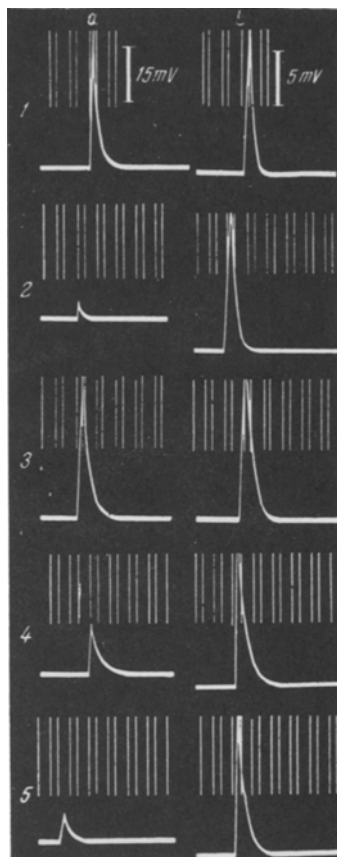


Fig. 2. Effect of hypophysectomy on action potentials. a) Experiment, b) control. 1) Initial recording; 2) after 3 minutes' stimulation; 3) after 10 minutes' immersion in Ringer; 4) after 60 minutes in Ringer; 5) after stimulating for 1 minute; time marker 50 msec.

potentials from a normal animal to their original value; in the adrenalectomized frog, not only is there no recovery, but a progressive decrease occurs.

If the muscle of either control group is left in Ringer for 1 hour, there is a marked reduction in the amplitude of the potentials obtained. There was no change in the controls.

These results show that both adrenalectomy and hypophysectomy cause marked alterations in the action potentials generated. Differences and resemblances can be found in the two operated groups; in both cases the amplitude of the potentials decreases when the muscle is left in Ringer, but the effect of stimulating for 3-5 minutes followed by an immersion in Ringer for 10 minutes is different in the two groups.

Because both the hypophysis and adrenals affect the level of carbohydrate and phosphorus metabolism, both directly, and indirectly through the other endocrine glands, the changes in muscle action potentials following removal of these glands is likely to be due to corresponding metabolic changes.

SUMMARY

Hypophysectomy and adrenalectomy caused changes in skeletal muscle action potentials. Stimulation for 3-5 minutes, or immersion for 60 minutes in Ringer, caused a reduction in the action potential amplitude.

For recording the action potential, the muscle was placed on a paraffin slab in a moist chamber. It was fixed in a somewhat extended condition in order to avoid distortion of the trace due to muscular contraction.

The action potentials were picked up by a unipolar electrode from the damaged and the undamaged part of the muscle through non-polarizable $Zn-ZnSO_4$ electrodes, and taken to a T-5 string electrocardiograph.

Electrical stimuli obtained from a neon discharge tube having a duration of 1 msec were applied at intervals of 1 second. The strength of the current was suprathreshold (the muscle contracted maximally).

The distance between the stimulating platinum electrodes was 1-1.5 mm, while the stimulating and pickup electrodes were separated by 10 mm, the distance between the pickup electrodes being 5-10 mm.

Between the recording, the muscle was kept in Ringer solution. The method for removing the hypophysis and adrenals has been described in detail previously [1, 2]. In all, 30 experiments were carried out on each of the two groups.

RESULTS

Fig. 1 shows changes occurring in the action potential 5 days after removal of the adrenals, while Fig. 3 shows the corresponding change 3 days after hypophysectomy. It can be seen that after both operations, the traces obtained do not differ from those of the controls (see Fig. 1).

However, stimulating the muscle for 3-5 minutes at a frequency of 1 per second caused a marked reduction in the amplitude of the potential after hypophysectomy, while in control muscles there was no change (Fig. 2).

Placing the muscle in Ringer for 10 minutes after a 3 minute period of stimulation restores the shape and amplitude of the muscle

LITERATURE CITED

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- [2] A. S. Mozzhukhin, in book: Problems of Electrophysiology,* volume 45 (Leningrad, 1950) pp. 70-79

* In Russian.