41. EFFECTS OF SCORPION VENOM AT NEUROMUSCULAR JUNCTION

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The skeletal muscle activity provoked by scorpion venom from Mexican Centruroides is due to effects on spinal motoneurons and neuromuscular junctions (1).

The latter is a local action because the venom did not activate either denervated muscle or muscular nerves when directly applied.

Mechanograms of muscular responses to single shock stimulations in cats and other mammals under scorpion venom intoxication render bigger and longer contractions than those obtained in normal animals (Fig. 1).

![Mechanograms of muscular responses](image)

Fig. 1 — Increase in amplitude and duration of muscular responses to maximal stimuli under the action of scorpion venom (B). A, control before the venom; C and D, decrease produced by the repetition of responses. (del Pozo and Augulano (1)).

Simultaneous electrical recordings from the muscle and its centrally cut nerves show series of potentials in fast sequence after such single shocks are applied to the nerves. If the nerve is severed from the muscle the repetitive activity suddenly disappears and only the normal action potentials persist (2) (Figs. 2 and 3).
FIG. 2 — Repetitive activity as shown by electromyogram. Several responses superimposed. Stimuli applied to the nerve. A, before the venom; B to D, after the injection of successive doses of scorpion venom.

The present study was carried out with the purpose of analyzing the origin and propagation of the described repetitive electrical potentials.

In cats anesthetized with phenobarbital, electrical records were taken from gastrocnemius muscles and from single fibers of the ventral spinal roots at L7. The roots were centrally cut. Electrical stimuli were applied to the sciatic nerve. The scorpion venom from Centruroides susiusus susiusus Pocock was injected intravenously or directly into the recorded muscle.

The repetitive potentials appeared first in the muscle and after several seconds or in some cases minutes, in the anterior roots. When the sciatic nerve was peripherally cut the repetitive discharges disappeared. In several experiments recordings electrodes were applied to the posterior spinal roots but no potentials were found (Fig. 4).

According to these results the antidromic propagation of the repetitive impulses by the efferent fibers may be affirmed. The single fiber records leaves no doubt about the repetitive electrical activity in the functional unit.

In other series of experiments, the effect of the venom on the end-plate potential was studied. Silver macroelectrodes were applied to the region of the end-plates of gracilis muscle of cats previously curarized.

The recorded potential was local and propagation with a great decrement was limited to a very short area of the muscle. Under scorpion venom the electrogram showed an initial fast component probably corresponding to immediate nerve terminals which was followed by a negative wave prolonged for about...
15 to 20 msec. With successive doses of the venom this long potential gradually changed in polarity and increased in duration to about two fold the initial time (Fig. 5).

Large doses of venom blocked the neuromuscular transmission. This block occurred many times when the electrical discharges in the nerve were very marked or even increased at the time of the block.
In some recent experiments intracellular recordings of the end-plate potential were done in frogs in order to determine the place of action of scorpion venom. Neuromuscular transmission was previously blocked by curare. The venom did not produce significant changes in the end-plate potential either in amplitude or duration. When the dose of venom was increased the end-plate potential suddenly disappeared. It was tested that these negative records were taken with the intracellular electrode in its place as it was shown by the resting potential appearing when the electrode was taken out (Fig. 6).

![Image of intracellular recordings from frog sartorius muscle under the action of scorpion venom. Successive responses to shocks applied to the nerve at 2 seconds intervals. The records are to be read from the lower to the upper part, left column first.]

Edwards working in this laboratory by measuring the quantal release of the transmitter from the pre-synaptic nerve terminals in frogs under the action of scorpion venom found evidence that this action takes place at the nerve endings.

The last two series of experiments described suggest that the action of scorpion venom at the neuromuscular junction corresponds to activity at the nerve terminals. This activity could explain the repetitive discharges in muscle and nerve previously described.

The extracellular recording of end plate potentials are always difficult to analyze because of the complex spatial arrangement of the elements that contribute to the potential registered.

However, is should be kept in mind that the intracellular recordings were done in frogs and the rest of the experiments correspond to cats and other mammals. There is always possible differences due to the species chosen.

**References**
