MULTIPLE RECORDING OF ELECTROMYOGRAMS IN CHRONIC EXPERIMENTS

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Chronic recording of muscular activity in laboratory animals requires the use of electromyographic (EMG) electrodes which are simple to make, are the least traumatic possible, and guarantee reliable contact with the muscle for a long period of time (up to one month or more). Known types of EMG electrodes do not possess the qualities listed above in full measure. For instance, in the design suggested by Oganesyan and Ivanova [1], the dogs' skin has to be punctured every time in order to ensure contact of the electrode with the amplifier through a subcutaneous capsule, filled with electrically conducting paste. Recording in this way may cause the paste to enter the tissue and to infiltrate the wound, not to mention the additional trauma produced by each injection of the needle electrode into the capsule. In the method used by Medvedev [2] on cats the process of fixation of the EMG electrode on the muscle, in which the uninsulated ends of the electrode emerged through the muscle to the outside and the area is covered with a special airtight substance on a silicone rubber disc, is laborious and time-consuming.

This paper describes a design of an EMG electrode which is easy to make, is made from widely available materials, is sufficiently light and may be quickly implanted into a muscle, virtually without any additional fixation.

The general appearance of the electrode is shown in Fig. 1. The recording part of the electrode (1) consists of a loop of silver wire 200 μ in diameter. The length of the loop is 1.5-2 cm, depending on the size of the muscles of the actual experimental animal. At the free end, a multiple-strand lead (3), 300 μ in diameter (brand MGTF is the best), is soldered to the loop. Where the wire is soldered a thin short wrapping (2), of any biologically inert material, is tied. The electrodes as described above were implanted in the adult cats under pentobarbital anesthesia (35 mg/kg) into antagonist muscles of the shoulder as follows. After preparation of the operative field on the lateral surface of the shoulder of the animal's forelimb the skin was divided together with superficial fascia at the level of the middle third in the superoinferior direction so that the length of the incision was about 5 cm. After separation of the superficial fascia of the shoulder from the fascial sheath of one head of the triceps muscle, an area measuring 1 × 1 cm, sufficient to apply two separate myographic leads to the particular muscle, was exposed. After this a special probe, consisting of a thin hollow metal tube 1 mm in diameter, complete with stilet, was passed through the whole thickness of the exposed area of muscle with the fascia propria, in the transverse direction, and the stilet was immediately replaced by the introduced electrode or, more precisely, its recording part. The conducting part of the electrode was passed through the loop of the active part, and in that way gripped the muscle firmly. The holes where the fascia propria of the muscle had been perforated were sutured by means of an atraumatic needle (of the disposable kind), so that the active part of the electrode did not come into contact with the adjacent tissues, and the electrode was more reliably fixed (it was discovered in practice that this last operation is unnecessary). At a distance of 7-10 mm from the point of insertion of the first electrode, the second electrode was introduced by the same method, and the two together formed a single bipolar myographic electrode for the given muscle. The conducting parts of the electrodes were brought out subcutaneously toward the surface of the previously scalped head, and after toilet, the operation wound was sutured in layers. Up to 8 electrodes were implanted in this manner in the muscle antagonists of the shoulder of both forelimbs of the cat. In the course of 1-2 days after the operation the ani-

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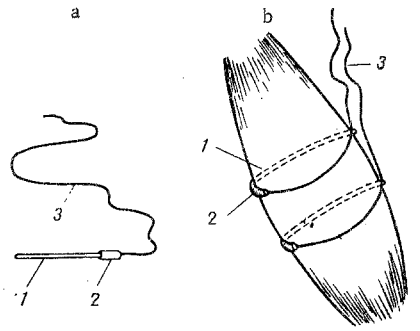

Fig. 1. General appearance of EMG-electrode (a) and its position in the muscle (b). Explanation in text.

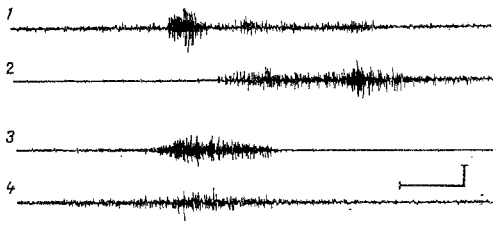

Fig. 2. Simultaneous recording of electromyogram from four muscles during striking at a target by the cat with its left limb. a) Left limb; b) right limb; 1, 3) m. biceps; 2, 4) m. triceps. Calibration: 1 sec, 200 μV.

mals limped with the limbs undergoing the operation, but within a few days they were able to run, jump, and so on again. The resistance between the electrodes implanted into one muscle remained virtually constant under these circumstances at 4-6 kΩ.

A simultaneous tracing of the electromyogram from four muscles, while a cat struck a target presented to it with its left limb, three days after implantation of the muscle electrodes, is given in Fig. 2.

The EMG electrodes designed by the writers have proved their worth in numerous experiments.

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