CHANGES IN ELECTRICAL EXCITABILITY AND MUSCLE RESPONSE SPEED IN DOGS WITH EXPERIMENTALLY INDUCED TUBERCULOSIS

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In our previous researches we have shown that in dogs with tuberculosis the chronaxy increases as the infection progresses, and attains a maximal value in the final stage of the disease. When the course of the disease is arrested, and clinical signs become normal, there is a gradual return of the chronaxy to its original level.

In a further study of the condition of the neuromuscular apparatus in experimental tuberculosis, we made measurements of the chronaxy and of the strength-duration curve, as well as of the lability (muscle response speed). The results are described in the present article.

METHOD

Measurements were made of the chronaxy of the flexors and extensors of the digits of the right hind feet, using a condensor chronaxiometer and Yu. M. Uflyand's standard method [4]. To determine the strength-duration curve and the muscle response speed of the gastrocnemius muscle of the right hind leg, we used an electrical stimulator made by the State Institute of Physiotherapy (1953); it was possible to regulate the intensity of the stimulus between 0 and 200 v, and its duration from 0.01 to 100 msec, the values being read off from a scale. The threshold value of the voltage for each impulse duration was plotted on special graph paper and the strength duration curve drawn. The lability of the muscle was measured by applying pulses at rates of 1, 5, 10, 20, 50, 100, 200, 300, etc. up to 1500 impulses/second, the voltage being maintained constant at a value 1½ times threshold, and the duration being fixed at 0.05 msec.

The contractions were recorded on a kymograph. In one experiment, 3-7 myograms were recorded to determine lability changes occurring during the course of the reaction (adoption of a "labilization" rhythm, lability constancy). We also studied the relation between the strength of the stimulus and the strength of the contraction of the gastrocnemius muscle. Using an impulse duration of 0.05 msec, and a frequency of 50 impulses/second, we measured the response to a threshold stimulus and to stimuli 1½ and 2 times threshold. In healthy dogs the response of the neuromuscular apparatus before and after repeated lability measurements was proportional to the strength of the stimulus (see Fig. a). Equalization, or an abnormal stimulus response relationship which occurred after an infection, showed we were dealing with phasic conditions as described by N. E. Wedensky in his work on parabiosis [1]. To infect the dogs with tuberculosis, we used the usual laboratory method of intravenous injection of 1 mg per kg of a culture of bovine tuberculosis mycobacteria.

The chronaxy, strength-duration curve, and lability were measured before and after infection on 7 dogs - Kvarus, Kutsy, Rex, Donor, Pepper, Blacky, and Dubok. Recovery of the chronaxy, strength-duration curve, and lability were studied in 4 dogs - Kvarus, Kutsy, Donor, and Pepper, because Rex and Blacky died 50-60 days after infection and Dubok was killed by electrocution for postmortem examination.
Fig. Changes in the physiological lability of the gastrocnemius muscle in experimental tuberculosis in the dog Kvartus at different times during the illness.

a) Before infection (stimulus 35 v); a1) before infection (frequency 50 impulses/second; b) on the 7th day after infection (stimulus 15 v); c) 21 days after infection (stimulus 70 v); c1) 21 days after infection (frequency 50 impulses/second); d – d1) 35 days after infection (stimulus 30 v).

Curves, from above downwards: myogram; stimulus marker (frequency of impulses per second shown on myograms a, b, c, d, and d1, and strength of stimulus in volts on myograms a1 and c1); time marker (1 second). Duration of impulses in all myograms 0.05 msec.

The condition of the animals which had recovered was confirmed by a positive Mantoux reaction, and in those which died the diagnosis was made from specific tuberculous changes in the lungs and pleura. On those that died — Blacky and Dukok — a test was made by culturing a portion of lung on a piece of Lowenstein's medium, when the pure culture of tuberculosis mycobacterium was grown.

We obtained 1211 myograms and 430 strength-duration curves. The condition of the dogs after infection may arbitrarily be described in terms of 4 periods: the incubation period, lasting for 4–8 days, the period of increasing clinical signs, which lasted from the 8th to the 12th day, the acute phase from the 14th to the 28th day, and recovery period (if such occurred) during the second and third months, or the terminal period if the dog died.

The first changes in the quantities measured before the manifestation of any clinical signs occurred on the 2nd-4th day after infection. The strength-duration curve was displaced towards the abscissa, and was altered in