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# Effect of Nerve Section upon Development of Nutritional Muscular Dystrophy in Young Rats.

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It is now well established that the young of female rats maintained on a diet restricted in Vitamin E, develop, towards the end of lactation, severe degeneration of the skeletal muscles. The pathological changes have been described in detail by Olcott,[1] by Pappenheimer,[2] and by Telford, Emerson and Evans.[3] Barrie[4] and Olcott found no abnormalities of the nerves, spinal cord or brain, and the spinal cord changes described by Lipschütz[5] in young rats on E-deficient diet, have not been present in our material. We have noted that even the terminal neurites and motor end plates are well preserved in the midst of the degenerating muscle fibers.

Although the histological evidence thus favors a "primary myopathy" as against a neural origin of the muscle lesions, so little is known of the pathogenesis of this disease that it seemed of interest to ascertain whether the muscle degeneration would be affected by the removal of nervous impulses.

Muscular dystrophy was induced in young rats according to the technic described by Goettsch and Ritzmann.[6] Under ether anesthesia, the left sciatic nerve was sectioned through an incision on the posterior surface of the thigh, a segment several mm in length being excised. The operation was performed on various days during the lactation period—the earliest at 5 days, the latest at 18 days. The animals were killed soon after the development of symptoms, or when these were not manifest, upon the 24th day. It has been our experience that muscle lesions may be found in rats which have shown no clinical evidence of the disease. The operation was performed upon 42 rats, of which 29 developed the disease.

1 Olcott, H. S., *J. Nutrition*, 1938, **15**, 221.

2 Pappenheimer, A. M., *Am. J. Path.*, 1939, **15**, 179.

3 Telford, I. R., Emerson, G. A., and Evans, H. M., PROC. SOC. EXP. BIOL. AND MED., 1939, **41**, 291.

4 Barrie, M. M. O., *Lancet*, 1937, **2**, 251.

5 Lipschütz, M. D., *Rev. Neurol.*, 1936, **65**, 221.

6 Goettsch, M., and Ritzmann, J., *J. Nutrition*, 1939, **17**, 371.

TABLE I.
Effect of Section of Left Sciatic Nerve upon Muscular Dystrophy of Young Rats on Vitamin E Deficient Diet.

| Serial No. | Litter No. | Age at operation in days | Age at death in days | Lesions | | |
|---|---|---|---|---|---|---|
| | | | | R. gastrocnemius | L. gastrocnemius | Other muscles |
| 1 | 234 a | 5 | 21 | ++++ | — | ++++ |
| 2 | 199 a | 7 | 22 | ++++ | — | ++++ |
| 3 | 200 a | 12 | 19 | ++++ | — | ++++ |
| 4 | c | 12 | 20 | ++++ | — | ++ |
| 5 | 189 a | 15 | 16 | ± | — | — |
| 6 | b | 15 | 18 | + (?) | +++ (?) | ++++ |
| 7 | 196 a | 15 | 20 | +++ | — | +++ |
| 8 | b | 15 | 20 | +++ | — | +++ |
| 9 | c | 15 | 24 | ++++ | — | +++ |
| 10 | e | 15 | 24 | ± | — | — |
| 11 | g | 15 | 22 | +++ | — | — |
| 12 | h | 15 | 22 | +++ | — | — |
| 13 | i | 15 | 23 | + | — | — |
| 14 | 218 a | 15 | 24 | ± | — | + |
| 15 | b | 15 | 23 | +++ | — | +++ |
| 16 | c | 15 | 24 | +++ | — | +++ |
| 17 | d | 15 | 23 | +++ | — | +++ |
| 18 | 240 a | 16 | 21 | ++++ | + | ++++ |
| 19 | b | 16 | 21 | ++++ | — | ++ |
| 20 | 217 a | 17 | 19 | ++++ | — | +++ |
| 21 | b | 17 | 22 | ++++ | — | +++ |
| 22 | 216 a | 17 | 25 | ++++ | — | ++++ |
| 23 | 224 a | 18 | 20 | +++ | +++ | +++ |
| 24 | b | 18 | 20 | +++ | +++ | +++ |
| 25 | c | 18 | 20 | +++ | +++ | +++ |
| 26 | d | 18 | 25 | +++ | +++ | +++ |
| 27 | e | 18 | 25 | — | +++ | +++ |
| 28 | 244 a | 18 | 20 | ++++ | ++++ | ++++ |
| 29 | b | 18 | 25 | ++++ | — | — |

The right and left gastrocnemius muscles were fixed in Zenkers fluid and compared histologically.

The results of these experiments, though unexpected, were very definite and consistent (Table I). On the right side, the gastrocnemius with intact nerve supply showed the usual intense lesions—hyaline necrosis and segmentation of fibers, interstitial oedema, polymorphonuclear and histiocytic reaction, activation and proliferation of myoblasts (Figs. 2a and 3a).

In sharp contrast to these necrotizing and inflammatory lesions, the left gastrocnemius which had been deprived of its nerve supply was found to show only the familiar alterations consequent upon the nerve section—reduction in the caliber of the fibers, concentration, swelling and often central location of the nuclei (Fig. 2b). The degeneration or complete disappearance of terminal neurites and motor end plates was confirmed in Cajal preparations.

From Table I, it will be seen that when the operation is deferred

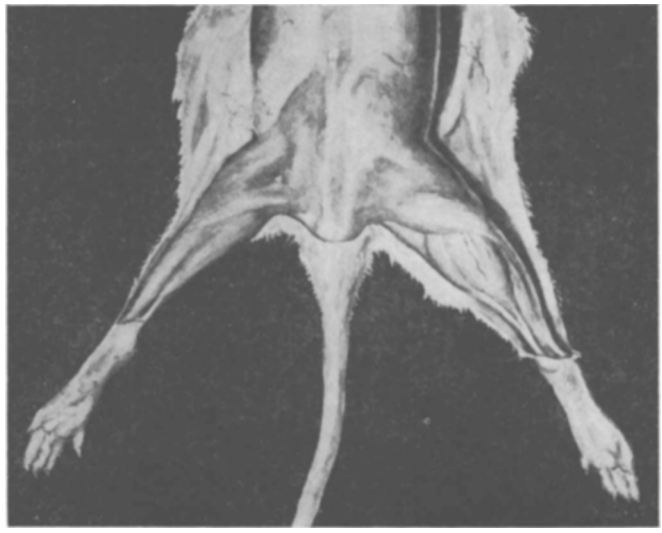

FIG. 1.

Rat 216a. Age 25 days. L. sciatic nerve sectioned on 17th day. R. gastrocnemius—swollen, streaky white, marked necrosis ++++. L. gastrocnemius—slight atrophy, otherwise normal in appearance.

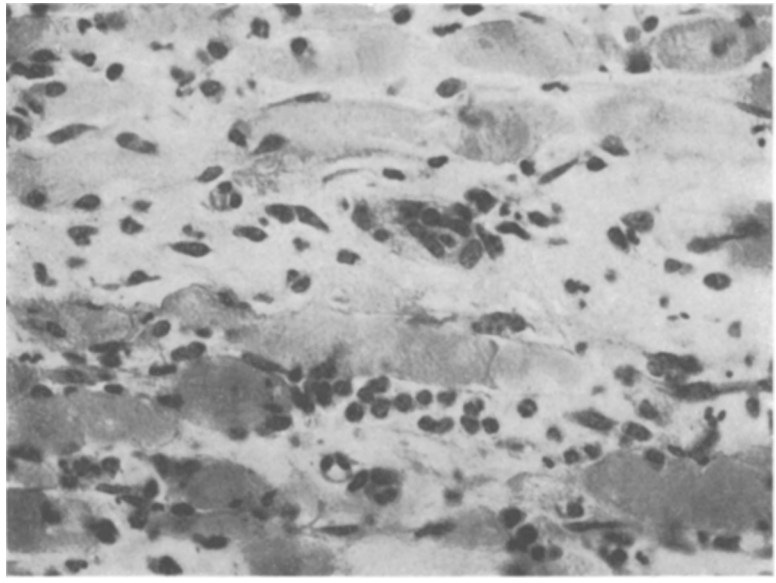

FIG. 2.

a. Rat 200c, age 20 days. Right gastrocnemius. Hyaline necrosis, segmentation, interstitial oedema, acute inflammatory reaction.

FIG. 2.

**b. Rat 200c, age 20 days.** Left gastrocnemius. Slight atrophy, otherwise normal fibers. Left sciatic nerve had been sectioned on 12th day.

until the 18th day, nerve section no longer confers protection. The failure to prevent the lesions by nerve section when the operation is carried out within 24 to 48 hours of the onset of the disease, may be explained by the persistence of excitability of the nerve during this period (Tower[7]).

One may safely conclude from these experiments that removal of nerve impulses protects the muscles of young rats from the usual effect of Vitamin E deficiency. The exact mechanism by which this protection is afforded—particularly the part played by the loss of sympathetic and motor impulses respectively—can be determined only by further experiments.

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7 Tower, S., *Phys. Reviews*, 1939, **19**, 1.