THE CALCIUM CONTENT OF MUSCULAR TISSUE 
DURING PARATHYROID TETANY.

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Excepting the observations of Loughridge (1) we have been unable to find data on the calcium content of striped muscle during parathyroid tetany. He found much less calcium in dog muscle during tetany (two animals) than in the muscles after recovery from tetany through treatment with calcium chloride or parathyroid extract (three animals). Katz (2) found 0.0685 parts of calcium per kilo of normal dog muscle. Behrendt (3) stated that the calcium content of muscles remains unchanged during parathyroid tetany in dogs, but gave no data. MacCallum and Voegtlin (4) found that the calcium content of brain tissue was reduced and assumed that it was lower in other tissues. Cooke (5) found slightly more calcium in the brains of dogs dying with tetany than in normals.

On account of the small amount of existing data we thought it desirable to determine calcium in the muscles of normal and of parathyroidectomized dogs either to confirm previous reports or add new findings.

EXPERIMENTAL.

Our series comprised nine parathyroidectomized dogs and eight normal ones. The parathyroidectomized animals were sacrificed from 3 to 8 days after operation. Mixtures of gluteal and quadriceps femoris muscles were used for analysis. The tissue was finely ground in a meat chopper and, after mixing, was divided into 20 gm. samples. Duplicate samples were always taken and in several determinations triplicates were used. The tissue was

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extracted for about 48 hours (with frequent shaking) in 200 cc. of 5 per cent trichloroacetic acid. The fluid was filtered from the residue, the volume noted, 10 cc. of concentrated nitric acid added, and the sample evaporated to about 5 cc. This was transferred to tapered centrifuge tubes, neutralized with concentrated ammonia water to approximately pH 6.0, and 1 cc. of saturated ammonium oxalate added for every 5 cc. of the neutralized fluid. The tubes were allowed to stand overnight, then centrifuged, and the precipitate washed and titrated as in the Kramer-Tisdall method for serum calcium. Determinations on standard solutions of calcium showed that recoveries of about 95 per cent could be expected. The calcium obtained from the muscle by the above procedure represented the amount which is acid-extractable and comes to equilibrium between tissue and fluid during the extraction process. The amount of calcium obtained multiplied by the quotient:

\[
\frac{\text{Volume of muscle} + \text{extraction fluid}}{\text{Filtrate obtained}}
\]

and converted into mg. per 100 gm. of tissue gave the results expressed in Table I.

Our data show a slightly higher average for the tetany series than for the normal animals but we believe that with a greater number of animals the difference would disappear. There was no

<table>
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<th>Dog No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
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<th>Minimum</th>
<th>Average</th>
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<td>8.9</td>
<td>7.5</td>
<td>8.0</td>
<td>8.9</td>
<td>10.5</td>
<td>5.2</td>
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<td>4.8</td>
<td>9.4</td>
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<td>6.7</td>
<td></td>
<td>10.5</td>
<td>4.8</td>
<td>7.7</td>
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</tbody>
</table>

* The dog developed a respiratory infection and was killed on the 4th day after operation; did not develop tetany.

Calcium in whole blood (trichloroacetic acid filtrate), Dogs P1, 2.3 mg.; P2, 3.6 mg.; P6, 4.1 mg.; P9, 1.4 mg.; Dog N1, 5.8 mg.

Severe tetany was present in Dogs P1, P2, and P8; moderate to mild tetany in Dogs P3, P4, P5, P6, and P7.
consistent variation between the two groups, although the individual variation in both was very great. The relatively large variation seen in different animals suggests that there may be sources of calcium in muscular tissue other than the calcium supposed to be present in muscular elements proper. If it is chiefly an integral part of the latter and has a definite function, the variations are remarkable. It seems noteworthy that Urano (6) found no calcium in Press-saft of muscles of frogs. Knowledge of the site of calcium in muscular tissue might lead to a better understanding of its function.

The findings agree with the report by Behrendt (3) but not with the conclusions drawn by Loughridge (1). However, our work is not directly comparable with his since we had no treated animals. One of our parathyroidectomized animals showed as low calcium as his untreated ones. Further work will be necessary to determine whether muscles will take up calcium when its salts are introduced parenterally or animals are treated with parathyroid extract.

A myogenic origin of tetania parathyreopriva is further negated by these findings.

SUMMARY.

The calcium content of striped muscle of nine parathyroidectomized dogs was found to lie in the same range as that of eight normal animals.

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