

Heart and Skeletal Muscle During Recovery from Hyperthyroidism.*

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The object of these experiments was to determine the correlation, if any, between the reparative changes in muscle during convalescence from the hyperthyroid state and the return of the creatine concentration to normal levels.

Rats were made thyrotoxic by the daily administration of 1 mg. of synthetic thyroxine (Hoffmann-La Roche) for 23 days. At this stage a number of the animals were sacrificed and heart and skeletal muscle removed and subjected to chemical analysis and microscopic study. From the remaining rats muscle was obtained from the left thigh for similar purposes. These animals were then allowed to recover for varying periods and sacrificed. Chemical analysis and histologic study of the corresponding muscles of the right thigh made it possible to determine such improvement as may have occurred. The regeneration of the myocardium was evaluated by comparison with controls and on the basis of considerable other data previously reported from this laboratory.

The changes produced in muscle in hyperthyroidism include swelling of the fibers and vacuolization. The cross striations become dim, or disappear; the fibers lose their individuality and undergo atrophy, hyalinization and fibrosis. Reduction in the concentration of glycogen and creatine accompany these changes. In rats maintained in a fair state of nutrition and at a suitable environmental temperature, regenerative changes, such as proliferation of the sarcolemma may go hand in hand with the degenerative process, but as may be anticipated, the former become more prominent when thyroxine is withdrawn. Gradually the cross-striations both in the skeletal and cardiac musculature become more visible and the fibers more discrete. However, in our experiments, even after 28 days, the reparative process was not complete, signs of previous and existing damage still remaining.

In Figure 1 are represented the values for creatine obtained in a typical series of experiments. On the average, the preliminary

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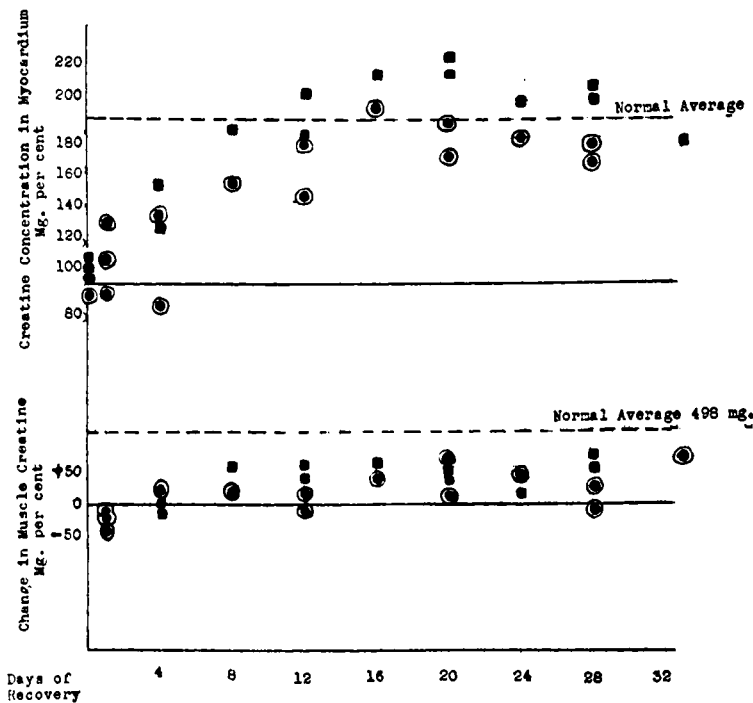


FIG. 1.

The return of the creatine concentration of the heart to normal during recovery from hyperthyroidism is illustrated in the upper part of the chart. The solid line in the lower portion represents the creatine concentration of the biopsy specimen, while the circles and squares above and below the line represent the change in concentration after partial recovery. Male rats are designated by circles; females by squares.

treatment with thyroxine produced about 20% reduction of creatine in skeletal muscle and 40-50% in the myocardium. Much further lowering of heart creatine seldom occurs owing to the intervention of death from heart failure. From the results it appears that the creatine concentration of the heart tends to return to normal rapidly, restitution being well in advance of tissue repair. In skeletal muscle, on the other hand, the earlier regenerative changes, especially in the presence of an inflammatory process, are often unaccompanied by any change in creatine. Later the increase in creatine concentration more or less parallels anatomic improvement.

Conclusions. In the hearts of rats recovering from hyperthyroidism restoration of the creatine concentration occurs in advance of any marked anatomic improvement and it is therefore not inconsistent to find normal values in the presence of moderate myocardial damage. Reparative processes occur somewhat more gradually in skeletal than in cardiac muscle and the restoration of creatine to normal more nearly parallels the degree of tissue regeneration.