2875

Calcium metabolism in tissues affected by calcium salts and ultra violet light.

W. DENIS and R. C. CORLEY.

[*From the Department of Bio-Chemistry of the School of Medicine, Tulane University, New Orleans, La.*]

Experiments have been carried out to determine whether excessive doses of calcium salts administered daily to rabbits over a considerable period could affect the calcium content of the tissues, and also as to the effect of daily exposure to ultra violet radiation with and without the ingestion of calcium salts.

Six animals were given a daily dose of 1.08 grams calcium lactate for 34 days, five received 0.5 grams calcium chloride for 40 days and six served as controls and were maintained for 35 days under the same living conditions as were the experimental animals.

In a second series eight rabbits were given calcium lactate for 31 days, eight calcium chloride for 38 days, and seven were used as controls. All of this latter group of animals received daily exposure for 30 minutes to the light of a Cooper-Hewitt mercury tungsten arc.

Calcium determinations made on the tissues and blood of these animals, indicated that there was no increase produced in the calcium content of the tissues by the administration of calcium salts either with or without the use of ultra violet light.

2876

Combined supernormal and fatigue phenomena in compressed cardiac muscle of the turtle.

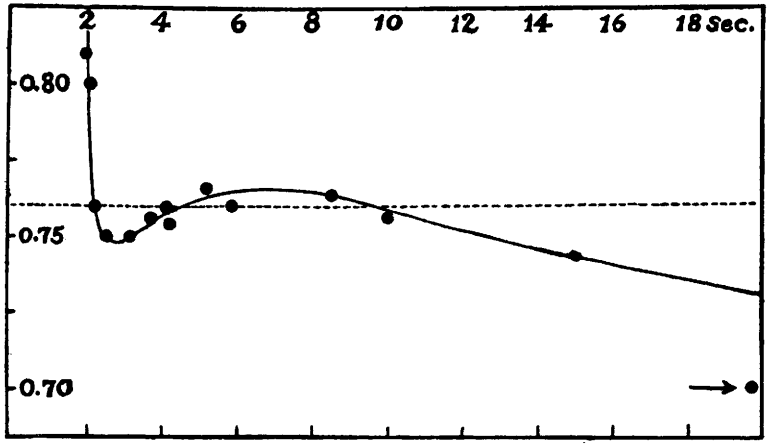
RICHARD ASHMAN and EOLA WOOLLEY.

[*From the Physiological Laboratory of the Tulane University School of Medicine, New Orleans, La.*]

One of the most characteristic features of low grade partial block, as seen clinically, is the gradual prolongation of the A-V

interval up to the time of the dropping out of a single ventricular response. This prolongation may be regarded as a fatigue effect. Furthermore, cases of partial heart block have been reported in which the recovery of conductivity passes through a supernormal phase,[1, 2] and the course of the supernormal recovery has been traced in compressed heart muscle of the turtle by one of us.[3] Therefore, since both supernormal recovery and fatigue are known to occur, separately at least, in clinical heart block cases, it appeared desirable to study the two phenomena as they occur simultaneously in the compressed turtle muscle. The results seem to us to have justified the effort, since certain relationships between the two have been discovered which could scarcely have been predicted from a study of the two phenomena separately.

In some experiments we used the atropinized, excised, bloodless hearts of *Chrysemys elegans* and *C. troosti,* rendered quiescent by removal of the sinus. In other cases, the unatropinized ventricle alone was employed, the muscle being split from the



Curve of recovery of conductivity in compressed auricular muscle. Abscissæ, intervals between auricular responses. Ordinates, the consequent A-V intervals in seconds. The point at end of arrow is at 30 sec., and is the average of 12 points, the A-V's of which varied between 0.68 and 0.71. It is supposed that if the compression had been increased to just the right degree, impulses corresponding to points above the dotted line would have been blocked, those below transmitted (see text).

[1] Lewis, T., and Master, A. M., *Heart,* 1924, xi, 371.

[2] Wilson, F. N., and Herrmann, G. R., *Arch. of Int. Med.,* 1923, xxxi, 923.

[3] Ashman, R., *Am. J. Physiol.,* 1925, lxxiv, 140.

base to near the apex. A heart clamp was placed in the A-V groove, or at the apex when the ventricle was used, and the desired degree of compression applied. The muscle was then caused to respond to induction shocks at any desired frequency. Simultaneous electrograms and myograms of the responses were recorded. Since the weather was warm, marked fatigue effects were invariably obtained. The supernormal phase was not so constant in its appearance, although shown by both types of preparation.

In the figure is shown a recovery curve of conductivity obtained when the clamp was in the A-V groove. The stimuli were applied in pairs, a 30 sec. rest being allowed after each pair. The intervals between the members of each pair were varied from 1.94 sec. up to 15.0 sec. Along the abscissæ, the time between responses is plotted. Along the ordinates, the A-V intervals in seconds. It will be seen that there is an interval, following the transmission of one impulse, during which a second impulse would have been blocked. The exact length of this interval is here undetermined. There is then rapid recovery of conductivity as determined by the duration of the A-V intervals, until the crest of the supernormal recovery curve is reached. Following this there is again depression of conductivity, succeeded in turn by the slower recovery from fatigue. Similar results were obtained with ventricular preparations (usually not atropinized since the ventricle receives no vago-inhibitory fibers).

Another experiment, typical of a number, and in which the degree of compression is greater, may be described. In this experiment (unatropinized ventricular muscle) an impulse following another at an interval shorter than 2.0 sec. was blocked; if between 2.0 and about 7.0 sec., *i. e.,* during the supernormal, it was transmitted; if between 7.0 and 28.0 sec., it was blocked; but if the impulse came later than about 28.0 sec. after the transmission of the previous one, it was transmitted. These statements require some modification for intervals up to 7.0 sec. since "treppes" and fatigue complicated the picture. Beyond 7.0 sec. there was no exception.

These experiments prove that when the supernormal recovery phase appears in a partially fatigued muscle, the conductivity after a relatively long rest may approach or exceed the conductivity at the crest of the supernormal phase, while conductivity is at other times depressed.

The relation between the "treppe" in conductivity and fatigue is illustrated in the following measurements, taken in sequence from one experiment. The numbers not in brackets represent the intervals between stimuli in seconds; those bracketed are the consequent V-V intervals, the ventricle being used. 120.0 (0.42), 7.5 (0.54), 5.5 (0.59), 15.3 (0.68), 3.0 (0.39), 2.1 (0.44) 2.2 (0.51), 2.1 (0.64), 2.4 (blocked), 2.4 (0.70), 30.0 (blocked), 4.1 (0.42), 3.9 (0.52), 4.9 (blocked), 5.9 (blocked), 4.1 (0.57). It is evident that the "treppe" is most clearly marked after a rest of moderate duration (10 to 30 sec.). After a longer rest, the V-V interval is again short and the "treppe" does not appear, although the onset of fatigue is rapid. This seems to prove a difference between the condition of the tissue immediately responsible for the fatigue, and the condition favorable for the appearance of the supernormal phase. The experiment likewise proves that the supernormal recovery of conductivity may, like the recovery of excitability, be depressed by fatigue. Certain applications of these conclusions will be found in the following communication.

2877

Periods of spontaneous rhythm in the turtle heart and their bearing upon paroxysmal tachycardia.

RICHARD ASHMAN and ROBERTA HAFKESBRING.

[*From the Physiological Laboratory of the Tulane University School of Medicine, New Orleans, La.*]

In frogs' hearts filled with mammalian serum and ligated between sinus venosus and auricles, or at other points, Luciani[1] observed and recorded periods of spontaneous rhythm separated by intervals of quiescence. We have obtained myograms and electrograms of the same phenomenon in turtle hearts perfused with strongly buffered, oxygenated physiological saline solutions at various H-ion concentrations. A typical period of auricular origin recorded with the string galvanometer is given in Figure 1. It will be noted that there is a rapid acceleration in the rhythm and then a more gradual retardation until the period ends.

[1] Luciani, *Human Physiology*, Eng. Trans., 1911, i, 302.