10290

Protoplasmic Movement in Cardiac Muscle During Interval Between Contractions.

CHARLES M. GOSS.

From the Departments of Anatomy, Columbia University and the University of Alabama School of Medicine, University, Ala.

The question of whether muscular contraction is related to the more general type of protoplasmic motion exhibited by nearly all cells is brought forward and partially answered by the following observations of both types of motion in the same cells.

The material consisted of tissue cultures of cardiac muscle whose spontaneous rhythmic contractions were interrupted by periods of rest. The explants were taken from the hearts of 16-day-old rat embryos and cultivated in a medium of rat plasma and embryo extract.[1] Most of the observations were with cultures incubated for 4 or 5 days without subculturing. The spontaneous contraction of heart muscle in tissue cultures is subject to variation both in the rapidity of its rate and the regularity of its rhythm. One of the irregularities is a remittent form in which short periods of rhythmic contraction alternate with similar or longer periods of rest. These cultures with remittent activity provided material in which cells of known contractile power could be studied during periods of quiescence.

The strands of new muscle growth which were to be observed for the slow unspecialized protoplasmic motion were first watched through the microscope to make sure that all the muscular elements contracted vigorously during the period of rhythmic activity. They were then focused on the film of a 16 mm movie camera through the 1.5 mm, 120× objective of the microscope. In order that the slow protoplasmic motion might be appreciated by the eye, it was made more rapid on the film by increasing the time between exposures. The exposures were taken every 5 seconds. Projected at the rate of 16 frames per second, the finished film increased the rapidity of motion 80 times.

In these pictures the outlines of the nuclei and the nucleoli were clearly visible. The cytoplasm contained compactly arranged and evenly distributed rod-shaped and granular bodies which have been identified as mitochondria.[2] Occasional fat droplets were recognized by their brilliant refractivity.

---

1 Goss, C. M., *Arch. f. exp. Zellforsch.*, 1933, **14**, 175.

2 Stilwell, E. F., *Arch. f. exp. Zellforsch.*, 1938, **21**, 446.

In the speeding up produced by the cinematographs, the interior of the muscle appeared to be a seething mass. Near the nucleus, the mitochondria were jostled against each other in a manner as irregular as Brownian motion. Toward the ends of the elongated fibers, the motion was more restricted. A typical journey for a granule in this portion consisted of a halting progress for some distance in the direction of the long axis of the fiber and back again. Motion in a direction perpendicular to the long axis was less frequent. The term "cell" has been avoided as much as possible because the outlines of the individual elements of the muscle were seldom visible. The presence of cell boundaries was indicated in certain places, however, by narrow zones across which the mitochondria did not pass.

Photographs were taken at 5 second intervals during the periods of rhythmic contraction as well as during the periods of rest. The record of slow protoplasmic motion was interrupted and confused by the succession of rapid movements of the entire fibers. In order to check the protoplasmic motion during the interval between each contraction of a regular rhythm, films of cultures with slow regular rhythms were taken at a more rapid exposure rate. They indicated that the slow type of motion was present during the interval.

The protoplasmic motion cannot be confused with the rapid movement of contraction. The former is so slow that it must be made more rapid by artificial means, as described above. The latter, on the other hand, is so rapid that it must be slowed. A description of slow-motion cinematographs of contracting muscle has been published,[3] and is unnecessary here. The protoplasmic motion described above is distinct from the quivering of the entire fiber which follows the full contractions.[3] It has no relation to the independent contraction of individual cells, or to the microfibrillation of Fredericq which Murray[4] has given the suggestive name of "twittering."

It has been stated that most of the observations were made with 4- or 5-day cultures. In these, the muscle was embryonic or undifferentiated. Similar pictures were taken of older cultures in which the muscle had reached the earlier stages of differentiation characterized by an arrangement of the mitochondria into transverse rows resembling cross striations.[1] Here the protoplasmic motion was less extensive and the individual mitochondria made more restricted excursions.

The above observations indicate that the slow generalized motion is distinct from the movement of muscular contraction. It is asso-

[3] Goss, C. M., PROC. SOC. EXP. BIOL. AND MED., 1931, **29**, 292.

[4] Murray, P. D. F., *Proc. Roy. Soc.*, Ser. B, 1934, **115**, 380.

ciated, apparently, with a physical state common in all forms of protoplasm. Muscular contraction, on the other hand, is probably associated with a different physico-chemical system superimposed upon the other.

10291 P

Intramuscular Administration of Anti-Pneumococcal Serum in Infants and Children.

LAMBERT KRAHULIK, VICTOR RUDOMANSKI AND GEORGE CUNNINGHAM. (Introduced by Jean Oliver.)

From the Department of Pediatrics, Long Island College of Medicine, Long Island College Hospital, and the Long Island College Division, Kings County Hospital.

The intramuscular administration of a single dose of antipneumococcal serum in the treatment of pneumonia in childhood was attempted in an effort to obtain the advantages of serum-therapy without the dangers and technical difficulty inherent in intravenous administration. A very severe reaction with a marked chill and a rise in temperature to 108.6° followed the intravenous administration of serum to a child 7 years of age ill with Type I lobar pneumonia, and although she recovered we did not feel that in a disease which carried such a low mortality we were justified in jeopardizing the patient's chances of recovery. Nemir[1] reports 2 deaths which she believes were due to the intravenous administration of the serum. The above experiences with the intravenous route are not uncommon in institutions where a great deal of serum-therapy is used. Without serum-therapy the mortality varies from 4 to 7%. Trask[2] reported a mortality of 6% in type specific pneumococcal pneumonias studied at New Haven. Holt and McIntosh[3] stated that of 1482 cases (over 3 years of age) taken from hospital practice the mortality was 4%. 497 cases (all ages) observed in our hospital from 1928 to 1936 showed a mortality of 7%.

Secretion for typing was obtained by means of a pharyngeal swab. In some of our cases, 24 to 48 hours elapsed before material containing pneumococci could be obtained for satisfactory typing.

1 Nemir, R. L., *J. Pediatrics*, 1938, **13**, 219.

2 Trask, James D., O'Donovan, Charles, Jr., Moore, Dorothea M., and Beebe, Agnes, *J. Clin. Invest.*, 1930, **8**, 623.

3 Lobar Pneumonia—Holt's Diseases of Infancy and Childhood, 10th Edition, p. 436.