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BRIEF NOTE

AN ELECTROPHYSIOLOGICAL STUDY ON THE DIFFERENCE OF CONDUCTION VELOCITY BETWEEN THE RED AND WHITE MUSCLE FIBERS

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Since the classic work of Grützner¹, it has been well known that the striated muscle of mammals are composed of an intimate mixture of red and white muscle fibers. And other recent physiological reports^{2,3} suggested that those two muscle fibers have different conduction velocity of excitation. In the present study, the conduction velocity of the red and white muscle fibers were measured by microelectrode technique and the differences of conduction velocities between these two fibers were demonstrated. The material of the experiment was soleus muscle of rat for the red fiber preparation and outer surface of femoral rectal muscle for the white fiber preparation. A thin muscle preparation was removed from muscle belly having entire length of tendon to tendon, and it was rapidly fixed on a glass slide at the same length *in vivo*. Then it was immersed in a 37°C Tyrode solution saturated with a gas composed of 95% O₂ and 5% CO₂. A Ag-AgCl stimulating electrode 100 μ in diameter was placed on the muscle specimen. A capillary microelectrode with the diameter of 0.30—0.50 μ was inserted into the same fiber at the point about 5—6 mm distant from the stimulating electrode by means of a micromanipulator. The distance from the stimulating electrode to the recording microelectrode was measured by an objective micrometer. The action current evoked by electric stimulation was observed on a cathode-ray oscillograph. By measuring the time from the point of stimulus artefact to the initial deflection point of the action current, the conduction velocity of each muscle fiber was calculated. Following the measuring of conduction velocity each muscle specimen was cut at 30 μ in -20°C cryostat and stained by histochemical succinoxidase reaction after the method described by OGATA⁴. And it was confirmed that the white muscle specimen was composed of only white fibers and the red one was of red fibers.

The conduction velocity of the white fibers was distributed between 3.6 m/sec. and 7.2 m/sec., and that of red ones between 0.8 m/sec. and 3.8 m/sec.

as shown in the histogram (Fig. 1). The average value of the white fibers was 5.57 ± 0.88 m/sec. and that of the red ones was 2.61 ± 0.68 m/sec.

It is widely known that the conduction velocity of muscle fiber is in proportion to the root of fiber diameter. As shown in Fig. 2, there is no obvious difference of fiber diameter between the white fibers in the surface part of femoral rectal muscle and the red fibers in soleus muscle of rat. Thus it may be reasonably concluded that the difference of conduction velocity between the red and white fiber depends upon the difference of their electrical characteristics of the membrane or the soma and not upon the difference of their diameter.

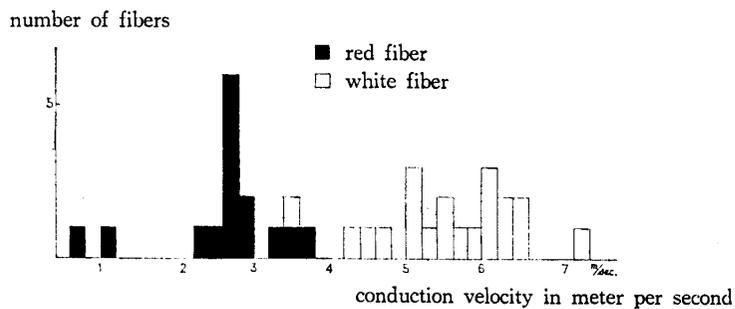


Fig. 1 A histogram of the conduction velocity of soleus (red fiber) and outer surface of femoral rectal muscle (white fiber) of rat.

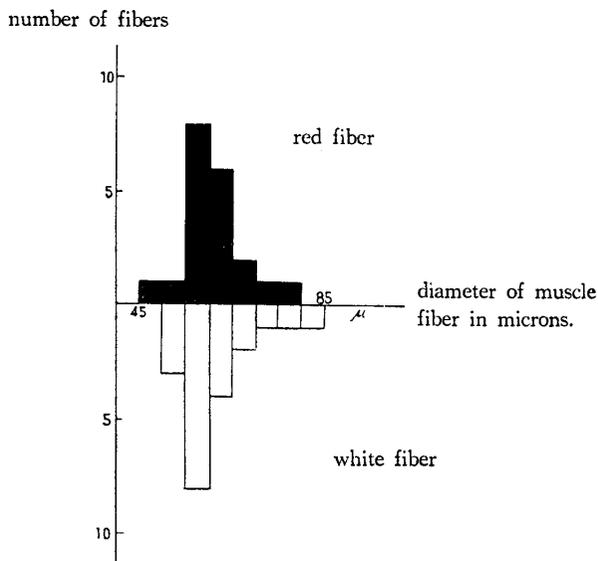


Fig. 2 A histogram of the diameter of red and white muscle fibers of rat.

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