PH 69

TIME-RESOLVED X-RAY DIFFRACTION STUDIES ON THE MOLECULAR MECHANISM OF FORCE ENHANCEMENT BY STRETCH IN TETANIZED FROG SKELETAL MUSCLE.

H.Sugi and T.Kobayashi. Dept. Physiol., Sch. Med., Teikyo Univ., Tokyo

Although it is well known that, when a tetanized skeletal muscle is stretched, the force attained after stretch is appreciably higher than the normal isometric force at the same muscle length, the force enhancement by stretch is not readily explained in terms of the sliding filament/cross-bridge hypothesis. By the method of time-resolved X-ray diffraction combined with intense X-ray sources from synchrotron radiation, we examined the change in the equatorial X-ray diffraction pattern from tetanized frog skeletal muscle during an applied slow stretch. It was found that the intensity of 1,1 equatorial reflection decreased during stretch, and showed a partial recovery after the completion of stretch; the above change in the intensity of 1,1 reflection was roughly an mirror image of the force change. On the other hand, the intensity of 1,0 reflection did not change significantly by stretch, due to a large scatter of the values measured. These results suggest that the force enhancement by stretch is associated with a decrease in the regularity of the myofilament lattice, which results in an increase in the overall electrostatic repulsion forces in the whole filament lattice.

PH 70

NEURALLY EVOKED ELECTROGENIC RESPONSE IN THE LARVAL BODY WALL MUSCLE OF DROSOPHILA.

K.Yamaoka (Natur. Sci.Lab., Toyo Univ.) and K.Ikeda (Div. of Neurosci., City of Hope Research Inst., U.S.A.).

In Drosophila larval muscles supplied with air, an electrogenic response was evoked by transmembrane depolarizing current. This response had a double-peaked configulation; a fast graded spike followed by a plateau response (Yamaoka and Ikeda, 1982, 1983). The present report demonstrates that the neurally evoked response in larval muscles 6A and 7A is also electrogenic. The muscles were supplied with air through the tracheoles. The segmental nerve was stimulated by using a suction electrode. Responses were induced intracellularly. In standard saline, slow responses were elicited by weaker stimuli, while fast graded spikes were evoked by stronger stimuli. The spikes sometimes showed an inflection on their rising phase, and were infrequently followed by a plateau. Both the spike and the plateau exhibited refractoriness. By extraperfusion with glutamate saline, the spike gradually decreased in amplitude and a slow response remained. The remaining responses exhibited summation, so that in the process of desensitization the plateau was easily triggered by stimulation with a pulse train of an appropriate interval. Almost equivalent results were obtained by extraperfusion with high Mg^{++} saline. The results suggest that the fast spike and the plateau are electrogenic, and that the slow responses are true EJP's.

PH 71

INHIBITORY SUBSTANCE OF RHYTHMIC CONTRACTION IN SEA URCHIN GONAD.

H. Nogi and M. Yoshida. Ushimado Mar. Lab., Fac. of Sci., Okayama Univ., Okayama.

In response to a few drops of isotonic KCl applied to the test cavity, sea urchin gonads (Temnopleurus toreumaticus) show a large and long lasting contraction. Superposed on it, small and rhythmic contractions occur and the rhythm is synchronized in all the five gonads. According to Okada et al (Biol. Bull.,1984), the site of the rhythm center resides in the aboral nerve ring. We have observed bundles of nerve fibers running from the aboral nerve ring to the gonad via the wall of gonoduct.

The rhythmic contraction is inhibited by glutamic acid (Glu) and aspartic acid at a concentration of 10^{-5} M. The effect is not due to the acidity. GABA is facilitatory, inducing resumption of the rhythm in quiescent gonads. Homogenates of ovaries and testes have the same inhibitory effect as Glu and the effectiveness does not disappear upon boiling. When the homogenate is fractionated by Sephadex gel filtration (G-25), the inhibitory effect is most evident in the Glu rich fraction and is abolished by treatments with glutamic acid decarboxylase. These results suggest that the inhibitory substance in the homogenate is Glu.

PH 72

THE EFFECT OF MYOSIN SULPHYDRIL MODIFICATION WITH p-PHENYLENEDIMALEIMIDE ON THE MECHANICAL RESPONSE OF GLYCERINATED RABBIT PSOAS MUSCLE FIBERS.

*M.Shimada,**S.Chaen and**H.Sugi. *Central Lab. Analyt. Biochem. and**Dept. Physiol., Sch. Med., Teikyo Univ., Tokyo.

It has been reported that p-phenylenedimaleimide (p-PDM) selectively reacts with the sulphydryls on the myosin head to result in the loss of its ability to combine with actin and to hydrolyse ATP. As an attempt to connect the knowledge of muscle biochemistry with that of muscle physiology, we examined the mechanical response of glycerinated rabbit psoas muscle fibers when they were treated with p-PDM at various concentrations. The magnitude of Ca-activated isometric tension (relative to the control value) in the p-PDM-treated fibers was found to be proportional to the square of the stiffness (also relative to the control value). If it is assumed that the probability to combine with p-PDM is the same between the two heads of each myosin molecule, the above relation between the isometric tension and the muscle fiber stiffness strongly suggests that (1) a cross-bridge can exert tension only when both heads are not modified by p-PDM, and (2) the stiffness represents the total number of unmodified myosin heads.