

Adrenaline on isotonic contractions of mammalian skeletal muscle

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The effect of adrenaline on the tension and time course of isometric twitches of mammalian skeletal muscle depends on the speed of contraction of the muscle. In fast-twitch muscle adrenaline increases both the maximal twitch tension and the times to peak tension and half relaxation; in slow-twitch muscle the opposite occurs. In neither muscle is the rate of tension development significantly affected (Bowman & Nott, 1969).

Although these changes are due to direct action on muscle fibres little is known of the mechanisms responsible. The increase in time to peak tension in fast-twitch muscle without significant change in the rate of development of tension suggests an action on the Ca^{2+} release/re-uptake mechanisms rather than changed activity of the contractile proteins. The

slow-twitch soleus muscle of the cat during continuous i.v. infusion of adrenaline.

Experiments were performed on seven cats anaesthetized with nembutal. Adrenaline was infused into the jugular vein and pressure in the common carotid artery was recorded in all experiments. Isometric contractions were recorded from either flexor digitorum longus or soleus muscles stimulated indirectly once every 10 seconds. After loaded isotonic shortening was measured by a rotary transducer (Birdsall, Buller & Kean, 1971).

Maximal effects of adrenaline on isometric twitches were produced at infusion rates of $5 \mu\text{g kg}^{-1} \text{min}^{-1}$ in flexor digitorum longus and by $1 \mu\text{g kg}^{-1} \text{min}^{-1}$ in soleus. These effects on twitches plus those on isometric and isotonic tetani are given in Table 1.

Adrenaline had no systematic effect on the shortening velocity of either fast-twitch or slow-twitch skeletal muscle of the cat.

These findings indicate an effect on Ca^{2+} release/re-uptake mechanisms. One aspect of this, which could be easily investigated, would operate through a change in the muscle action potential.

Table 1 Percentage change in contraction characteristics

	<i>Flexor digitorum longus</i>	<i>Soleus</i>
Isometric twitch		
Peak tension	19.6 (1.88)**	-5.5 (1.41)*
Time to peak	16.6 (1.89)**	-12.6 (0.96)**
Time to half relaxation	22.5 (1.87)**	-20.3 (1.72)**
Rate of rise of tension	8.7 (3.6)*	4.8 (2.88)
Isometric tetanus		
Maximum tension (P_0)	2.9 (2.49)	-2.0 (2.12)
Maximum rate of rise of tension	-1.3 (5.3)	-1.2 (1.64)
Isotonic tetanus		
Maximum velocity	2.1 (3.83)	3.5 (6.8)
a/P_0	-13.1 (7.01)	-3.6 (11.6)

Figures in brackets are s.e. mean.

Changes significant at the 0.05 level are indicated as * and at the 0.001 level as **.

changes in slow-twitch muscle suggest a similar site of action. However, adrenaline is known to affect the properties of the contractile proteins in cardiac muscle as measured by changes in the force/velocity characteristics during isotonic contractions.

We have tested this point directly by measuring isotonic shortening velocities at various loads in fast-twitch flexor digitorum longus (F.D.L.) muscle and

References

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