

Effect of adrenaline on intracellularly recorded action potentials of mammalian skeletal muscle

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The most striking effect of adrenaline on isometric twitches of mammalian skeletal muscle is the altered time course of contraction; prolongation occurs in fast-twitch muscle and shortening in slow-twitch muscle. The rate of development of tension and the shortening velocity are not appreciably affected (Lewis & Webb, 1976). Such findings indicate an effect on Ca^{++} release/re-uptake mechanisms which may operate by a change in the muscle action potential. Therefore, we have investigated the effect of adrenaline on intracellularly recorded action potentials (AP) in both fast-twitch flexor digitorum longus (FDL) and slow-twitch soleus muscle of the cat.

Experiments were performed on cats anaesthetized with pentobarbitone. Adrenaline ($1 \mu\text{g kg}^{-1} \text{min}^{-1}$ for soleus, $5 \mu\text{g kg}^{-1} \text{min}^{-1}$ for FDL) was infused into the jugular vein and pressure in the common carotid artery was recorded in all experiments. The technique used for recording intracellularly with microelectrodes was similar to that described by Buller, Lewis & Ridge (1966) for mammalian muscle *in vivo*. Micropipettes were filled with 3 M-KCl and had resistances in the range 15–25 M Ω . Movement was limited by the use of a concentric needle electrode, ground flat at the tip, to stimulate a small bundle of fibres.

Control AP records from between 25–35 different fibres were obtained in the muscle under study and a similar number of fibres were sampled during the 40 min infusion period and again 1–1.5 h after the infusion. Results obtained in this way from 4 Soleus and 4 FDL muscles are given in Table 1.

Adrenaline had no significant effect on resting potential or measured amplitude and duration parameters of the action potential. We conclude its effect on activation processes in mammalian skeletal muscle is most likely on intracellular mechanisms, e.g. handling of Ca^{++} by *t*-tubules or sarcoplasmic reticulum.

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References

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Table 1 Effect of adrenaline (ADR) on muscle action potential

	Flexor Digitorum Longus			Soleus		
	Control	ADR ($5 \mu\text{g kg}^{-1} \text{min}^{-1}$)	Post-ADR control	Control	ADR ($1 \mu\text{g kg}^{-1} \text{min}^{-1}$)	Post-ADR control
No. of fibres	118	111	98	129	90	90
Resting potential (mv)	84.0 (0.79)	82.0 (0.65)	83.9 (0.81)	82.9 (0.49)	79.3 (0.83)	77.1 (0.64)
Overshoot (mv)	33.1 (0.86)	33.9 (0.81)	34.4 (0.95)	20.2 (0.57)	23.3 (0.95)	21.7 (0.88)
Time above 0 mv (μs)	382.7 (0.91)	442.9 (0.61)	422.5 (0.68)	457.7 (0.51)	476.5 (0.82)	453.5 (0.80)
Time above -50 mv (μs)	807.6 (1.69)	866.3 (0.93)	834.6 (1.23)	1066.1 (0.95)	1156.4 (1.75)	1085.7 (1.24)
Time to peak (μs)	382.1 (0.65)	397.5 (0.55)	375.4 (0.64)	507.2 (0.79)	464.9 (0.76)	432.2 (1.18)
Rate of rise (v.s. ⁻¹)	1062.2 (18.5)	912.8 (19.4)	976.1 (22.8)	630.1 (9.8)	622.5 (16.5)	719.1 (18.5)

Figure in brackets are s.e. mean.