The influence of caffeine on the rate of decay of end-plate currents in frog skeletal muscle

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End-plate currents were recorded from cutaneus pectoris muscles of the frog *Rana temporaria* using a new technique which avoids the use of neuromuscular blocking drugs or glycerol treatment usually necessary to prevent contraction when the nerve is stimulated in Ringer solutions containing calcium (1.8 mM) as the only divalent cation. Stefani & Schmidt (1972) were able to make stable intracellular recordings of action potentials in indirectly stimulated muscles stretched to about 150% of their *in situ* length, and the present experiments extend this technique to two microelectrodes connected in a negative feedback, 'voltage-clamp' circuit to prevent firing of action potentials in the muscle fibre of interest.

Caffeine (1 mM, Sigma) applied in the solution flowing over the muscle, caused a lengthening of the decay phase of end-plate currents. In the conditions of the present experiments the effect reached a steady level in less than 1 min and was reversible. End-plate current decay remained approximately exponential in the presence of caffeine, the rate constant for decay decreasing by a factor of 1.9 (mean, range 1.6 to 2.2, 10 fibres at 21 to 24°C). It was concluded that this effect of caffeine was predominantly postsynaptic because the rate of decay of miniature end-plate currents was similarly reduced. The prolonging effect of caffeine was not diminished in the presence of 10 μM edrophonium which inhibits acetylcholinesterase, the mean decrease in rate of decay in these conditions being 1.9, range 1.6 to 2.3, 5 fibres.

If the slower rate of decay of end-plate currents in caffeine solution were to reflect a longer mean lifetime of ion channels opened by acetylcholine, it could underlie the increase in sensitivity to iontophoretically applied acetylcholine of frog muscle exposed to caffeine, reported by Mambrini & Benoit (1963). The prolonged time course of end-plate currents would also be expected to contribute to the increase in amplitude of end-plate potentials which has been found to occur in the presence of caffeine (Mambrini & Benoit, 1963).

References

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