

The effect of succinylcholine on the isolated retractor bulbi muscle of the cat*

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The retractor bulbi muscle of the cat does not contain multi-innervated slow fibres, and succinylcholine (suxamethonium), 1-1000 $\mu\text{g/ml}$, causes no contracture of the isolated muscle. However, succinylcholine in a concentration of 1 $\mu\text{g/ml}$ causes a contracture of the isolated inferior oblique and rectus muscles of the cat eye.

VARIOUS drugs cause a contracture of extraocular muscles; these drugs include acetylcholine (Duke-Elder & Duke-Elder, 1931) and depolarizing neuromuscular blocking drugs such as succinylcholine (Hofman & Lembeck, 1952, Dillon, Sabawala, Taylor & Gunter, 1957). In this respect, the extraocular muscles resemble denervated skeletal muscles (Brown, 1937).

The rectus and oblique muscles of the cat eye contain both singly and multi-innervated muscle fibres (Hess & Pilar, 1963, Peachey, 1967); the former, and at least some of the latter, are twitch fibres (Bach-y-Rita & Ito, 1966). The multi-innervated fibres respond to succinylcholine by contracture (Bach-y-Rita & Ito, 1966). Histological (Alvarado, Steinacker & Bach-y-Rita, 1967), physiological and pharmacological studies *in vivo* (Bach-y-Rita & Ito, 1965) have shown that the retractor bulbi muscle of the cat does not contain slow fibres like those found in other extraocular muscles; the fibres resemble typical skeletal muscle twitch fibres.

In the *in vivo* preparation, with the eyeball enucleated, succinylcholine-induced contracture of the rectus and oblique muscles may produce an apparent shortening of the retractor bulbi muscle, which can be prevented by tying the tendons of the rectus and oblique muscles to prevent the muscles shortening. We have now compared the effect of succinylcholine on the isolated retractor bulbi muscle, which consists of singly innervated twitch fibres only, with the effect on isolated rectus and oblique muscles, which consist of both singly and multi-innervated muscle fibres.

Methods

Nine retractor bulbi muscle slips, 3 inferior oblique, 1 superior rectus and 1 lateral rectus muscle were studied. The muscles were obtained from cats anaesthetized with phenobarbitone. A portion of the sclera, including the muscle insertion, was cut from the eyeball. The eyeball was removed from the cat and the muscle dissected free as close to the origin as possible. The muscle, attached by the portion of sclera to the mounting assembly, was suspended in a 50 ml bath containing modified Krebs-Henseleit solution at 37°, and gassed with oxygen 95% and carbon dioxide 5%. An average tension of 1.0 g was applied to the muscle. The method

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of recording isometric contractions and the formula of the modified Krebs-Henseleit solution are described fully elsewhere (Levy & Richards, 1965). The concentration of succinylcholine chloride is expressed in $\mu\text{g/ml}$.

Results

Succinylcholine (1 $\mu\text{g/ml}$) caused an immediate contracture of the inferior oblique and the rectus muscles. Larger contractures are produced by increasing the concentration of succinylcholine by 10 and 20 $\mu\text{g/ml}$ (Fig. 1a). Succinylcholine in concentrations of 1–1000 $\mu\text{g/ml}$ caused no contracture of the retractor bulbi muscle (Fig. 1b). However, succinylcholine in a concentration of 100 $\mu\text{g/ml}$ often caused a brief contraction of less than 40 mg tension for less than 2 sec. This response is similar in time course to that of the gastrocnemius muscle of the cat on administration of acetylcholine *in vivo* (Brown, Dale & Feldberg, 1936).

At the end of each experiment the muscle contracted to a direct electrical stimulus. This demonstrated its viability.

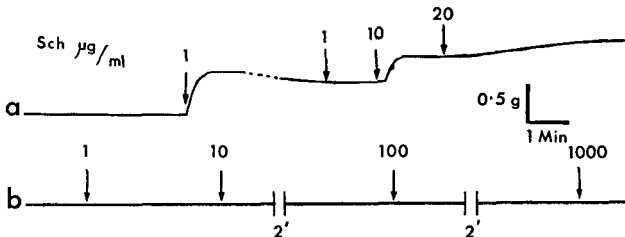


FIG. 1. Responses of isolated retractor bulbi and inferior oblique muscles of the cat to succinylcholine. Succinylcholine was added cumulatively to the bath at the arrows to increase the concentration, in $\mu\text{g/ml}$, in the bath by the amount indicated above these arrows. Contraction of a muscle is indicated by an upward deflection of the trace. Trace (a) shows the responses of the inferior oblique muscle and trace (b) those of the retractor bulbi muscle.

Discussion

Alvarado & others (1967) have shown that the retractor bulbi of the cat resembles normal skeletal muscle in being made up of singly innervated large twitch fibres. The rectus and oblique muscles, however, are made up of both singly and multi-innervated fibres. It would be expected that succinylcholine would cause a contracture of these muscles and not the isolated retractor bulbi muscle. The present experiments have confirmed this expectation.

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