of contraction with doubling of frequency up to a maximal response at 20 or 40 shocks/sec; stimulation at 80 shocks/sec usually gave a reduced contraction.

Lignocaine (1×10^{-5} g/ml.) abolished the response to electrical stimulation (20 shocks/sec; 0.1 msec) and the response returned on washing out the drug. The contractions were not diminished by ganglion blocking drugs (hexamethonium 1×10^{-5} g/ml. or mecamylamine 1×10^{-5} g/ml.) but were abolished by guanethidine (2×10^{-6} g/ml.) and this blockade was reversed by dexamphetamine (2×10^{-6} g/ml.). The threshold contraction to noradrenaline was at about 3×10^{-7} g/ml. and the maximum was achieved at about 2×10^{-5} g/ml. Tyramine ($2–8 \times 10^{-5}$ g/ml.) also contracted the human vas deferens. When examined histologically, conventional staining showed the human vas to consist of a thin, poorly defined, inner layer of longitudinal muscle fibres, a well defined middle layer of circular fibres and a thick outer layer of longitudinal fibres disposed in fasciculi well separated by connective tissue. Histochemical examination (Spriggs, Lever, Rees & Graham, 1966) showed a spare distribution of fluorescent varicose nerve terminals. The noradrenaline and adrenaline content of seven vasa was measured by the method of Brownlee & Spriggs (1965) and found to be 2.9 ± 0.46 μg/g and 0.22 ± 0.06 μg/g respectively.

Taken together, these results indicate that the human vas deferens is innervated by adrenergic postganglionic nerve fibres, but the innervation, compared with most other species that have been studied (Sjostrand, 1965), is not dense. Further analysis, of cholinergic mechanisms, suggests that if there is a cholinergic component to the innervation, it is small.

This work was supported by grants from the Medical Research Council, the Tobacco Research Council and the Central Research Fund of the University of London. I am grateful to Mr. Derek Packham, urological surgeon, for supplying the vasa deferentia.

REFERENCES

BIRMINGHAM, A. T. & WILSON, A. B. (1963). Preganglionic and postganglionic stimulation of the guinea-pig vas deferens. *Br. J. Pharmac. Chemother.*, **21**, 569–580.

BROWNLEE, G. & SPRIGGS, T. L. B. (1965). Estimation of dopamine, noradrenaline, adrenaline and 5-hydroxytryptamine from single rat brains. *J. Pharm. Pharmac.*, **17**, 429–433.

SJOSTRAND, N. O. (1965). The adrenergic innervation of the vas deferens and accessory male genital glands. *Acta physiol. scand.*, **65**, Suppl. 257.

SPRIGGS, T. L. B., LEVER, J. D., REES, P. M. & GRAHAM, J. D. P. (1966). Controlled formaldehyde catecholamine condensation in cryostat sections to show adrenergic nerves by fluorescence. *Stain Tech.*, **41**, 323–327.

Monoamine oxidase and catechol-O-methyl transferase activities in cat nictitating membrane and rat and guinea-pig vas deferens after sympathectomy

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Although there is considerable evidence in favour of the view that postganglionic sympathetic neurones contain the enzyme monoamine oxidase (MAO), sympathetically innervated tissues also contain variable amounts of extra-neuronal MAO activity. After sympathectomy, however, either no significant change, or falls in MAO activity ranging from 10 to 50%, have been reported in various animal tissues (Burn & Robinson, 1952; Burn, Philpot & Trendelenburg, 1954; Snyder, Fischer & Axelrod, 1965; Waltman & Sears, 1964). The greatest reductions in MAO

activity were observed in organs having a dense sympathetic innervation (nictitating membrane, iris, pineal gland). As a preliminary step to an investigation of the biochemical properties of intra and extra-neuronal MAO, we have sought a suitable peripheral tissue in which a consistent large reduction in MAO activity can be demonstrated after surgical sympathectomy.

Cat nictitating membranes were obtained at various intervals after unilateral superior cervical ganglionectomy. Rat and guinea-pig vasa deferentia were sampled at various intervals after unilateral sympathectomy by the technique described by Birmingham (1967). Tissues were homogenized in 0.005 M potassium phosphate buffer and samples of the homogenates were taken for enzyme assays and protein determinations. MAO activity was assayed radiochemically using ^{3}H-tyramine or ^{3}H-5-hydroxytryptamine (5-HT) as substrates. Catechol-O-methyl transferase (COMT) activity was assayed radiochemically using 3,4-dihydroxybenzoic acid and ^{3}H-S-adenosyl methionine as substrates. Fourteen days after sympathectomy there was a marked reduction in MAO activity (with tyramine as a substrate) in both the nictitating membrane and vas deferens, to levels between 40 and 60% of contralateral normally innervated control tissues. In both organs, the fall in MAO activity was significantly less when benzylamine was used as a substrate. The reduction was similar using either ^{3}H-tyramine or ^{3}H-5-HT as substrates. On the other hand, catechol-O-methyl transferase activity was not significantly changed in any denervated tissue. The time course of the reduction in MAO activity in both tissues will be described, and appears to parallel the time course of disappearance of the terminal sympathetic innervation. These results suggest that a substantial proportion of the total MAO activity in cat nictitating membrane or in rat and guinea-pig vas deferens is present in the rich terminal sympathetic innervation of these tissues. The sympathectomized vas deferens appears to be a suitable preparation for studies of the intra- and extra-neuronal enzymes.

In agreement with other studies, COMT did not significantly change after sympathectomy and is therefore located extra-neuronally.

REFERENCES

BIRMINGHAM, A. T. (1967). Denervation of the vas deferens of the guinea-pig. *J. Physiol., Lond.*, **190**, 16–17*P*.

BURN, J. H. & ROBINSON, J. (1952). Effect of denervation on amine oxidase in structures innervated by the sympathetic. *Br. J. Pharmac. Chemother.*, **7**, 304–318.

BURN, J. H., PHILPOT, F. J. & TRENDELENBURG, U. (1954). Effect of denervation on enzymes in iris and blood vessels. *Br. J. Pharmac. Chemother.*, **9**, 423–428.

SNYDER, S. H., FISCHER, J. & AXELROD, J. (1965). Evidence for the presence of monoamine oxidase in sympathetic nerve endings. *Biochem. Pharmac.*, **14**, 363–365.

WALTMAN, S. & SEARS, M. (1964). Catechol-O-methyl transferase and monoamine oxidase activity in the ocular tissue of albino rats. *Invest ophthalm.*, **3**, 601–605.

Receptors mediating the effect of catecholamines on glucose release from guinea-pig liver *in vitro*

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There is much uncertainty about the receptors concerned in the hepatic glycogenolysis caused by catecholamines. Part of the difficulty stems from the existence of wide variations between species ; in addition evidence has been obtained