A new sympathetic nerve preparation in the anaesthetized rat

B.J. LARGE

Department of Pharmacology, School of Medicine, Leeds LS2 9NL

During experiments on anaesthetized mice the paradox of biphasic cardiac responses to vagal nerve stimulation was resolved by the discovery of two separable nerve bundles, stimulation of one (cervical sympathetic) producing only tachycardia and the other (vagus) only bradycardia. To determine whether species differences exist and for ease of manipulation, experiments have been conducted on rats and preliminary findings are described here.

Male Wistar rats, 270-280 g, anaesthetized with chloralose 100 mg/kg and pentobarbiton 30 mg/kg were artificially ventilated. Blood pressure from a cannulated iliac artery, heart rate integrated from the pressure wave and isometric contractions of the inferior eyelids were recorded. Cervical vagi and sympathetic nerves were isolated, immersed in liquid paraffin and stimulated through bipolar platinum electrodes with rectangular pulses, duration 0.5 ms, at supramaximal voltage. Drugs were given via the left external jugular vein. Initial mean blood pressure was 70-100 mmHg, heart rate 290-340 beats/min and eyelid tension 0.5 grams.

A similar frequency-dependent bradycardia occurred on stimulation of the cardiac end of the severed right or left vagus nerve; somewhat smaller responses were seen if the intact nerves were stimulated. Contractions of the ipsilateral inferior eyelid resulted from stimulation of the cephalic end of the sectioned sympathetic nerves (Gertner, 1956), requiring a minimal frequency of 1 Hz and developing maximum tension (+0.5 to 0.8 g) at 20 Hz. Sometimes at 20 Hz, but more usually at 50 Hz, the eyelid was unable to maintain its contraction.

Stimulation of the cardiac end of the sectioned sympathetic nerves caused tachycardia, more pronounced with the right than the left. On the right side 0.2 Hz often raised heart rate by 20 beats/min^{-1}, maximal increases of 150 to 190 beats/min occurred with 5 or 10 Hz and the tachycardia within this frequency range could be maintained for several minutes during stimulation. The sensitivity to low frequencies compares with the findings of Armstrong & Boura (1973) who stimulated spinal sympathetic outflow in the pithed rat. Pressor responses were frequently seen during stimulation in the present experiments.

There is likely to be a different anatomical distribution of fibres in the left nerve since a smaller tachycardia invariably resulted from its stimulation. A similar uneven effect has been reported in the dog (Furnival, Linden & Snow, 1973) and in the cat, where Armstrong & Boura (1970) found only inotropic responses to left cardiac nerve stimulation. In the present experiments larger increases in pulse pressure occurred through stimulation of the left compared with the right nerve.

Eyelid retraction and cardiac changes can be measured simultaneously simply by stimulating the intact sympathetic nerves with one electrode and from such experiments it was concluded that most of the sympathetic fibres being stimulated were pre-ganglionic because hexamethonium reduced the responses, although doses of 5 to 25 mg/kg were required for substantial inhibition. Selective block of the cardiac effects was achieved with propranolol (0.3 mg/kg) and of the eyelid retraction with phentolamine (2.5 mg/kg), whilst both effects were blocked by guanethidine (3 mg/kg).

References

ARMSTRONG, J.M. & BOURA, A.L.A. (1970). The effect of adrenergic neurone blockade on responses of the cat heart to sympathetic nerve stimulation. *Br. J. Pharmac.*, **39**, 228P.

ARMSTRONG, J.M. & BOURA, A.L.A. (1973). Effects of clonidine and guanethidine on peripheral sympathetic nerve function in the pithed rat. *Br. J. Pharmac.*, **47**, 850-852.

FURNIVAL, C.M., LINDEN, R.J. & SNOW, H.M. (1973). Chronotropic and inotropic effects on the dog heart by stimulating the efferent cardiac sympathetic nerves. *J. Physiol., Lond.*, **230**, 137-153.

GERTNER, S.B. (1956). Pharmacological studies on the inferior eyelid of the anaesthetized rat. *Br. J. Pharmac.*, **11**, 147-150.