linear function with respect to ($Na^+$). This was not so with (−)-MA, the amine uptake versus ($Na^+$) curve being biphasic. Pretreatment with reserpine (1 mg/kg) 18 h before death had no effect on (+)-MA uptake in the presence of various ($Na^+$). Reserpine treatment significantly decreased (−)-MA uptake both under normal conditions and in media containing low ($Na^+$). The effect of reserpine was to abolish one phase of the (−)-MA versus ($Na^+$) curve and the resultant curve was linear with respect to ($Na^+$). These observations strongly suggest that reserpine abolished a $Na^+$-dependent optically specific transport system.

These studies suggest that the characteristics of the $Na^+$-dependent uptake of (−)-MA are similar in both the rabbit heart and the guinea-pig Auerbach plexus.

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REFERENCES

CRANE, R. K. (1968). Gradient coupling and the membrane transport of water-soluble compounds: a general biological mechanism? In: *Proceedings of XVth Annual Symposium on Protides of the Biological Fluids*, ed. Peeters, H., pp. 227–235. Amsterdam: Elsevier.

GOLDNER, A. M., SCHULTZ, S. G. & CURRAN, P. F. (1969). Sodium and sugar fluxes across the mucosal border of rabbit ileum. *J. Gen. Physiol.*, **53**, 362–383.

GOVIER, W. C., SUGRUE, M. F. & SHORE, P. A. (1969). On the inability to produce supersensitivity to catecholamines in intestinal smooth muscle. *J. Pharmac. exp. Ther.*, **165**, 71–77.

SUGRUE, M. F. & SHORE, P. A. (1969a). The mode of sodium dependency of the adrenergic neuron-amine carrier. Evidence for a second, sodium-dependent, optically specific and reserpine-sensitive system. *J. Pharmac. exp. Ther.*, **170**, 239–245.

SUGRUE, M. F. & SHORE, P. A. (1969b). The mode of potassium action on the adrenergic neuron-amine transport system. *Life Sci.*, **8**, Part 1, 1337–1341.

## Adrenoceptors in the human foetal colon

S. L. HART* and M. S. MIR

*Department of Pharmacology, Chelsea College, University of London, Manresa Road, London SW3*

Previous investigations have shown that the ileum from human foetuses contains both α- and β-adrenoceptors with a predominance of the latter and that stimulation of either receptor results in relaxation (McMurphy & Boreus, 1968; Hart & Mir, 1971). This study shows that the adrenoreceptors of the colon differ from those of the ileum.

The intestinal tract was removed from the foetus by the staff of the Tissue Bank, Royal Marsden Hospital, 2–4 h after hysterotomy had been performed for the legal termination of pregnancy. The tissue was stored in Krebs solution at 4°C. Within 2 h of removal from the foetus, 2–3 cm of the colon was suspended in a 10 ml bath containing Krebs solution bubbled with 5% $CO_2$ in $O_2$ at 37°C and the tone and movements of the longitudinal muscle were recorded with an isometric transducer under a tension of 2–4 g. The tissue was allowed to equilibrate for 2 h before the administration of drugs.

The actions of noradrenaline were studied on tissue from thirty foetuses of gestational age between 12 and 24 weeks. Three preparations gave biphasic responses whilst of the remainder, twenty-four contracted and sixteen relaxed. Contractions occurred more frequently with the ascending and transverse colon in contrast to the descending colon which usually relaxed ($P<0.001$). When isoprenaline was studied, each region of the colon relaxed. The predominant response to phenylephrine was contraction which was observed in each of the regions of the colon. Eight of the 23 tissues relaxed

in the presence of phenylephrine but in two of these the relaxation changed to a contraction as the experiment proceeded.

The relaxation of the colon appeared to involve typical $\beta$-adrenoceptors because it was antagonized by propranolol ($10^{-7}$–$10^{-6}$ g/ml) but not by phentolamine ($10^{-6}$ g/ml). In three tissues the relaxation produced by noradrenaline was converted to a contraction by propranolol.

The contraction observed in the presence of phenylephrine and noradrenaline was antagonized by phentolamine in nine out of twelve preparations whilst propranolol was without effect in six preparations. In two experiments phentolamine converted the response to noradrenaline from a contraction to a relaxation.

Contractions of the alimentary tract involving $\alpha$-adrenoceptors are well documented (Lee, 1970) and in adult humans they have been reported in the oesophagus (Ellis, Kauntze & Trounce, 1960) and at the ileocaecal junction (Gazet & Jarrett, 1964). Preliminary observations suggest that the $\alpha$-adrenoceptors in foetal colon are neurogenic because the contractions were antagonized by tetrodotoxin ($10^{-7}$ g/ml, five tissues); they were also antagonized by atropine ($5 \times 10^{-8}$ g/ml, ten tissues), suggesting that the neurones may be cholinergic.

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REFERENCES

ELLIS, F. G., KAUNTZE, R. & TROUNCE, J. R. (1960). The innervation of the cardia and lower oesophagus in man. *Br. J. Surg.*, **47**, 466–472.

GAZET, J. C. & JARRETT, R. J. (1964). The ileocaeco-colic sphincter. *Br. J. Surg.*, **51**, 368–370.

HART, S. L. & MIR, M. S. (1971). Adrenoceptors in the human foetal small intestine. *Br. J. Pharmac.*, **41**, 567–569.

LEE, C. Y. (1970). Adrenergic receptors in the intestine. In: *Smooth Muscle*, ed. Bulbring, E., Brading, A. F., Jones, A. W. & Tomita, T., pp. 549–557. London: Arnold.

MCMURPHY, D. M. & BOREUS, L. O. (1968). Pharmacology of the human foetus: adrenergic receptor function in the small intestine. *Biol. Neonat.*, **13**, 325–339.

## Differential effect of alterations in the calcium and magnesium concentrations on the responses to sympathomimetic amines in the perfused rat mesentery

A. J. GEORGE* and G. D. H. LEACH
*Postgraduate School of Studies in Pharmacology, University of Bradford, Bradford 7*

Perfusion of the rat mesenteric artery preparation with different Krebs solutions containing either reduced concentrations of calcium, magnesium, or zero calcium and magnesium, modifies responses to tyramine and noradrenaline (Leach & Zumani, 1969). In these experiments the rat mesenteric artery preparation (modified from the method described by McGregor, 1965) was perfused with normal and modified Krebs solution and the responses to a series of four sympathomimetic amines, noradrenaline 200 ng, octopamine 50 $\mu$g, metaraminol 20 $\mu$g and tyramine 100 ug, were studied. Tachyphylaxis to tyramine did not occur in any of the perfusion solutions under the experimental conditions used.

Perfusion with a $Ca^{2+}$- and $Mg^{2+}$-free solution potentiated the responses to tyramine by 600%. Similarly, the potentiation of the response to octopamine was 200% and to metaraminol, 80% and to noradrenaline, 40%.

Experiments in which the $Mg^{2+}$ concentration was varied from one-sixteenth to twice normal in a calcium-free Krebs solution demonstrated that, as the concentration