

Interaction between Adrenergic and Cholinergic Systems: Presynaptic Inhibitory Effect of Noradrenaline on Acetylcholine Release

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With 5 Figures

Summary

Noradrenaline and adrenaline inhibit acetylcholine release due to nerve activity, through α -adrenoceptors. The inhibition of acetylcholine release by the adrenergic transmitters is, in fact, a rather economical way for the adrenergic (orthosympathetic) nervous system to counteract the parasympathetic nervous system. It is shown that there is a permanent adrenergic control of acetylcholine output. The increase in acetylcholine output after catecholamine depletion or α -blockade of nervous tissue only represents partial removal of an adrenergic restraint. The modulatory role of catecholamines on acetylcholine release mechanism seems to be of physiological importance. Furthermore, it is also shown that acetylcholine may regulate its own release by a negative feedback mechanism. Although this mechanism operates in brain cortex, no such phenomenon, however, was found in the Auerbach plexus.

In this report a special form of functional interaction between the cholinergic and noradrenergic nervous system, *viz.*, the presynaptic inhibitory action of noradrenaline on acetylcholine release from cholinergic nerve terminals (Vizi, 1968; Paton and Vizi, 1969) will be discussed. This phenomenon is likely to be of physiological importance.

Gastrointestinal Tract

The two types of autonomic nerves are classically considered to be reciprocal in function: parasympathetic nerves are mainly excitatory and sympathetic nerves are inhibitory. It has been shown by *Paton and Vizi (1969)* and *Vizi (1968)* that noradrenaline and adrenaline (10^{-7} – 10^{-6} g/ml) are capable of inhibiting the ACh output due to stimulation of the nerve terminals and that the inhibitory action is mediated via α -adrenoceptors on presynaptic nerve terminals (Fig. 1). When sustained stimulation was used, the inhibitory effect of NA varied inversely with the frequency. The fewer the shocks delivered and the lower the frequency applied, the higher was the volley output in the control period and the greater was the reduction by noradrenaline.

Furthermore, *Knoll and Vizi (1970, 1971)* have shown using high frequency stimulation that for brief trains of shocks (3–10) adrenaline and NA both reduce release as measured directly,

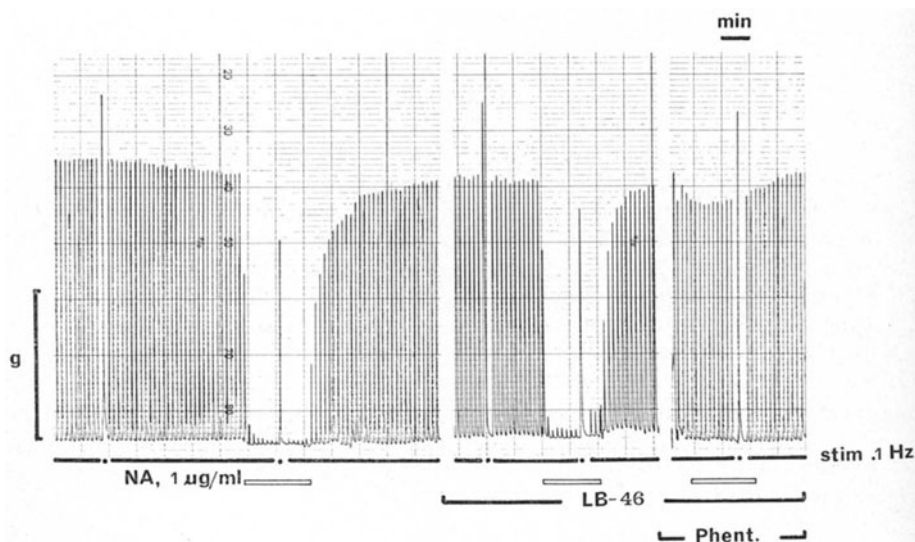


Fig. 1. Inhibitory effect of noradrenaline on contractions of a longitudinal muscle strip of guinea-pig ileum to electrical stimulation at 0.1 and 10 Hz. At 10 Hz, ten shocks were delivered as indicated by dots. Krebs solution. Field stimulation. 95% O₂ + 5% CO₂. As β -receptor blocking agent LB/46 (22 ng/ml) was used. Phentolamine (Phent.) 1 μ g/ml. Note that phentolamine suspended the inhibitory action of noradrenaline and LB/46 failed to influence its effect. This fact indicates the role of the α -receptor in the presynaptic inhibitory effect of noradrenaline on acetylcholine release