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Effects of catecholamines on the electrical and mechanical activity of the guinea-pig ureter

R. CASTEELS,* H. HENDRICKX and R. VERECKEN (introduced by EDITH BÜLBRING)
Laboratorium voor Fysiologie, Universiteit Leuven, B 3000 Leuven, Belgium

We have studied the activity of the isolated guinea-pig ureter by recording simultaneously the transmembrane potentials and the intraluminal pressure development. This pressure was a better measure for the mechanical activity of the ureter than the longitudinal tension development. The ureter, isolated from the pelvis, is not spontaneously active *in vitro* and was therefore stimulated electrically throughout the experiment at a rate of 1/minute. The normal action potential is characterized by an initial depolarization at a rate of 15 V/s and a plateau phase on which, in its initial part, about ten oscillations occur. This action potential is accompanied by an increase of the intraluminal pressure from the resting level of 3 cm water to about 50 cm.

Noradrenaline (2×10^{-7} to 10^{-6} M) induces spontaneous activity, increases the number and frequency of oscillations during the initial part of the plateau phase of the action potential and prolongs the total duration of the action potential by a factor of 1.3 to 2. The electrophysiological effect of adrenaline is similar but less pronounced. Moreover both catecholamines increase the active intraluminal pressure by a factor of 1.2 to 1.4. Isoproterenol (5×10^{-7} M) neither induces spontaneous activity nor modifies significantly the action potential. However, it reduces the intraluminal pressure development during an elicited action potential by a factor of 0.5.

We have tried to elucidate these actions of the different catecholamines by using adrenergic blocking agents. The α -adrenoceptor blocking agent phenoxybenzamine (10^{-6} M) exerts an action, which is similar to the action of noradrenaline. It induces spontaneous activity and increases the active intraluminal pressure. Phentolamine (10^{-6} M) does not induce spontaneous activity and causes only a small increase of the intraluminal pressure. Both drugs prolong the duration of the action potential to about 3 times the control value. Adding noradrenaline during exposure of the ureter to an α -adrenoceptor blocking agent slightly reduces the effect of these substances on the duration of the action potential and on the intraluminal pressure.

The β -adrenoceptor blocking agent, propranolol (10^{-6} M), causes a small prolongation of the action potential and decreases the number of its oscillations. This substance also prevents the decrease of tension caused by isoproterenol.

These experimental results indicate that sympathomimetic drugs and adrenoceptor blocking agents can affect the excitability and the excitation-contraction coupling in the isolated guinea-pig ureter. The significant modification of the action potential by some of these substances suggests that their action is not limited to adrenoceptors, but might also exert a direct action on the properties of the smooth muscle membrane.