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PREVENTION OF ADRENALIN-INDUCED HEART LESIONS BY THE ANTIOXIDANT IONOL

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Activation of lipid peroxidation arises in the heart in emotional-painful stress and the contractile function of the myocardium is disturbed [3-5]. Preliminary administration of antioxidants prevents both these phenomena [1, 6]. Since the principal harmful factor in stress is generally considered to be an excess of catecholamines, it was decided to study whether disturbances of the contractile function of the heart caused by injection of large doses of catecholamines can be prevented by means of antioxidants.

The aim of this investigation was to evaluate quantitatively the disturbances of cardiac contractility induced by injection of a large dose of adrenalin and to discover whether these disturbances can be prevented by the antioxidant ionol.

EXPERIMENTAL METHOD

Experiments were carried out on male Wistar rats weighing 200-250 g. There were four series of experiments: I) control, II) subcutaneous injection of 50 mg/kg adrenalin, III) intraperitoneal injection of 50 mg/kg ionol daily for 3 days, IV) injection of ionol before adrenalin. The heart was removed from the rats under urethane anesthesia 48 h after injection of adrenalin or the last injection of ionol. The contractile function of the papillary muscle of the left ventricle was investigated. The posterior papillary muscle was isolated and placed in a constant-temperature chamber containing oxygenated Krebs–Henseleit solution (pH 7.4, 29°C, 5.5 mM glucose). The muscle contracted for 1 h under isotonic conditions under the influence of electrical stimulation with a frequency of 20 pulses/min, and a weight of 250 mg was attached to it. The optimal load at which the muscle was stretched to a length permitting maximal isotonic shortening of the preparation was then determined. The length of the muscle was recorded by measuring displacement of a lever of the apparatus to which the muscle was attached. This displacement was measured with a capacitive transducer and recorded on a "Disa" indicator by means of a "Crossor" camera. The amplitude of contraction in each experiment was expressed as a percentage of the initial length of the muscle. The maximal rate of contraction and relaxation of the muscle was calculated graphically in conventional units per second.

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TABLE 1. Effect of Adrenalin and Antioxidant Ionol on Contractile Function of Isolated Papillary Muscle of Rat Heart (M ± m)

Parameter	Series of experiments			
	I (n=12)	II (n=12)	III (n=10)	IV (n=11)
Amplitude of shortening, % of initial length	12,8±0,7	7,4±0,5	12,6±0,8	12,2±0,7
Maximal rate of shortening, conventional units/sec	1,90±0,11	1,10±0,09	1,96±0,12	1,91±0,13
Maximal rate of relaxation, conventional units/sec	1,60±0,09	0,93±0,05	1,53±0,07	1,49±0,08
Index of relaxation, sec^{-1}	12,5±0,9	11,8±0,9	12,3±0,8	12,3±0,7

EXPERIMENTAL RESULTS

It will be clear from Table 1 that injection of adrenalin into the animals caused a disturbance of myocardial contractility. The amplitude of shortening of the papillary muscle and also the maximal rate of its shortening and relaxation were significantly reduced — on average by 40%. The index of relaxation did not change significantly under these circumstances. Injection of ionol had no appreciable effect on parameters of contractility of the papillary muscle, but prevented disturbances caused by adrenalin. The decrease in amplitude and in the maximal rate of shortening, and also in the maximal rate of relaxation was significant. Preliminary injection of the antioxidant ionol thus prevented disturbances of the contractile function of the papillary muscle caused by injection of a large dose of adrenalin.

The mechanism of the harmful and necrotizing action of catecholamines has not yet been adequately explained. Kogan et al. [2] showed that injection of adrenalin causes an increase in free-radical lipid peroxidation in the myocardium, the products of which possess a harmful action through activation of lipid peroxidation. To prevent adrenalin-induced lesions of the myocardium, it was therefore decided to use the powerful antioxidant ionol, which effectively inhibits lipid peroxidation in animals and man [6]. The result confirms the view that the preventive action of antioxidants in stress is due to the fact that they prevent activation of lipid peroxidation in the heart under the influence of an excess of catecholamines.

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