EFFECT OF NEUROGENIC INJURY TO THE MYOCARDIUM ON ACTIVITY OF SOME ENZYMES OF ITS ENERGY METABOLISM

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After electrical stimulation of the arch of the aorta in rabbits for 3 h exhaustion of the tissue noradrenalin (NA) reserves in the myocardium was accompanied by an increase in the activity of hexokinase (HK), lactate dehydrogenase (LD), and glucose-6 phosphate dehydrogenase (G6PD). Injection of L-Dopa after electrical stimulation prevented the fall of the NA level in the heart muscle and the change in activity of the above enzymes. The results confirm the important role of disturbances of mediator metabolism in mechanisms of development of metabolic and generative injuries.

KEY WORDS: heart muscle; noradrenalin; hexokinase; lactate dehydrogenase; glucose-6-phosphate dehydrogenase; neurogenic injury.

Degenerative changes in heart muscle after neurogenic injury are accompanied by a disturbance of the tissue nonradrenalin(NA) balance [1-3]. At the same time sharp changes developed in energy metabolism, with the accumulation of lactate, uncoupling of oxidative phosphorylation, and a deficiency of high-energy compounds [2].

Since metabolism is regulated by changes in the rate of enzyme reactions [4], the object of this investigation was to study the activity of certain enzymes of glycolysis and of the pentose phosphate pathway in the myocardium during neurogenic injury.

EXPERIMENTAL METHOD

Male rabbits weighing 2.5-3 kg were used. Neurogenic injury to the myocardium was caused by electrical stimulation of the arch of the aorta for 3 h [1]. Immediately after electrical stimulation and 48 h later, activity of hexokinase (HK), lactate dehydrogenase (LD), and glucose-6-phosphate dehydrogenase (G6PD) in the soluble fraction of heart muscle (20,000 g, 40 min) was investigated. Activity of HK and G6PD was determined spectrophotometrically at a wavelength of 340 nm and was expressed in μmoles NADP reduced per hour per milligram protein [11, 13]. LD activity was expressed in μmoles NAD/min/mg protein [14]. Protein was determined by Lowry's method [12]. The tissue NA content was investigated fluorometrically [6].

EXPERIMENTAL RESULTS AND DISCUSSION

After stimulation of the arch of the rabbits' aorta for 3 h a marked fall was observed in the NA level in the heart muscle (0.11 ± 0.008 compared with 0.56 ± 0.06 μg/g wet weight of tissue normally). The NA deficiency still persisted 48 h after stimulation (0.1 ± 0.02 μg/g).

HK and LD activity rose immediately after stimulation (0.39 ± 0.4 and 24.0 ± 1.0 compared with 0.21 ± 0.023 μmoles NADPH/mg protein/h and 17.0 ± 1.0 μmoles NAD/mg protein/min normally) and remained at the same high level for another 48 h. This is in agreement with observations on lactate accumulation during neurogenic injury to the heart [2, 5]. Activity of G6PD, the enzyme which limits the velocity of the pentose phosphate

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TABLE 1. Effect of L-Dopa on NA Content and Activity of Some Enzymes of Heart Muscle during Neurogenic Injury (M ± m)

Group of animals	Activity of enzymes			
	NA, μg/g wet weight of tissue	HK, μmoles NADPH/mg protein/h	LD, μmoles NAD/mg protein/min	G6PD, μmoles NADPH/mg protein/h
Control (n = 10)	0,4±0,035	0.19±0,019	18±1,00	0,52±0,05
48 h after stimulation for 3 h (n = 10)	0,1±0,02	0,39±0,03	23±1,05	0,86±0,079
L-dopa 48 h after stimulation (n = 10)	0,42±0,05	0,24±0,024	18±1,00	0,6±0,03

Legend. n) Number of animals

pathway of glucose oxidation, also increased after stimulation (0.67 ± 0.03 and 0.86 ± 0.079 immediately and 48 h respectively after stimulation compared with a normal value of 0.46 ± 0.035 μmole NADPH/mg protein/h).

Exhaustion of the NA reserves in the heart muscle caused by neurogenic injury is thus accompanied by sharp changes in enzyme activity. These results may indicate a role for NA in the regulation of the activity of these enzymes and they are in harmony with the results of investigations of enzyme activity in denervated liver tissue, where the NA level is also sharply reduced [7-9].

To continue the analysis of the role of NA, it was decided to use L-Dopa, which promotes NA synthesis [10]. L-Dopa, in a dose of 10 mg/kg, was injected into the rabbits four times over a period of 48 h after stimulation of the arch of the aorta. The results of these investigations (Table 1) showed that L-Dopa completely restored the NA concentration in the heart tissue. No changes in myocardial enzyme activity likewise were observed in the rabbits which received L-Dopa.

It can accordingly be concluded that metabolic disturbances in the heart accompanying its neurogenic injury are connected with the associated NA deficiency.

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