

EFFECT OF K-STROPHANTHIN- β AND OLITORISIDE ON THE CONTENT OF GLYCOGEN AND HIGH-ENERGY PHOSPHORUS COMPOUNDS IN HEART MUSCLE IN EXPERIMENTAL MYOCARDITIS

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The effect of K-strophanthin- β and olitoriside on the content of glycogen and high-energy phosphorus compounds in the heart muscle was studied in rats with experimental adrenalin myocarditis. The new cardiac glycosides K-strophanthin- β and olitoriside were shown to have a therapeutic effect in adrenalin myocarditis by restoring the content of glycogen and high-energy phosphorus compounds in the heart muscle. The experimental results are discussed.

Investigations [6, 7] have shown that administration of K-strophanthin- β and olitoriside to healthy animals led to an increase in the content of glycogen and high-energy phosphorus compounds in the heart muscle. However, many aspects of the action of these glycosides on metabolism under pathological conditions remain unstudied.

The object of this investigation was to study the effect of olitoriside and K-strophanthin- β on the course of the carbohydrate-phosphorus metabolism of heart muscle in adrenalin myocarditis, when energy production in the myocardium is disturbed [5].

EXPERIMENTAL METHOD

Two series of experiments were carried out on 173 albino rats with experimental adrenalin myocarditis [2]. In series I the glycosides (K-strophanthin- β and olitoriside) were injected in doses of 0.36 and 0.30 mg/kg respectively into the caudal vein on the 2nd day of development of myocarditis and the animals were then decapitated 24 h later. In series II the same doses of glycosides were injected starting from the 4th day of development of the pathological process, daily for 8 days. These animals were sacrificed on the 12th day of development of the myocarditis. The control consisted of 70 rats with myocarditis not receiving cardiac glycosides.

The content of glycogen and high-energy phosphorus compounds and the phosphorylase activity in the heart muscle were determined as described previously [6].

EXPERIMENTAL RESULTS AND DISCUSSION

A single injection of olitoriside and K-strophanthin- β increased the glycogen content in the myocardium to 260 ± 19 and 252 ± 15 mg% respectively compared with the control level of 212 ± 21 mg%, while at

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TABLE 1. Effect of Cardiac Glycosides on Content of Phosphate Compounds in Heart Muscle in Experimental Myocarditis (M±m)

Index	Single injection of glycosides (3rd day of myocarditis)			Repeated injection of glycosides (12th day of myocarditis)		
	control	control + K-stro- phanthin-β	control + olitoriside	control	control + K-stro- phanthin-β	control + olitoriside
Inorganic phosphorus (in μmoles P/g)	12.06 ± 0.42	13.10 ± 0.58	13.69 ± 0.35	11.40 ± 0.50	12.84 ± 0.60	13.46 ± 0.09
Creatine phosphate (in μmoles P/g)	1.96 ± 0.20	1.63 ± 0.20	1.04 ± 0.10	1.17 ± 0.14	2.18 ± 0.17	1.40 ± 0.20
ATP (in μmoles adenosine/g)	0.61 ± 0.11	1.29 ± 0.12	1.10 ± 0.11	1.68 ± 0.19	1.84 ± 0.20	1.76 ± 0.20
ADP (in μmoles adenosine/g)	1.21 ± 0.08	2.01 ± 0.22	2.20 ± 0.32	2.01 ± 0.19	2.11 ± 0.30	1.85 ± 0.20
AMP (in μmoles adenosine/g)	3.24 ± 0.04	2.81 ± 0.03	2.28 ± 0.03	2.32 ± 0.24	2.28 ± 0.30	2.07 ± 0.22

the same time it reduced phosphorylase activity to 1.85 ± 0.21 and 1.99 ± 0.16 μmole P/g, from its raised level in myocarditis of 2.36 ± 0.20 μmoles P/g. The creatine phosphate content was reduced by the action of both glycosides while the inorganic phosphorus level was increased. The action of the glycosides was most clearly seen on the quantitative composition of the adenosine phosphates. The ATP content was considerably increased, its accumulation by the action of K-strophanthin-β being greater than that due to olitoriside, whereas K-strophanthin-β produced a greater increase in the ADP concentration. The opposite effect was found in the case of AMP (Table 1).

Prolonged daily administration of K-strophanthin-β to the experimental rats increased the glycogen content to 356 ± 27 mg%, while olitoriside increased it to 368 ± 23 mg% (control 282 ± 14 mg%), while at the same time phosphorylase activity was reduced to 1.64 ± 0.17 and 1.85 ± 0.22 μmole P/g respectively compared with 2.29 ± 0.14 μmoles P/g in the control.

The content of inorganic phosphorus and of adenosine phosphates by this time had regained the normal level observed in the heart of intact animals and showed no significant changes despite repeated administration of the compounds, although the creatine phosphate content was slightly increased (Table 1).

Accumulation of glycogen in the heart muscle under the influence of the glycosides in experimental myocarditis took place partly as the result of suppression of phosphorylase activity. Cardiac glycosides, by blocking anaerobic glycogenolysis, evidently restrict the utilization of glycogen as an energy-yielding substrate. Meanwhile, according to results obtained by Kondrashova [4], strophanthin K has a mild uncoupling action on oxidative phosphorylation and causes a parallel increase in oxygen utilization, so that the formation of high-energy phosphorus compounds is increased, although the P:O ratio is slightly altered. Consequently, the observed increase in the content of ATP and ADP in the myocardium under the influence of K-strophanthin-β and olitoriside can be regarded as an index of the early normalization of oxidative phosphorylation through the stimulation of cell respiration. The results of investigations conducted in the authors' laboratory have shown that K-strophanthin-β, when given in myocarditis, stimulates oxidative processes utilizing predominantly free fatty acids as the substrate in the heart [1].

The early normalization of the energy metabolism of the heart muscle in disease by the action of cardiac glycosides can accordingly be regarded as a possible mechanism of their clinical therapeutic effect.

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